International Journal of Education in Mathematics, Science and Technology

Volume 1, Number 4, October 2013

EDITORIAL BOARD

Editor in Chief
Ismail SAHIN - Necmettin Erbakan University, Turkey

Co-Editors
Mack Shelley - Iowa State University, U.S.A.
I. Ozgur Zembat - Mevlana University, Turkey

Associate Editor
S. Ahmet KIRAY - Necmettin Erbakan University, Turkey

Editorial Board
Ann D. THOMPSON - Iowa State University, U.S.A
Bill COBERN - Western Michigan University, U.S.A.
Douglas B. CLARK - Vanderbilt University, U.S.A.
Gokhan OZDEMIR - Nigde University, Turkey
Hakan AKCAY - Yildiz Technical University, Turkey
Huseh-Hua CHUANG - National Sun Yat-sen University, Taiwan
Ilhan VARANK - Yildiz Technical University, Turkey
James M. LAFFEY - University of Missouri, U.S.A.
Kamisah OSMAN - National University of Malaysia, Malaysia
Lynne SCHRUM - George Mason University, U.S.A.
Mary B. NAKHLEH - Purdue University, U.S.A.
Mehmet AYDENIZ - University of Tennessee, U.S.A.
Musa DIKMENLI - Necmettin Erbakan University, Turkey
Pasha ANTONENKO - Oklahoma State University, U.S.A.
Pornrat WATTANAKASIWICH - Chiang Mai University, Thailand
Robert E. YAGER - University of Iowa, U.S.A.
Sanjay SHARMA - Roorkee E&M Technology Institute, India
Sevilay ATMACA - Cyprus International University, Cyprus
Sinan ERTEN - Hacettepe University, Turkey
Tsung-Hau JEN - National Taiwan Normal University, Taiwan
Yilmaz SAGLAM - Gaziantep University, Turkey

Technical Support
Selahattin ALAN - Selçuk University, Turkey

International Journal of Education in Mathematics, Science and Technology (IJEMST)
The International Journal of Education in Mathematics, Science and Technology (IJEMST) is a peer-reviewed scholarly online journal. The IJEMST is published quarterly in January, April, July and October. The IJEMST welcomes any papers on math education, science education and educational technology using techniques from and applications in any technical knowledge domain: original theoretical works, literature reviews, research reports, social issues, psychological issues, curricula, learning environments, research in an educational context, book reviews, and review articles. The articles should be original, unpublished, and not in consideration for publication elsewhere at the time of submission to the IJEMST. Access to the Journal articles is free to individuals, libraries and institutions through IJEMST’s website.

Submissions
All submissions should be in electronic (.Doc or .Docx) format. Submissions in PDF and other non-editable formats are not acceptable. Manuscripts can be submitted through the journal website. All manuscripts should use the latest APA style. The manuscript template for formatting is available on the journal website.

Contact Info
International Journal of Education in Mathematics, Science and Technology (IJEMST)
Email: ijemst@gmail.com
Web: http://www.ijemst.com
TABLE OF CONTENTS

Uptake as a mechanism to promote student learning

Clare Valerie Bell

Images, Anxieties, and Attitudes toward Mathematics

Shashidhar Belbase

Classroom Observations and Reflections: Using Online Streaming Video as a Tool for Overcoming Barriers and Engaging in Critical Thinking

Angela T. Barlow, Michael R. McCrory, Stephen Blessing

Results of the Salish Projects: Summary and Implications for Science Teacher Education

Robert Yager, Patricia Simmons

Determining the Factors That Affect the Objectives of Pre-Service Science Teachers to Perform Outdoor Science Activities

Ersin Karademir, Sinan Erten

Teachers’ Remarks on Interactive Whiteboard with LCD Panel Technology

Ömer Koçak, Aslan Gülcü
Uptake as a Mechanism to Promote Student Learning

Clare Valerie Bell*  
University of Missouri

Abstract

This study is a descriptive examination of uptake that occurred during classroom discourse in 33 Algebra I classrooms in nine U.S. states. Uptake refers to the act of taking up mathematical comments, questions, and constructions as objects of discourse. Uptake is important because it can be used for scaffolding authentic opportunities to learn and promoting productive dispositions toward learning.

Data used in this study were taken from video-recorded and transcribed observations of 63 class sessions—30 participating teachers were observed twice and 3 were observed only once. Coding of uptake data resulted in 5 categories of types of utterances being taken up and 16 categories of how the utterance was used in the episode of uptake. Analysis across all categories indicates that teachers most frequently provided mathematical explanations and reasoning, even when asking for students’ reasoning and explanations, which limited students’ opportunities to express mathematical reasoning. Episodes of uptake resulting in more dialogic interaction did occur, but were relatively rare. Findings of this study have potential to help teachers and teacher educators become more aware of using uptake to strategically foster more authentic, student-centered discourse environments and increase students’ opportunities to learn.

Key words: Uptake, Algebra I, Opportunity to learn

Introduction

The National Research Council broadened the definition of mathematical proficiency by recommending five interrelated strands: conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive dispositions (NRC; Kilpatrick, Swafford, & Findell, 2001). Mathematical proficiency is developed as students engage in problem solving, communicate ideas and reasoning, make connections among ideas inside and outside the domain of mathematics, and represent mathematical ideas in a variety of forms (National Council of Teachers of Mathematics (NCTM), 2000). More recently the Common Core State Standards (National Governors Association Center for Best Practices (NGAC), Council of Chief State School Officers (CCSSO), 2010) have integrated these strands of mathematical proficiency and NCTM process standards in the Common Core State Standards for Mathematical Practice. The practices include engagement in activities that require looking for and expressing regularity in reasoning, modeling with mathematics, and constructing viable arguments as part of learning mathematics with understanding.

One approach to engaging students in communication about mathematical practices is through the use of uptake within classroom discussions (Cobb, Boufi, McClain, & Whitenack, 1997; Nystrand, Wu, Gamoran, Zeiser, & Long, 2003; Yackel & Cobb, 1996). Uptake refers to discourse processes during which a teacher takes up verbal utterances, prior actions, or non-verbal constructions as objects of discourse. Students’ verbal utterances may include questions, answers, conjectures, or descriptions of actions or mathematical reasoning (e.g., “Did you hear what Peter asked? Let’s listen again and try to respond to his question.”). Prior actions may include any actions observed by the teacher or students (e.g., “I just saw Kiera use a table to solve that problem. Why might that be a good strategy?”). Non-verbal constructions may include a variety of mathematical representations related to students’ actions during their mathematical work (“Take a look at the equation that Mari wrote. What might she have been thinking about this situation?”).

* Corresponding Author: Clare Valerie Bell, bellcv@umkv.edu
[Uptake] makes the [original] response the momentary topic of discourse... [and] may play an important role in facilitating the negotiation of understandings, as conversants listen and respond to each other. Moreover, by building on the voices of others and by establishing intertextual links among speakers, uptake acts to promote coherence within the discourse. (Nystrand et al., 2003, p. 146)

This study of a sample of Algebra I classrooms across 9 U.S. states focuses on uptake, which can be used to scaffold opportunities to learn and promote productive dispositions toward learning. While the use of uptake has been examined in English and social studies classes (e.g., Nystrand et al., 2003), literature examining other content areas, particularly mathematics, is rare. Studies of revoicing, a particular type of uptake, is more common in mathematics education literature (e.g., Herbel-Eisenmann, Drake, & Cirillo, 2009; O’Connor & Michaels, 2009). The aim of this study is to more broadly examine the use of uptake in Algebra I classes and how it might contribute to opportunity to learn (OTL; Gee, 2008). I argue that scaffolding students’ mathematical reasoning during classroom discourse is critical to providing OTL, specifically to learn mathematics with understanding as called for in current standards for mathematics education. Uptake has potential to bring students’ mathematical reasoning to the forefront of classroom discussions, to engage students in discussion of their own reasoning, and to disrupt pervasive Initiate-Respond-Evaluate (IRE) patterns of discourse (Pape et al., 2010). This research was guided by following questions: What types of student utterances are taken up in Algebra I classrooms? In what ways is uptake used in these classes?

**Theoretical Framework**

This study is framed within a sociocultural perspective of teaching and learning (e.g., Gee, 2008; Rogoff, 1990, 1998; Vygotsky, 1978) and literature on classroom discourse (e.g., Baxter & Williams, 2010; Cobb, Boufi, McClain, & Whitenack, 1997; Gresalfi, 2009; Nystrand et al., 2003; Williams & Baxter, 1996). Through a discussion of the literature, I make a case for examining teachers’ uptake of students’ comments, questions, and products of mathematical work for discussion in order to better understand the effects of such uptake on providing opportunities to learn (see Gee, 2008).

**Sociocultural Theory and Classroom Discourse**

Sociocultural perspectives on teaching and learning recognize the importance of social interaction within learning environments (Bakhtin, 1986; Rogoff, 1990, 1998; Vygotsky, 1978). From these perspectives, knowledge is not constructed individually, but is constructed jointly within a learning community. Students develop their understanding of competence in mathematics through interactions within the social contexts of the classroom (Baxter & Williams, 2010; Gresalfi, 2009; Gresalfi, Martin, Hand, & Greeno, 2009; Williams & Baxter, 1996). Teachers support students’ learning by engaging them in mathematical practices that include communication of mathematical reasoning. Communication in mathematics classes may include talking, listening, writing, reading, and various other forms of social interaction where participants share ideas with one another (Heibert et al., 1998).

Williams and Baxter (1996) use the term *discourse-oriented teaching* to describe “actions taken by a teacher that support the creation of mathematical knowledge through discourse among students” (p. 22). They believe that teachers regularly make decisions during instruction that create contexts for the construction of mathematical knowledge. In other words, teachers help lead or direct students to make mathematical meaning. To create a supportive discourse-oriented context, a teacher must provide both social and analytic scaffolding. Social scaffolding refers to supporting “norms for social behavior and expectations regarding discourse” (Williams & Baxter, 1996, p. 24). Analytic scaffolding refers to supporting students’ developing mathematical ideas. When scaffolding mathematical ideas, a teacher may need to redirect a conversation, push students to go more deeply in expressing their ideas, provide essential information, model thinking processes, or revoice students’ ideas to provide clarification.

In an investigation of the relationships between classroom discourse and individual student’s understanding of mathematical concepts, Cobb et al. (1997) focused on two related constructs: reflective discourse and collective reflection. *Reflective discourse* refers to situations in which previous student and teacher mathematical actions become explicit objects of discussion. *Collective reflection* refers to “the joint or communal activity of making what was previously done in action an object of reflection” (p. 258). For example, a teacher might scaffold students’ development of mathematical understanding by taking up their ideas in the form of questions,
comments, or other representations (“experientially real mathematical objects,” p. 260) with the purpose of analyzing them at a higher cognitive level. An analysis of such uptake within classroom discourse is of interest to teachers and teacher educators because it clarifies how teachers might proactively support their students’ development of mathematical understanding in ways that are compatible with current process and practice standards for mathematics.

Patterns of Discourse

Very often, classroom discourse consists mainly of IRE patterns of interaction, where the teacher controls the content of discussion (Mehan, 1979; Nystrand et al., 2003). IRE interactional turns consist of three utterances: (a) the teacher initiates with a question, (b) the student responds to this question, and (c) the teacher evaluates the student’s response. Typically, the purpose of IRE is for students to demonstrate recall of information or provide correct mathematical calculations. As an alternative, a teacher may work to create a more student-centered context for learning by facilitating meaningful verbal interactions that engage students in construction rather than simply recall of knowledge (Cazden, 2001; Chapin, O’Connor, & Anderson, 2003).

The notion of providing meaningful verbal interactions aligns with goals conveyed in mathematics education reform documents, such as positioning students’ ideas as central components of discourse-rich classroom contexts (Kilpatrick et al., 2001; NCTM, 2000; NGAC-CCSSO, 2010). As suggested in the literature presented above on discourse and collective reflection, a teacher may scaffold meaningful verbal interactions by questioning students’ ideas, pressuring them to explain or justify their reasoning, or asking them to reflect on their mathematical thinking. With the belief that it is important for teachers to be aware of classroom interaction as a dynamic process, Nystrand et al. (2003) have sought to understand unfolding classroom discourse in English and social studies classrooms. The researchers were particularly interested in what types of teacher actions led to episodes of dialogic discourse, which can be contrasted with the relatively predictable form and content of IRE patterns of interaction. Dialogic discourse refers to verbal classroom interactions that function to persuade discourse participants and negotiate meaning (e.g., Bakhtin, 1986) and are used as a thinking device to generate new meaning (e.g., Lotman, 1988).

In a previous study, Nystrand and Gamoran (1991) found that very little class time is spent on authentic teacher questions, extended episodes of uptake, and discussion. This was also a finding of Nystrand et al. (2003); however, they additionally found that specific types of teacher and student discourse moves led to the dialogic discourse that did occur. Authentic teacher questions (i.e., questions for which the answer was not readily known by the teacher) and uptake of students’ comments served as bids for dialogic interaction. In addition, student questions, when taken up for discussion, were especially strong in initiating dialogic episodes. In episodes of dialogic interactions, the teacher’s role was to facilitate discussion while students made substantive contributions in the form of observations, conjectures, argumentation, and reasoning.

Scaffolding of OTL

Gee (2008) conceptualizes OTL in terms of the relationship between learners and their environments, with acknowledgement of the central role of participation in shared talk and other social practices. According to Gee, learning environments, which include the material world and other people and their actions and speech, consist of affordances or perceived action possibilities with which students interact. The student must have the capacity to transform the affordances into action. The ways that affordances are made available, made public, and come to be used are critical issues in OTL. The teacher’s role is to provide support for students to act upon affordances of the classroom. Discourse provides a conduit between classroom affordances and student learning—it is through discourse that teachers are able to scaffold students’ actions on affordances of the classroom environment toward learning mathematics.

In a study of students’ engagement in mathematical practices and motivations in taking up OTL, Gresalfi (2009) examined the participation of four students in two separate eighth-grade classrooms. The context for mathematical practice in each classroom was different. One provided instruction in how to collaborate and encouraged group members to take responsibility for everyone’s understanding. In the other classroom, students were often asked to work together, but instruction in collaborative group work was not provided and the teacher emphasized correct mathematical work over collaborative practice. A concern of the study was “how practices create affordances for particular kinds of participatory acts for some students but not others” (Gresalfi, 2009, p. 361). Gresalfi noted that understanding an individual’s participation in mathematics class requires looking
beyond the individual’s performance to the ways in which students’ actions in the classroom are made meaningful in the larger context. She found that “individual participation, small group work, and teacher interventions conjointly shape productive dispositions and students’ opportunities to learn” (Gresalfi, 2009, p. 362). Furthermore, structures of the context such as the expectation for collaborative work influenced the likelihood of students developing productive dispositions, allowed deeper conceptual understanding of mathematical concepts, and helped prepare students for future learning.

In summary, contemporary views of mathematics education call for engaging students in mathematical activities to develop mathematical proficiency (Kilpatrick et al., 2001; NCTM 2000; NGAC, CCSSO, 2010). It is through social interaction that students develop understanding of culturally established mathematical practices (Gresalfi, 2009; Williams & Baxter, 1997; Wells, 2007; see also Rogoff, 1990, Vygotsky, 1978). Classroom discourse provides the conduit between affordances of the classroom and student learning. Teachers can facilitate meaningful classroom interactions that engage students in the construction of knowledge (Cazden, 2001; Chapin, O’Connor, & Anderson, 2003) by taking up students’ mathematical comments, questions, and constructions for collective reflection (e.g., Cobb et al., 1997; Gresalfi, 2009; Nystrand et al., 2003). Uptake makes students’ ideas and representations of their mathematical thinking available for public (whole class) examination. Strategic use of uptake during mathematics class can increase social support for learning and provide opportunities for students to act on affordances for learning, thus increasing OTL (Gee, 2008; Gresalfi, 2009).

With this study, I seek to understand how uptake is used in Algebra I classrooms. Addressing this gap in the literature will provide teachers and teacher educators with information about a variety of possibilities for strategically using uptake to foster learning environments where students act on affordances of the classroom to develop mathematical understanding.

Context of the Study

The present study is based on classroom observations that occurred during the first year of a four-year randomized control trial. Treatment group teachers participated in a one-week summer institute and implemented classroom connectivity technology (CCT) during the first year of the study. The CCT, TI-Navigator™, allowed the teacher to wirelessly communicate with the students’ graphing calculator through the teacher’s computer and a hub system. Control group teachers and their students used graphing calculators without CCT. Control group teachers participated in treatment activities during the second year. The focus of the present study is on the social interactions in both treatment and control group classrooms during the first year and does not consider the impact of CCT for comparative purposes.

Method

Participants

Thirty-three (Rx = 17, C = 16) of 127 teachers in the larger study participated in classroom observations. Project investigators identified potential classrooms for observation and sought teachers’ agreement. The observations were conducted in nine U.S. states (i.e., North-East: New York and Pennsylvania; South: Arkansas, Florida, North Carolina, and South Carolina, and Texas; Mid-West: Ohio; and West: Oregon), a convenience sample selected to minimize travel and lodging expenses.

Most teachers were white (.88) and female (.79). Over half of the teachers held a mathematics degree. A majority taught in suburban (.58) or urban (.33) areas with fewer teachers in rural areas (.09). On average, the teachers had 13 years of teaching experience ($SD = 8.46$) with fewer years of teaching Algebra I ($M = 6.69; SD = 5.91$). The schools had relatively low percentages of students eligible for free/reduced lunch ($M = 15.82; SD = 14.33$) and non-white students ($M = 18.04; SD = 19.55$).

Data Sources

Sixty-three video-recorded classroom observations and corresponding transcripts were considered for this study. Thirty participating teachers were observed in one algebra class over two days. Three were three single-day observations. Observations were transcribed verbatim.
Data Analysis

The present study focuses on portions of the classroom observations that were previously coded as uptake (correct answers, incorrect answers, questions, or comments) according to a priori coding categories in a classroom discourse codebook (Pape, Owens, Bell, Bostic, Kaya, & Irving, 2008; Pape et al., 2010). Uptake was just one of approximately 20 coding categories in the previous codebook that were established through an iterative process beginning with a review of extant literature. A team of four researchers, including the author, trained together for four days to review the coding scheme, videos, and transcripts. In the first phase of training, we watched 2 videos and coded them together. In the second phase, we watched 2 videos, coded individually, and then discussed results to come to consensus. Following training, the remaining transcripts were randomly assigned to pairs of coders (first and second). First coders initially watched the video to become familiar with participants, the lesson, and the classroom environment. The first coder then coded the transcript, reviewing the video as needed for clarification. The coded transcript was then sent to the second coder, who verified coding and indicated any discrepancies with the first coder. Discrepancies were resolved through discussion. Overall, there was 94% agreement between pairs of coders in this phase of coding.

For the present study, coding and analysis involved an emergent process. Each episode of uptake identified in the previous study was re-examined and recoded in NVivo by the author using a constant comparative method of inquiry. New categories were created by renaming each episode. This cyclical process was repeated several times as new categories emerged.

Results

Coding of the uptake led to identification of two categorical divisions—content type and function (Bell & Pape, 2012). Content type included (a) correct answers or solutions, (b) incorrect answers or solutions, (c) multiple answers or solutions, (d) other comments, ideas or mathematical constructions, and (e) questions (see Table 1). The categories of correct answers, incorrect answers, and multiple answers are self-explanatory. Comments and ideas included uptake of other statements (not discussed in terms of being correct, incorrect, or multiple answers); constructions included non-verbal representations, such as graphs, drawings, and data collected with the CCT. The final category, questions, is also self-explanatory.

Table 1. Categories and themes of uptake by content type and function

<table>
<thead>
<tr>
<th>Category</th>
<th># of Sources</th>
<th># of References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answers or solutions</td>
<td>16</td>
<td>27</td>
</tr>
<tr>
<td>Incorrect answers or solutions</td>
<td>19</td>
<td>31</td>
</tr>
<tr>
<td>Multiple answers or solutions</td>
<td>13</td>
<td>18</td>
</tr>
<tr>
<td>Other comments, ideas, mathematical constructions</td>
<td>31</td>
<td>77</td>
</tr>
<tr>
<td>Questions</td>
<td>23</td>
<td>47</td>
</tr>
</tbody>
</table>

(200 total)

<table>
<thead>
<tr>
<th>Theme</th>
<th># of Sources</th>
<th># of References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Initiating and sustaining activity</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>2. Identifying and clarifying</td>
<td>27</td>
<td>51</td>
</tr>
<tr>
<td>3. Explaining processes</td>
<td>36</td>
<td>90</td>
</tr>
<tr>
<td>4. Examining mathematical ideas</td>
<td>37</td>
<td>95</td>
</tr>
<tr>
<td>5. Focusing on reasoning</td>
<td>13</td>
<td>21</td>
</tr>
</tbody>
</table>

Note. # of Sources indicates the number of classroom observation transcripts (out of 63) in which each category of uptake was evident. # of References indicates the total number of times each coding category was evident. Each episode of uptake (200 total) was coded only once for content type but may have been coded in more than one function category, which is why totals are not provided for functions of uptake.
For the purpose of this discussion, categories of function were grouped into five themes, including (a) *initiating and sustaining activity*, (b) *identifying and clarifying*, (c) *explaining processes*, (d) *examining mathematical ideas*, and (e) *focusing on reasoning* (see Table 1). Within the presentation of themes that follows, a limited number of episodes of uptake are offered as examples.

### Functions of Uptake

The first theme within functions of uptake, *initiating and sustaining activity*, involved encouraging mathematical activity by *activating prior knowledge* or *adding information* to a discussion (see Table 2). These typically occurred when teachers introduced a new topic or when students needed more information in order to begin or continue engagement in mathematical activity. For example, in the following excerpt, the teacher was activating students’ knowledge of the previous day’s topic by taking up one student’s correct answer (“slope,” line 1.1.4) to a question about the meaning of *m* in the formula *y* = *mx* + *b*.

1.1.1† T: Who remembers the formula I taught you yesterday; the slope intercept form for linear equations? *Y equals.* Emily.

1.1.2 S: *Mx* plus *b*.

1.1.3 T: *Y equals* *mx* plus *b.* … Who can tell me what *m* stands for? Yes, ma’am.

1.1.4 S: Slope.

1.1.5 T: Slope. What is slope? Brian was absent yesterday … if you say “Brian, *m* equals slope,” and he says, “What is slope?” what would you tell him?

1.1.6 S: Slope is the angle that it goes down.

1.1.7 T: Okay. And what can you tell from that *m*, like we were talking about, if it’s negative or positive; what does that tell you?

1.1.8 S: That it’s going down or it’s going up.

In this excerpt, the teacher took up the term “slope” by asking questions in the context of helping another student understand the meaning of the mathematical concept (line 1.1.5). The student responded with an answer that was true for an example of a negative slope. By following up with the question in line 1.1.7, the teacher pressed for a more generalized statement. Although the student did provide a more general statement, the teacher continued to ask for more. This press helped to bring out a greater number of ideas about slope in the continuing discussion.

### Table 2. Categories within theme 1: Initiating and sustaining activity

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
<th># of Sources</th>
<th># of References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activating prior knowledge</td>
<td>Asking about and discussing questions or statements that referred to mathematical content that had been part of a previous class session</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Adding information</td>
<td>Providing additional information to extend information provided by students</td>
<td>6</td>
<td>9</td>
</tr>
</tbody>
</table>

The second theme within functions of uptake, *identifying and clarifying*, included identifying response accuracy, identifying errors, repeating question and giving answer, repeating student statement, and clarifying terminology (see Table 3). Frequently, teachers repeated or revoiced students’ statements to verify a students’ statement or to provide clarity. For example, a teacher took up a student’s graph of a linear equation (line 2.1.1), which was projected on a screen for whole-class examination, and another student, Lori, identified an error.

2.1.1 T: What could have happened here? … Lori.

2.1.2 L: They had like the wrong intercept.

2.1.3 T: It appears that the slope is correct, but they have the wrong intercept. What intercept did they have?

† Classroom discourse excerpts are numbered to identify the theme, episode example, and speakers’ turn (i.e., theme.example.speaker turn). For instance, two examples are provided for the second theme (identifying and clarifying). Accordingly, the third spoken turn of the second example of theme 2 was labeled 2.2.3.
In this excerpt, Lori responded to the teacher’s prompt by making an observation about another student’s representation (line 2.1.2). The teacher revoiced Lori’s statement to first highlight the portion of the projected representation that was correct (“It appears the slope is correct…”) and then repeated Lori’s identification of an error (“but they have the wrong intercept”). The students were then asked to analyze the graph in more detail.

Table 3. Categories within theme 2: Identifying and clarifying

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
<th># of Sources</th>
<th># of References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifying response accuracy</td>
<td>Eliciting statements of correctness of students’ answers to questions</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Identifying errors</td>
<td>Requesting identification of inaccuracies</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>Repeating question and giving answer</td>
<td>Repeating student’s question before answering it</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Repeating student statement</td>
<td>Repeating student statement without further elaboration</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Clarifying terminology</td>
<td>Focusing on the meanings of particular words</td>
<td>14</td>
<td>19</td>
</tr>
</tbody>
</table>

A significant portion of this second theme, identifying and clarifying, resulted from teachers’ efforts to focus students’ attention on terminology. These episodes of uptake were focused on meanings of words, as in the following excerpt coded as clarifying terminology that began with a student’s mathematical comment.

2.2.1 S: I’m thinking that maybe when you add or subtract it moves the origin up or down on the y-axis. Like if you subtract it will move it down because it makes it a negative, and if you add it, it moves it up.

2.2.2 T: Did you say it moves the origin?

2.2.3 S: No, I mean it moves the place where it crosses the line.

2.2.4 T: Where it crosses what line?

2.2.5 S: The y-axis.

2.2.6 T: The y. Okay.

The student initially used the term origin to talk about the y-intercept (line 2.2.1). Instead of pointing out the student’s error, the teacher took up the statement by asking a question (line 2.2.2). This allowed the student to discover his/her own error. Overall, episodes of clarification helped students understand important terms, differences between terms, or correct usage so that they would be able to accurately express their ideas.

A third theme within functions of uptake, explaining processes, included discussing procedure, eliciting student explanation, explaining by teacher, and guiding to answer (see Table 4). When a student provided an answer, the teacher could have requested an explanation of how the student arrived at that answer. The largest number of uptake episodes within this category, however, involved the teacher rather than a student providing an explanation, which limited the students’ expressions of mathematical understanding.

3.1.1 T: Let’s look at the other ones that are correct; we have a lot of them. What do they have in common? They’re doing what times x?

3.1.2 S: Two times.

3.1.3 T: Two times the x. You found when you tried to add a number it didn’t work; there was no pattern. When you tried to multiply there was no nice pattern. So you have to combine the multiplication and addition … We tried multiplying all the x’s by two and found that when we added one to it, it gave us out the right y value. That is the correct pattern.

If considering only the comment and first question in line 3.1.1, the teacher appeared to be asking students to make observations and analyze the correct student answers. The second question in 3.1.1, however, limited the expectation, indicating the desire for a specific response. A student provided the expected response, and the teacher then finished the discussion of how to find the correct answers to the original problem, thus limiting students’ opportunities to learn.
Table 4. Categories within theme 3: Explaining processes

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
<th># of Sources</th>
<th># of References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discussing procedure</td>
<td>Talking about procedural steps</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Eliciting student</td>
<td>Asking students how they arrived at an answer or solution</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>explanation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explaining by teacher</td>
<td>[Teacher] explaining a process used by a student</td>
<td>27</td>
<td>58</td>
</tr>
<tr>
<td>Guiding to answer</td>
<td>Leading the students to find an answer</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

The fourth and largest theme within functions of uptake was examining mathematical ideas, which included examining answer, examining concept, and inquiring (see Table 5). Within this theme, students were encouraged to assess their actions and to explain or justify their reasoning. In the following example coded as examining concept, the teacher had been guiding students to explore their mathematical conjectures. The teacher took up a student’s comment by questioning the meaning of the term the student had used while suggesting how another student might be able to use two coordinate points on a plane to generate the equation of a graphed line. During this exchange, the CCT provided a shared display that allowed discussion of the concept in terms of its graphic representation (line 4.1.2).

4.1.1 T: What do you mean by “relation”?
4.1.2 S: Like see how they both connect.... They had the same equation because they’re both on the line.
4.1.3 T: Okay, so you know it’s the same equation because they’re both on the line. Okay.
4.1.4 S: So you want to figure out what that equation is by looking at the coordinates and see what x is compared to y.
4.1.5 T: Okay, I followed everything up to that last thing. What do you mean you want to see what x is as compared to y?
4.1.6 S: Okay, you look at your x and you say, “Well what do I have to do to x to get it to y.”

Because the teacher’s statement in line 4.1.3 implied desire for more detail, the student continued to voice understanding of a relationship between x (input) and y (output) values of a function. After the teacher pressed for more (line 4.1.5), the student restated her reasoning in terms of “self-talk” that might be used during mathematical activity (line 4.1.6). This discussion not only provided a picture of the student’s conceptual understanding for the teacher, but also a model of his/her mathematical reasoning for other students in the class.

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
<th># of Sources</th>
<th># of References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examining answer</td>
<td>Discussing a specific student answer</td>
<td>24</td>
<td>49</td>
</tr>
<tr>
<td>Examining concept</td>
<td>Discussing a specific mathematical concept</td>
<td>23</td>
<td>38</td>
</tr>
<tr>
<td>Inquiring</td>
<td>Guiding the class to try out an idea presented by a student</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>

Episodes of the category of examining answer occurred more frequently than examining concept (see Table 5). In the following excerpt, which was coded as both examining answer and adding information, students were asked to identify the y-intercept of an equation.

4.2.1 T: We have eight people saying the y-intercept is eight, some saying three, two, and negative eight. What do you think?
4.2.2 S: Eight.
4.2.3 T: We’ve got a plus eight so it’s a positive eight. If it was minus eight it would be a negative eight. So y-intercept is at eight. If you went up eight units on the y-axis, that’s where this thing would fall.

The focus on a specific answer in this episode may have had a limiting effect on the student’s response. The teacher’s question in line 4.2.1, “What do you think?” was interpreted as “Which answer do you think is
correct?” and the teacher accepted the student’s answer. Notice how the teacher added an explanation of the answer. Not all episodes of uptake coded as examining answers were as limited in student input, but they tended to elicit short responses to a teacher’s question.

A less prevalent category within examining mathematical ideas was inquiring, which occurred when a teacher suggested exploring a process based on a student’s question or conjecture (see Table 5). The student’s conjecture in the following example, which was restated by the teacher in line 4.3.1, related to the subscripts of coordinate points in the distance formula†—whether choosing one point as “first” and the other as “second” would matter.

4.3.1 T: Dylan said it matters which one we pick. So let’s reverse it and see what happens. Let’s call that one “one” and that one “two.” …now tell me – let’s see, Sally, what is my y sub two?

T: What is the y in the second point?

S: Sorry. Y. I mean zero.

T: Very good. And let’s see, Irma, what is my y sub one? The y in the first point? Which is?

I: First point.

T: One. Okay, and now we’re going to say x sub two. Casey, which one is x sub two?

C: Negative one. … [Conversation continued with the teacher asking questions and students calculating values.]

T: Oh, did it matter?

Ss: No.

The restatement of the student’s conjecture was followed by the teacher’s suggestion of trying the formula with the order of the points reversed (line 4.3.1). The teacher’s questions that followed (every other line) were requests for identification of the values of the coordinates and calculations, which required one- or two-word responses from the students. Trying alternative approaches in this category of uptake was often in the context of enacting procedures with the teacher talking through the steps. While it is possible that the students gained deeper understanding of a concept, there is no evidence of how the students thought about the mathematics after trying the alternative approach.

Finally, the fifth theme within functions of uptake, focusing on reasoning, occurred when teachers pressed students to express their mathematical reasoning or asked them to talk about their strategic behavior, which made students’ mathematical thinking objects of classroom discourse (see Table 6). It is important to note, however, that this type of uptake did not occur very frequently. The following excerpt, coded as press for reasoning, followed the teacher’s uptake of a student’s correct response to a question. It resulted in a lengthy dialogue (more than 80 teacher and student “turns”) with voicing of mathematical conjectures and reasoning. The class was investigating the relationship between \( y = -2x \) and \( y = -1x \) on graph paper after having explored the relationships between \( y = x \) and \( y = 2x \), and then \( y = 4x \).

5.1.1 T: So how did you know which way your line was going to move? ... Was it going to go up, was it going to get steeper? More shallow? How did you know what was going to happen to it. Wendy? …

W: Since there’s a negative in the formula it can’t—the line can’t go through a plane, as Sara called it, where there’s two positives because one of them has to be negative.

T: Okay, so what Sara was talking about a minute ago?

W: Yes. And since we already plotted the \( y \) equals \( x \) and this is just the same thing except there’s a negative in there, so I knew just to flip it. There’s a negative.

T: Okay, so you looked more at your \( y \) equals \( x \) line and said it’s just going to be inverse?

Before this excerpt, the CCT had been used to stimulate discussion of relationships between linear equations with positive coefficients of \( x \). Then, based on the new understanding, students were asked to predict comparable relationships between linear equations with negative coefficients of \( x \) (line 5.1.1). Following the first question, the teacher expedited discussion by providing examples of what the students may have observed about the graphic representations. In response, a student referenced an earlier statement made by another student.

Given the two points \((x_1, y_1)\) and \((x_2, y_2)\), the distance between these points can be calculated using the following formula:

\[
d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}
\]
student. This is an example of social construction of knowledge and provides evidence of students having acted upon affordances for learning (see Gee, 2008; Gresalfi, 2009). The student then offered more detailed information about the inverse relationship (line 5.1.4), which the teacher revoiced to support students’ understanding and development of language to express mathematical ideas.

Table 6. Categories within theme 5: Focusing on reasoning

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
<th># of Sources</th>
<th># of References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressing for reasoning</td>
<td>Asking for mathematical reasoning</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>Talking about strategy</td>
<td>Discussing a strategy to solve a problem</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

In the following excerpt, also coded as press for reasoning, the student responded to the teacher’s question with a statement she believed to be true, but did not explain the “why.”

5.2.1 T: Identity. What leads you to believe it's an identity?
5.2.2 S: Because … three-\(t\) plus six and three-\(t\) minus six is … [identity].
5.2.3 T: So she says three-\(t\) plus six and three-\(t\) minus six is going to end up with an identity. Let's see if she's right. .... Now your reasoning? Three-\(t\) plus six and three-\(t\) minus six, so you knew it was one of those special cases. If we look back at the three-\(t\)'s you told me that they will [inaudible], and if the six equals negative six it's going to eliminate the three-\(t\)'s from both sides, is that a true statement or a false statement?
5.2.4 S: False.
5.2.5 T: It's a false statement. So is a false statement going to lead us to no solution or an identity? No solution.

Following the teacher’s question in line 5.2.1, the student responded, and the teacher repeated the student’s incorrect answer. The teacher then proceeded to discuss a procedure for testing for identity, leading to the conclusion that the equation had no solution. As also seen in the theme of explaining processes (see Table 4), where the majority of episodes of uptake consisted of teacher explanations, the teacher took over explaining instead of pressing the students to do more.

In another episode of press for reasoning, the teacher and students were discussing parabolas and axes of symmetry. One student, Haley, noticed that all of the solutions had been “\(x\) equal something” and asked, “Can it never be \(y\) equals?” The teacher indicated that it was a good question, and then proceeded to encourage the students to answer Haley’s question (line 5.3.1).

5.3.1 T: If I do \(y\) equals something, it’s going to go this way, right? Is there any way that I can do a \(y\) equals something that will cut that in half?
5.3.2 S: Well can you have the graph sideways?
5.3.3 T: Yes. … In Algebra Two you’ll get into that and they’re called hyperbolas …but for right now it’s just going to go up and down. ….  
5.3.4 S: What if you had two of them, one up and down… like parallel?

As the conversation continued, students made conjectures and asked further questions of each other and the teacher to explore the concept of axes of symmetry, which illustrates students acting upon affordances of the social environment as they took up each other’s ideas for the purpose of understanding the mathematics more deeply.

Discussion

Teachers have a responsibility to help students “take advantage of what is offered by the objects or features of the environment” (Gee, 2008, p. 81). For this study, data analysis was focused on classroom discourse and uptake as features of the environment. With uptake, students’ ideas and products of their work become objects of discussion (Nystrand et al., 2003), potentially providing additional affordances for learning. For that reason, episodes of uptake were examined for evidence of OTL in terms of the teacher’s role in scaffolding students’ expression of mathematical reasoning and engagement in collective reflection.
Resulting categories of coding were grouped according to content type and function. Each episodes of uptake was coded only once for content type, but may have been coded in more than one category of function. For example, a correct answer (content type) may have resulted in deeper examination a mathematical concept (function), explanation of a process (function), and/or press for students to voice the reasoning used in problem solving (function).

Analyses across all categories of uptake indicate that teachers frequently provided mathematical explanations and reasoning during episodes of uptake, which can be seen in many excerpts provided above. For example, uptake that was coded as the teacher adding information (a category within the theme of initiating and sustaining activity; see Table 2) often revealed that teachers provided answers or extended student comments rather than pressing the students to express their ideas (e.g., 4.2.1 – 4.2.3). Similarly, in the majority of episodes coded within explaining processes (see Table 4), the discussion following the initial uptake consisted of teacher-centered exchanges focused on the “how-to” of mathematical procedures rather than students’ justifications of their actions (e.g., 3.1.1 – 3.1.3). Although these episodes of uptake may have helped students to begin or continue mathematical activity, they did not encourage them to express and discuss mathematical reasoning, which limited OTL (see Gee, 2008; Gresalfi, 2009).

Two other frequently occurring categories within functions of uptake contained little, if any, evidence of students’ mathematical reasoning. For example, in explaining by teacher (within the theme of explaining processes; see Table 4), a teacher explanation typically started with either repetition of a student’s answer or direction of the students’ attention to a mathematical representation, and then the teacher told the students how they should have found the answer or provided an evaluation of the mathematical representation (e.g., 3.1.3). Examining answer (within the theme of examining mathematical ideas; see Table 5), a second frequently occurring category, was predominantly focused on how to get a specific answer (e.g., 4.2.1 – 4.2.3). The discussion was about what should have been done rather than why it was done.

There were notable differences in the nature of discourse between particular categories of the function of uptake and the type of content being taken up for discussion. For example, uptake coded as pressing for reasoning (within the theme of focusing on reasoning; see Table 6) provided insight into differences in the ways that teachers’ discourse moves facilitated opportunities for students to express mathematical reasoning. Pressing for reasoning was most effective, meaning that students provided mathematical reasoning and contributed more to discussion, when the teacher took up content types of correct answers and solutions and other comments, ideas, and mathematical constructions (see 5.1.1 – 5.1.6 above). Within these episodes, teachers often used open-ended and “why”-type questions or they revoiced students’ comments to model mathematical language (e.g., 5.1.5). With such scaffolding of OTL, students were able to collaboratively analyze and discuss products of their own work.

In contrast, pressing for reasoning when taking up content-type categories of students’ incorrect answers or solutions, multiple answers or solutions, and questions rarely resulted in expression of student reasoning (e.g., 5.2.1 – 5.2.5). This difference may be attributed to beliefs that follow from traditional teaching paradigms where students’ work is evaluated as either correct or incorrect. If correct answers are assumed to be evidence of good mathematical thinking or ability, discussion of correct answers should provide examples of good mathematical reasoning. Following the same line of reasoning, incorrect answers would be indicators of weak mathematical reasoning or lack of ability. Therefore, when taking up incorrect answers, multiple answers, and student questions, a teacher “helps” by providing solutions and reasoning. Such an approach might be seen as limiting OTL because the teacher responds to errors or questions as though the students who provided them are not able to express mathematical reasoning, which then limits the class’s exposure to a variety of models of mathematical reasoning and may discourage development of productive dispositions (see Gresalfi, 2009). In the few instances where taking up a student’s question did result in exploration of a concept and expression of students’ reasoning, the uptake was followed by one or more of the following: (a) the teacher asked guiding questions to help students to construct an answer to their own questions, (b) the teacher continued to take up students comments during the episode, and/or (c) students continued to ask questions beyond the original question that was taken up (e.g., 5.3.1 – 5.3.4 above).

The illustrations and discussion of classroom discourse provided above have important implications for teachers and teacher educators who are interested in increasing OTL and improving dispositions toward learning by engaging their students in reflective discourse. Most teachers did take up a few student utterances during Algebra 1 classes. What was done with the uptake, however, varied greatly. As teachers often retained control of the mathematical processes and reasoning, students were given relatively menial roles in the process of learning. Limiting students’ roles in such a fashion could adversely affect their conceptions of their own abilities to
engage in mathematical reasoning. Conversely, when teachers engaged students in relatively dialogic, reflective discourse, students themselves provided mathematical reasoning, asked questions, and were motivated to look more deeply into particular mathematical concepts. The dialogic interactions appear to have increased opportunities to learn mathematics with understanding.

Conclusion and Recommendations

While teachers participating in this study did take up students’ utterances a few times during observed lessons, most episodes of uptake only weakly supported students’ expression of mathematical reasoning. However, through uptake, teachers can encourage extended conversations where students express their own reasoning, ask questions, and explore options for answering questions. My recommendation based on this study is for teachers to use uptake more often during mathematics classes so that students’ actions form the base from which understanding is built. This approach to building understanding would highlight students’ actions as affordances of the classroom leading to greater OTL through social interaction.

Although uptake can serve as a bid for dialogic discourse and help to create contexts for students to more actively and meaningfully participate in the construction of knowledge, uptake cannot guarantee that dialogic interaction will occur. Uptake can be used superficially, resulting in IRE patterns of interaction. If the goal in mathematics education is to engage students in meaningful activities and discussions where they construct mathematical knowledge, then more emphasis must be placed on creating rich environments and supporting OTL.

Teachers may find that uptake is most effective when they purposefully focus on the function of uptake during mathematical discussions. They must ask themselves what they want to accomplish with not only understanding of a particular mathematical concept, but also with mathematical processes and practices, including communication of mathematical ideas. Teachers might also encourage students to take up their classmates’ mathematical contributions. Uptake potentially encourages deeper examination of mathematical concepts than is evidenced through IRE patterns of verbal interaction. Both teacher and student uptake can engage discourse participants in mathematical processes as envisioned by NCTM (2001), NRC (Kilpatrick et al., 2001) and NGAC, CCSSO (2010).

Limitations

Recoding of uptake for this study was done by the author. The categories of uptake function were determined by the verbal context. I looked at questioning and comments leading up to and following the utterance that was taken up by the teacher. Teachers were not asked to verify my interpretations. Additionally, this study did not include comparisons between classrooms with and without CCT. Next steps for research will include investigation of data for the effects of CCT on uptake and other patterns of interaction during classroom discourse over three years.

References


H. Haertel, & L. J. Young (Eds.), *Assessment, equity, and opportunity to learn* (pp. 76-108). New York: Cambridge University Press.


Images, Anxieties, and Attitudes toward Mathematics

Shashidhar Belbase*1
1University of Wyoming

Abstract
The purpose of this paper is to discuss and analyze images, anxieties, and attitudes towards mathematics in order to foster meaningful teaching and learning of mathematics. Images of mathematics seem to be profoundly shaped by epistemological, philosophical, and pedagogical perspectives of one who views mathematics either as priori or a posteriori, absolute or relative, and concrete or nominal. These images, as perceived by an individual can play a significant role in the development of attitudes towards mathematics in the long run. Images of mathematics can have possible negative and positive impacts on teaching and learning of mathematics with the subsequent development of attitudes toward mathematics as positive or negative and also associated mathematics anxiety. A theoretical model with different combinations of images, anxieties, and attitudes toward mathematics can be a helpful tool to develop an understanding of the different relationships among them. Some pedagogical implications can be drawn from these relationships.

Key Words: Image of mathematics, Mathematics anxiety, Attitude toward mathematics, Affect in mathematics education

Introduction
How do students perceive mathematics in schools? What are different images of mathematics that students perceive? How these images impact their learning? What is math anxiety? What are the causes of math anxiety? What is the relation of image of mathematics as perceived by students with math anxiety? What are different attitudes toward mathematics? How these attitudes impact learning mathematics? How images, anxieties and attitudes are related to each other? How do they form the personality of students in terms of mathematics? There are a number of past studies on images, anxieties, and attitudes towards mathematics, but none of them clearly discuss the relationship or interaction among them. In this paper I would like to bring them together with a model and seek to understand the impact of different combinations in teaching and learning mathematics.

It seems that the number of dissertations and published articles dealing with attitude towards mathematics increased geometrically since Feierabend’s (1960) report “Review of research on psychological problems in mathematics education” (Aiken, 1970). This shows a growing interest of mathematics education researchers in the area of attitudes toward mathematics. In this context, mathematics educators have considered the connection between students’ attitudes toward mathematics, and their achievement in the subject as one of the major concerns (Ma & Kishor, 1997). Ma and Kishor further stated that “the research literature, however, has failed to provide consistent findings regarding the relationship between attitude toward mathematics and achievement in mathematics” (p. 27). This discrepancy of result might have stemmed from differences in research method, context, and other intervening factors. Some researchers (e.g., Deighan, 1971) demonstrated that there is a low correlation (below 0.5) between attitude toward mathematics and achievement in mathematics; however, other researchers (e.g., Kloosterman, 1991) demonstrated that the attitudinal variables are significant indicators of math achievement. This paper is an attempt to analyze the images of mathematics in relation to anxieties and attitudes toward mathematics, and their effects on teaching and learning mathematics.

From a psychological perspective, there is a general myth that mathematics is an enigmatic subject. Some people claim that they like mathematics while others claim that they dislike mathematics. Some people are even scared of simple mathematics while others enjoy challenging problem solving in mathematics. The people who

* Corresponding Author: Shashidhar Belbase, belbaseshashi@gmail.com, sbelbase@uwyo.edu
claim that they like mathematics often choose mathematics in their college study, while those who prefer to say they dislike mathematics view mathematics as a difficult subject (Sam, 1999) and most possibly they discontinue mathematics in higher education.

According to different perspectives, mathematics can be a battle, a mountain, or a bridge, and mathematics can be viewed differently in terms of inherent characteristics as perceived by teachers and students (Sterenberg, 2008). These metaphorical images of mathematics held by students and teachers play a significant role in developing beliefs and attitudes toward mathematics in terms of having favorable or unfavorable opinions. These images reveal that relationships and meanings are produced metaphorically through a transfer between domains of mathematics and terms related to representing mathematics. Such a transfer forces us to make sense of mathematical objects (Game & Metcalfe, 1996). Many people tell stories of their childhood when they were frustrated in mathematics class and/or scared of problem solving in mathematics. The long thread of their struggle in learning mathematics in schools may create different images of mathematics; many of them, unfortunately, negative (Sterenberg, 2008).

Many past studies (e.g., Lakoff & Nunez, 2000; Ma & Kishor, 1997; McLeod, 1992; Richardson & Suinn, 1972; Sam, 1999; Wigfield & Meece, 1988; Wood, 1988) focused attention to psychological, philosophical, epistemological, and pedagogical images of mathematics. They also touched upon different attitudes toward mathematics and mathematics anxieties. Philosophical and epistemological lenses toward looking at mathematics and mathematics education in terms of realism, intuitionism, formalism, constructivism, criticalism, postmodernism, and integralism seem to have a powerful influence in shaping these images of mathematics, different attitudes toward mathematics, and different levels of positive and negative anxieties toward mathematics.

**Affective States in Mathematics Learning**

Historically, many researchers in mathematics education (e.g., Forgas, 2001; Goldin, 2002; McLeod, 1992; Petty, DeSteno, & Rucker, 2001) discussed affect as an important aspect of teaching and learning mathematics. They clarified the psychological and cognitive meaning of affect and its implication in mathematics education. McLeod (1992) articulated affect as a major concern in teaching and learning mathematics in terms of psychological theories, cognitive approaches, and reconceptualization of the affective domain in mathematics education. He outlined some aspects of beliefs, attitudes, emotions, and confidence in learning mathematics from the contemporary literatures of research in mathematics education. He also explicated the nature of affective domains in mathematics education in terms of self-concept, mathematics anxiety, self-efficacy, effort and ability attributions, causal attributions, learned helplessness, motivation, autonomy, and aesthetics. However, these discussions did not clearly articulate how images of mathematics foster different attitudes and anxiety levels of the learners of mathematics. Also, he did not articulate the pedagogical relationship among various affective factors and how they contribute to each other. The contemporary research on affective factors in teaching and learning mathematics seemed focused heavily on measurement rather than finding the subtle reasons and implications in mathematics education. The affective states of teachers and students in terms of their experiences in mathematics, both formal and informal, may have a tremendous impact on how they think about the subject, how they interact with others mathematically, how they perceive their role, how they conceive their world, how they prepare themselves for the future, and how they make conscious efforts to overcome the sense of uncertainty. In this context, images of mathematics, mathematics anxiety, and attitude toward mathematics as a part of affective domain can be interrelated to see their implications in teaching and learning mathematics.

**Images of Mathematics**

When one thinks about images of mathematics, two things may come up in his or her mind: images as objects or images as abstraction. I think images as objects in relation to mathematics are related to symbols and images as abstraction is related to operations. The images as objects seem to be static view that visualizes mathematics as a subject matter. The images as an abstraction seem to be dynamic that visualizes mathematics as a process or operation.

Tall and Vinner (1981) defined a concept image as cognitive structures related to a mathematical concept, including both mental images and construction of words. A concept (e.g., the color of a leaf) must allow for variability with time and context. If we imagine an object shaped like an apple that is purple, we can still believe that it is an apple. We have the freedom to recombine familiar ideas in novel ways. Since we have never seen a purple apple, it is unlikely that we would form an image of one, when hearing the word apple (Browne, 2009).
McGinn (2004) asserts that images are part of an active nature, since they are subject to the will of the viewer. Percepts belong to the passive part of thinking and imagination. In other words, one must make an effort to form an image of something, while the same may not hold true for just looking.

In absolutist viewpoint, images of mathematics are viewed as an impartial, absolute, definite, and persistent body of knowledge based on deductive logic (Ernest, 1991). Ernest further claims, “among twentieth century philosophies, logicism, formalism, and, to some extent, intuitionism and Platonism may be said to be absolutist in this way” (Ernest, 1991, p. 2). However, Ernest (2008) claimed that absolutism is not much concerned about unfolding mathematics or mathematical knowledge in the world around us.

Rensaa (2006) asserts that in the past few decades a new tendency of epistemology, pedagogy, psychology, and philosophy of mathematics is securing a ground, and these days many mathematicians and mathematics educators propose a non-absolutist justification of mathematics. Kitcher and Aspray (1988) described this as “the ‘maverick’ tradition that emphasizes the practice of, and human side of mathematics, and characterizes mathematical knowledge as historical, changing, and corrigeble” (Ernest, 1991, p. 2). The image of mathematics is generally viewed as falsifiable (can be wrong), contextual (changes with the situation), and relative (mathematical rules are not universal, but subject to verification within a context).

A widespread public image of mathematics in the West is that it is difficult, cold, abstract, theoretical, and ultra-rational, and, also important and largely masculine (Ernest, 2008). It also has the image of being remote (distant) and inaccessible (not possible to reach) to all, but a few extra-ordinary human beings with ‘mathematical minds’ (Buerk, 1982; Buxton, 1981; Ernest, 1996; Picker & Berry, 2000). For many people this negative image of mathematics is also associated with anxiety and failure in mathematics. When Bridgid Sewell was gathering data on adult numeracy for the Cockcroft (1982) inquiry, she asked a sample of adults on the street if they would answer some questions. Half of them refused to answer further questions when they understood it was about mathematics, suggesting negative attitudes. Extremely negative attitudes such as mathophobia (Maxwell, 1989) probably only occur in a small minority in Western societies, and may not be significant at all in other countries. In fact, the world-wide consensus of mathematics educators is that school mathematics must counter that image, and offer, instead, something that is personally engaging and useful, or motivating in some other way, if it is to fulfill its social functions (Howson & Wilson, 1986; NCTM, 1989; Skovsmose, 1994).

Mathematics Anxiety

When one thinks about mathematics anxiety, two things may come to his or her mind: one is ‘anxiety as progressive thinking’ and the other is ‘anxiety as regressive thinking’. To me all anxieties are not worthless things. Anxieties can be both good and worthless. If it promotes progressive thinking (like when one is puzzling in a mathematics problem for a few days and he or she is trying to solve it in a variety of ways without losing the passion), then certainly it is a good thing. Anxiety is mostly taken as regressive thinking in which a person having anxiety tries to go away or get rid of mathematical problem simply by avoiding it and taking it negatively.

Mathematics anxiety is an anxious state in response to mathematics-related situations that are perceived as threatening to self-esteem. Cemen (1987) proposed a model of mathematics anxiety reaction consisting of environmental antecedents (e.g., negative mathematics experiences, lack of parental encouragement), dispositional antecedents (e.g., negative attitudes, lack of confidence), and situational antecedents (e.g., classroom factors, instructional format) are seen to interact to produce an anxious reaction with its physiological manifestations (e.g., perspiring, increased heartbeat, and restlessness). Many researchers (e.g., Ma & Kishor, 1997; Richardson & Suinn, 1972; Tobias & Weissbrod, 1980) reported the consequences of being anxious toward mathematics, including the inability to do mathematics, the deterioration in mathematics achievement, the escaping of mathematics courses, the limitation of students in selecting college mathematics majors and related future careers, and the extremely deleterious feelings of guilt and humiliation. Ma and Kishor (1997) claimed that mathematics anxiety is usually associated with mathematics achievement individually. A student’s level of mathematics anxiety can significantly predict his or her mathematics performance (Fennema & Sherman, 1977; Wigfield & Meece, 1988), probably both in negative and positive ways.

Miller and Bichsel (2004) claimed that math anxiety appears to primarily impact one’s visual working memory that contradicts previous research findings that mathematical anxiety is primarily processed in verbal working memory and supporting the hypothesis that math anxiety does not function similarly to other types of anxiety. They identified two general types of anxiety: trait and state. They clarified that individuals experiencing trait
anxiety have a characteristic tendency to feel anxious across all types of situations. In contrast, individuals possessing state anxiety tend to experience it only in specific personally stressful or fearful situations. Trait anxiety is more related to a wide range of situations to which one feels a kind of threat, unsecured, and challenge all the time. In mathematics, students under this anxiety have a fear of mathematics class, homework, exam and any situation when comes to mathematics. According to Spielberger et al. (1970), state anxiety reflects a temporary emotional state characterized by personal, deliberately perceived feelings of mental tension and uneasiness with a greater sensitiveness in the nervous system. Several past studies demonstrated that both state and trait anxiety affect task performance in mathematics (e.g., MacLeod & Donnellan, 1993; Miller & Bichsel, 2004). Concluding the findings from these researches, Miller and Bichsel stated that individuals with high trait anxiety show poorer performance on various tasks than low trait anxiety individuals. This difference tends to be exacerbated in a high state anxiety condition. With reference to research on the impact of gender on math anxiety, Hembree (1990) found math anxiety being more predictive of math performance in males than in females. However, further study is necessary to re-confirm this claim.

Attitude toward Mathematics

Images of mathematics as perceived by a person develop his or her positive or negative attitude towards mathematics. These images have a significant impact on one’s choice of mathematics as major in higher education. In this context, many studies have been conducted on attitudes toward mathematics (e.g., Eleftherios & Theodosius, 2007; Hannula, 2002, 2004; Zan & Di Martino, 2007) with contradictory results. Eleftherios and Theodosius (2007) used the term ‘beliefs’ in the meaning of personal judgments and views, which constitute one’s subjective knowledge, does not need formal justification. They investigated the students’ beliefs and attitudes, which mainly concerned studying and learning mathematics. Specifically, they explored their factorial structure. Also, they investigated whether there were differences in students’ beliefs and attitudes regarding their social status and gender; they examined whether these factors correlated and influenced students’ performance, and their capability in dealing with mathematical proofs. They found a significant statistical difference between female and male students concerning “mathematical understanding is achieved through procedures and studying mathematics with understanding” (p. 101). Students’ interest or motivation in learning mathematics was found to be correlated positively with studying of mathematics involving understanding and reflection, with high performance at school and with the ability to understand mathematical proofs. The results from this study identified the factors that lead to the development of students’ positive and negative attitude towards mathematics with a significant impact on their learning of mathematics and achievement.

According to Zan and Di Martino (2007), the phenomenon of ‘negative attitude towards mathematics’ is related to the learning of the discipline. They further claimed that the negative attitude towards mathematics affects various aspects of the social context: the refusal of many students to enroll in scientific undergraduate courses due to the presence of exams in mathematics, a worrisome about even simple mathematical illiteracy, or an explicit and generalized refusal to apply mathematical rationality, and a tendency to uncritical acceptance of models that are only apparently rational. Their results suggested that the attitudes do not seem to have the characteristics of a theoretical instrument capable of directing their work. They found from personal essays that the two dimensions - vision of mathematics and like/dislike - are mutually independent. They further noticed that this independence was strongly expressed in characterizing mathematics as useful/useless and easy/difficult subject.

Hannula (2002, 2004) asserted on everyday-notion-of-attitude referring as someone’s basic liking and disliking of a familiar target. He discussed students’ attitude towards mathematics separating them into four different evaluative processes: emotions the students experience during the mathematics-related activities, the emotions that students automatically associate with the concept mathematics, evaluations of situations that students expect to follow as a consequence of doing mathematics, and the value of mathematics related goals in the students’ global structure. Through an action research, the researcher was successful to change attitudes, beliefs, and behaviors of a participating student. He also proposed a theoretical framework about emotions, associations, expectations, and values to study attitude towards mathematics. The most significant conclusion from this study was that the proposed framework of emotions, associations, expectations, and values was useful in describing attitudes, and their changes in detail. He further concluded that attitudes, sometimes, could change dramatically in a relatively short time and the negative attitude towards mathematics could be a successful defense strategy of a positive self-concept.
Relationship among Images, Anxieties and Attitudes

It seems that images, anxieties, and attitudes play a significant role in learning mathematics. These attributes are related to personal psychology, philosophy and epistemology. Wigfield and Meece (1998) assessed relations between math anxiety and other key mathematical attitudes, students’ beliefs and values, and their mathematical performance measured in a large study as one way of assessing the distinctiveness of math anxiety. Several researchers (e.g., Fennema, 1977; Fennema & Shermon, 1977; Richardson & Suinn, 1972; Tobias & Weissbrod, 1980) reported a negative correlation between math anxiety and low performance in mathematics, and then poor images associated with negative attitude towards mathematics. Although research studies have been undertaken to examine the affective domain, it has become central to describe a person’s attitude towards mathematics using precise but connected terminology, e.g. beliefs, emotions, confidence, anxiety, self-concept or image (McLeod, 1992).

There are some commonly held beliefs about mathematics which are still true today as they are associated with math anxiety (Kogelman & Warren, 1978). Sam (1999) reported that these beliefs are: (a) inherited mathematical ability that some people have a mathematical mind and some don’t, (b) one must always know how he or she got the answer, (c) there is one best way to solve a mathematics problem, (d) mathematics requires a good memory, (e) men are better at mathematics than women, (f) it is always essential to get the answer exactly right, (g) mathematicians solve problems quickly in their heads, and (h) it is bad to count on your fingers. These beliefs seem to be more like misconceptions developed in societies about mathematics. These misconceptions are hindering factors for people’s interest to study mathematics, use mathematics to solve problems, and think mathematically about their world.

Based upon above discussions on images, anxieties and attitudes towards mathematics, a theoretical model leading to the success or failure of mathematics teaching and learning with regard to student achievement, and motivation can be suggested. Images of mathematics as infallible or fallible, mathematics anxiety as high or low self-esteem, and attitude towards mathematics as positive or negative can be modeled into a triangular relation leading to a perception about mathematics. This theoretical model can be represented in a diagram as in figure 1. This untested model can be considered as a basis to relate images, anxieties and attitudes together with several possibilities of combinations. There are eight possible outcomes from the model representing different perceptions about mathematics including, (1) infallible, high self-esteem, positive attitude; (2) infallible, high self-esteem, negative attitude; (3) infallible, low self-esteem, positive attitude; (4) infallible, low self-esteem, negative attitude; (5) fallible, high self-esteem, positive attitude; (6) fallible, high self-esteem, negative attitude; (7) fallible, low self-esteem, positive attitude; and (8) fallible, low self-esteem, negative attitude.

![Figure 1: Model of triangular relation of images, anxieties and attitudes towards mathematics](image)

Among these combinations, the combinations (1), (4), (5) and (8) seem practically viable psychological states in terms of the interrelation of images, anxieties, and attitudes. The rest of the combinations may be theoretically viable, but they seem to be non-practical because high self-esteem and negative attitude, and low self-esteem and positive attitude towards mathematics seem to contradict. The contradiction in high self-esteem and negative attitude, and low self-esteem and positive attitude is obvious as they represent opposite characters about one’s perception towards mathematics.
Among the four possibilities, the first one is a combination of infallible (image), high self-esteem (low degree of anxiety), and a positive attitude. This combination is possible to develop a perception towards mathematics as absolute, infallible and incorrigible; however, the student has high self-esteem and positive attitude towards mathematics. The view of mathematics as absolute and infallible leads the student to develop a positivistic philosophy that can lead to the development of his or her personality as an Absolutist. The student with this kind of personality enjoys routine problem solving, follows a rigid procedure to solve problems, and values high scores in tests.

The fourth combination of infallible, low self-esteem and negative attitude is a problematic situation. Teacher centered teaching and learning that have fewer activities in the class for students, less emphasis to group or peer works, less questioning by the students, and authoritative instructions may result into low self-esteem and negative attitude towards mathematics. Teaching and learning mathematics guided by drill, practice, and copy from the board instead of construction of ideas by students may lead to this situation impacting severely in students’ understanding of mathematics and then achievement.

The fifth combination of fallible, high self-esteem and positive attitude leads to the development a perception that mathematical objects are socially constructed, it is fallible and questionable, and the student has a high self-esteem towards mathematics leading to positive attitude. This combination develops the personality of students to question mathematical objects and processes, maintain high self-esteem about learning mathematics, and think positively about his or her ability to learn mathematics. These students value the process of learning mathematics and they try to understand the nature of mathematics from examples and practices. They enjoy non-routine type unstructured problem solving.

The eighth combination of fallible, low self-esteem and negative attitude leads to the development a perception that mathematical objects are socially constructed, fallible, and questionable; however, the student has low self-esteem due to some internal and external problems to cope with the situation in the classroom that ultimately leads to the development of negative attitude. The teacher can help such students to develop high self-esteem by changing the pace of learning and helping him or her to learn from contexts to unstructured problem solving. The triangular relation among images, anxieties, and attitudes toward mathematics has some pedagogical implications that have been discussed in the next section.

Implications in Teaching and Learning of Mathematics

Choice of instructional methods and resources and their appropriate use in classroom teaching and learning of mathematics largely depends on images of mathematics as perceived by the teacher and students. Images based on an absolutist view of mathematics as neutral and value-free regarding teaching the contents as necessitating the adoption of humanistic, connected values have raised the issue of the relationship between epistemology and philosophy of mathematics, values and teaching (Ernest, 1995). Empirical research (e.g., Cooney, 1988) confirmed the claims that teachers’ personal views, opinions, perceptions, beliefs, and priorities about mathematics do influence their instructional practices (Thompson, 1984). “Thus it may be argued that any philosophy of mathematics (including personal philosophies) has many educational and pedagogical consequences when embodied in teachers’ beliefs, curriculum developments, or examination systems” (Ernest, 1995, p. 457). These images of mathematics from the epistemological, psychological, and philosophical perspectives value inductive and deductive reasoning as a way to learn and teach mathematics. Those images of mathematics have possible negative and positive impacts on teaching and learning of mathematics with the subsequent development of attitudes toward mathematics as positive or negative (e.g., Ma & Kishor, 1997; Lakoff & Nunez, 2000).

Based upon the above discussion, we can say that effective teaching depends on one’s image of mathematics based on personal epistemology and philosophy. It is up to a teacher to select a method of instruction in the classroom to engage students in learning mathematics. If the teacher views that school mathematics is merely a collection of formulas, rules, and procedures that must be memorized and mastered, then he may apply traditional teaching techniques like drilling in the class, working with individual worksheet practices, and using flashcards. If the teacher believes that mathematics is an integrated whole, a study of structures and the relationships among different things, and study methods and one’s understanding the world, then the goal of teaching mathematics may change. Now the teacher helps students develop the skills they can use to solve mathematical, non-mathematical, and non-routine problems. This also may include the students’ ability to reason mathematically or quantitatively, to clarify and justify mathematical ideas, to use mathematical and other
resources, to work collaboratively with other people, and to be able to generalize situations, as well as the their ability to carry out mathematical computations and procedures (Zemelman, Daniels, & Hyde, 1998).

In summary, different studies (as discussed above) indicated a positive relationship among images, anxieties and attitudes towards mathematics, and these emotional factors had a negative relationship with student’s achievement. However, there is a lack of research that examines the teachers’ pedagogy and students’ achievement in relation to different combinations of images, anxieties, and attitudes toward mathematics. The theoretical model presented in this paper with varying combinations of fallible or infallible images, high or low self-esteem and positive or negative attitudes can have significant pedagogical implications. A teacher’s awareness to these combinations can help him or her to maintain a balance among different approaches of teaching and learning mathematics as per the needs and contexts in the classroom. Such a balance of teaching and learning approaches, followed by a constructivist approach in conjunction with instructionist approach, can be helpful to teach mathematics lessons in a meaningful way through which students gain high quality learning experiences.

Acknowledgements

I would like to acknowledge Dr. Martin Agran, Professor in the Department of Professional Studies, College of Education, University of Wyoming, for his guidance and care while writing this manuscript as a course assignment in his class of Writing for Publication in the spring of 2010. I would like to thank the anonymous reviewers for their encouraging feedback/comments to the manuscript.

References


Classroom Observations and Reflections: Using Online Streaming Video as a Tool for Overcoming Barriers and Engaging in Critical Thinking

Angela T. Barlow*, Michael R. McCrory, Stephen Blessing

1Middle Tennessee State University
2Blue Mountain College
3Coffee County School District

Abstract

In typical school settings, teachers are not afforded the opportunity to observe the instructional practices of their peers. Time constraints, opportunity, and willingness to participate in observational practices are just three of the factors that may limit teachers’ engagement in this type of activity. To provide teachers with opportunities to observe a standards-based, elementary mathematics classroom, online streaming videos of instruction were disseminated to third grade teachers within a single school. As they viewed each video, the participants were presented with the opportunity to read the teacher’s introduction explaining the focus of the video and engage in discussion around each video through text. Discussions included posting their own comments, reading other participants’ comments, or posing questions. The purpose of this research was to examine the properties and/or qualities of the online streaming video that attracted the participants to use it, to identify the remaining obstacles that prevented the participants from utilizing the technology, and to explore the potential of online streaming video for engaging teachers in critically thinking about instruction and in turn impacting beliefs. Data was gathered in the form of surveys, interviews, and online comments. Results are provided and future research directions are given.

Key words: Mathematics education, Professional development, Online video, Critical thinking, Beliefs

Introduction

With the release of Principles and Standards for School Mathematics (PSSM) in 2000, the National Council of Teachers of Mathematics (NCTM) established a vision for school mathematics, in which the classroom engages students in the mathematical processes of problem solving, communicating about mathematics, representing mathematical concepts, reasoning and proof, and forming connections among mathematical ideas. Such a classroom is often referred to as a standards-based classroom. Equipping teachers with the knowledge and skills necessary to develop a standards-based classroom has been the focus of professional development since the release of PSSM (Balfanz, Mac Iver, & Byrnes, 2006; Heck, Banilower, Weiss, & Rosenber, 2008). This focus has intensified with the introduction of the Common Core State Standards for Mathematics (CCSSI, 2010), as its Standards for Mathematical Practices have these same mathematical processes as a foundation.

In order to accomplish change in classroom practices, it is necessary to consider the teachers’ beliefs concerning classroom practices with respect to teaching mathematics and the impact these beliefs have on decisions that are made (Stuart & Thurlow, 2000). The key belief components that teachers hold can be sorted into three categories: their view or conception of the nature of mathematics; their model or view of the nature of mathematics teaching; and their model or view of the process of learning mathematics (Ernest, 1988). These belief components are shaped by the hours spent in a classroom setting while students themselves. It is thought that these beliefs may remain dormant during preservice training at the university and can become a major force once the teacher is in his or her own classroom (Raths, 2001). In other words, a teacher may rely more upon how they were taught as students as opposed to the pedagogy to which they are exposed in methods classes. The result is the need for professional development that supports teachers in establishing a new vision of their roles as mathematics teachers (Sowder, 2007).

* Corresponding Author: Angela T. Barlow. Angela.Barlow@mtsu.edu
While there are possibly many factors that contribute to a teacher’s willingness and ability to develop a standards-based classroom, teacher educators recognize that many teachers have never seen such a classroom in action (Franke, Kazemi, & Battey, 2007). As a result, a goal of professional development should be to support teachers in establishing a vision of such a classroom (Borasi & Fonzi, 2002). To this end, most would argue that teachers need opportunities to observe these classrooms in action. Finding the time and opportunity to visit the classrooms of colleagues, however, is often a difficult obstacle to overcome. The purpose of this qualitative study was to examine the potential that online video streaming holds for circumventing lack of time and opportunity as barriers to observation of standards-based classrooms. In addition, the researchers sought to examine the impact of this learning opportunity on teachers’ beliefs as well as the level of critical thinking exhibited by the teachers in this online setting. Such reflection has been noted as a key element of professional development for teachers considering the establishment of their own standards-based classroom (Sowder, 2007). To guide the research, the following questions were posed.

1. What properties or qualities of online streaming video enable teachers to utilize it as a means for viewing a standards-based elementary mathematics classroom?
2. What are the barriers that prevent teachers from viewing video via online video streaming?
3. What level(s) of critical thinking are demonstrated in online video comments?
4. Does viewing instruction via online video streaming support change in teachers’ beliefs about teaching and learning mathematics?

Given the previously identified barriers, the significance of this study lies in its potential to establish online streaming video as a viable option to engage teachers in critically thinking about standards-based elementary mathematics lessons and supporting shifts in their beliefs.

Video as a Tool

“Video is generally thought to be a valuable medium for exploring teaching and learning because it captures much of the richness of the classroom setting” (Sherin, Linsenmeier, & van Es, 2009, p. 214). When compared with watching classroom lessons in person, videos provide the benefit of being able to pause the lesson, re-watch selected lesson components, and reflect on critical instances (Sherin et al., 2009). Through this process, videos of instruction provide teachers with a means for expanding their understanding of mathematics teaching and learning (Smith, 2001).

In selecting videos of instruction, Sherin and colleagues (2009) described three key issues to be considered. First, the authenticity of the featured instruction must be considered. Research by Brophy (2004) and Merseth (1996) demonstrated the need for videos to feature authentic classrooms that are similar to the classrooms of the teachers viewing the video. Second, teachers benefit from knowledge of the classroom context from which the video was taken (Sherin et al., 2009). Third, the intent of the video must be considered. In helping teachers develop their understanding of mathematics teaching and learning, videos can be separated into two categories (Brophy, 2004; Carter, 1999; Wang & Hartley, 2003). In the first category, “exemplars,” the video is intended to demonstrate an instructional strategy or setting that the teacher could potentially emulate in his or her own classroom. Such video may support teachers in envisioning their new roles as mathematics teachers, as described by Sowder (2007). This is in contrast to the second category, “problem situations,” which aims to provide teachers with a classroom-based dilemma to be resolved (Brophy, 2004; Carter, 1999; Wang & Hartley, 2003). Here, the intent is to provide a context for reflecting on practice (Sherin et al., 2009).

With calls for research on the use of video as a learning tool (e.g. Lundeberg, Levin, & Harrington, 1999; Morris, 2008), mathematics education researchers have begun investigating the impact of video on both preservice and inservice teachers (Borko, Jacobs, Eiteljorg, & Pittman, 2008; Kazemi, Lenges, & Stimpson, 2008; Morris, 2008; van Es & Sherin, 2008). A review of the literature revealed two studies that used video with inservice teachers for purposes similar to that of the present study. Each of these is described below.

In the first of these studies, Borko et al. (2008) utilized video from teachers’ classrooms as a means for engaging them in discussions about the teaching of mathematics. The two-year professional development program utilized video as a medium for facilitating teacher discussions about their classrooms and problem solving. As part of the program, teachers met in groups and discussed video taken from their own classrooms. The researchers reported that over the course of the two years the participants grew in terms of ability to examine video and reflect upon its contents.

In the second study, van Es and Sherin (2008) utilized a video club to engage teachers in discussing the pedagogy associated with mathematics. Specifically, through the use of video clips taken from the teachers’
classrooms, teachers examined and discussed children’s mathematical thinking. Findings of the study indicated that, through their participation in the video club, teachers grew in their ability to notice and discuss children’s thinking.

In each of these cases, the use of video allowed the teachers to overcome the obstacle of opportunity, therefore achieving the goals of the professional development projects in which they participated. There are three key components to these studies, however, that must be noted as these components might have become obstacles in a different setting. First, the teachers welcomed the videoing of their classrooms. Second, the video of the teachers’ classrooms produced video of a standards-based classroom. Third, there was a common time available for teachers to meet to view and discuss the classroom videos. If similar conditions are not present, what avenues are available for engaging teachers in observation of a standards-based classroom? Answering this question motivated the work of the researchers in this study.

**Practical Inquiry Model**

Although identifying online streaming video as an option for overcoming the barriers associated with viewing standards-based instruction is a key component in this study, the level of critical thinking evidenced by the teachers upon viewing the videos was also of interest. To address this, the researchers sought to have a means for examining the written comments posted by participants in response to the videos. In 2004, Garrison, Anderson, and Archer introduced the practical inquiry model. Researchers (e.g. Arnold & Ducate, 2006; Bai, 2009; Fahy, 2005) have used this model as a framework for assessing the level of critical thinking provided in online discussions. The model consists of four phases, namely triggering, exploration, integration, and resolution. These phases will be briefly described in the paragraphs that follow. Although the use of the model is not limited to the field of education, the examples provided will focus on teacher responses to a fictitious scenario.

In the triggering phase, the teacher recognizes and/or questions an issue that arises in a given context. For example, a question such as, “I wonder why the students were having difficulty with the multiplication?” would be classified as triggering. In this example, the teacher has communicated her recognition and curiosity regarding the students’ work.

Statements categorized as being in the exploration phase indicate that the teacher has begun to explore or investigate the issue, therefore moving beyond the initial recognition. Here, the teacher may offer suggestions or provide conclusions related to the issue. For example, if the teacher stated, “The students probably do not have a strong background in modeling multiplication. Does that seem right?” the response would be classified as exploration. The teacher has thought about the issue previously recognized and made a proposal as to why the issue might have arisen in an attempt to explain its occurrence.

In the next phase, integration, the teacher reflects on the connection between the issue recognized in the triggering phase and the possible reason provided in the exploration phase. Through this reflection, the teacher develops some understanding of the proposed reason and decides whether he or she agrees, offering some support to his/her reasoning. Continuing the previous example, the teacher might say, “I agree with this idea. Often, teachers rush to memorization of facts and skip modeling of multiplication. Students, then, do not have a chance to develop a real understanding of what multiplication means.” Notice in this statement, the teacher has not only proposed a potential reason behind the issue but also has included justification.

In the final phase, resolution, the teacher tests the idea(s) asserted in the integration phase, therefore resolving the issue that was initially recognized. While actually testing the ideas may not be possible, the proposal of how to test the ideas is also classified as being in the resolution phase. For example, the teacher might state, “I think the teacher in that classroom could spend some time letting students model multiplication with pictures and then have the students try the problem again to check for understanding of multiplication.” Here, the teacher has described a means for testing the ideas previously identified.

In summary, the practical inquiry model consists of four phases, which are linked to the processes associated with critical thinking. As a result, the model assesses critical discourse and reflection (Garrison et al., 2004). Statements classified as triggering or exploration demonstrate an attempt to initiate a discussion or share information. Therefore, researchers have classified statements in either of these categories as low levels of critical thinking. Alternatively, researchers have classified integration or resolution statements as representing high levels of critical thinking (e.g. Fahy, 2005).
Methodology

Subjects

In August 2008, the researchers invited third grade teachers at one elementary school to participate in the study. Located in a small town in the southeastern United States, the elementary school included students in grades two and three, with an approximate enrollment of 560 students. The student population was 47% Caucasian, 46% African American, 4% Asian, and 3% Hispanic. Each year, third grade students complete the state’s mandatory assessments in mathematics and language arts. For the 2008-2009 school year, third grade scores in mathematics were as follows: 7.5% minimal, 31.7% basic, 43% proficient, and 17.7% advanced.

All third grade teachers who taught mathematics (n = 10) agreed to participate in the study. Although participation was voluntary, participants were provided with the incentive of receiving continuing education units (CEU’s) based on the level of participation in the study. All ten teachers were Caucasian/white, and only one was male. Table 1 provides information regarding the number of years of the participants’ teaching experience.

<table>
<thead>
<tr>
<th>Participation</th>
<th>0 - 5</th>
<th>6 - 10</th>
<th>11 - 15</th>
<th>16 - 20</th>
<th>21 – 25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Instruments and Data Sources

In answering the research questions, the researchers utilized surveys, interviews, and online comments. Each of these will be described in the paragraphs that follow.

Survey 1

The researchers created Survey 1 (see Appendix A) to gain background information on the participants as well as an understanding of participants’ technology use. Section 1 of the survey included seven questions that enabled participants to identify the grade level taught, age range, academic preparation, teaching experience, and confidence in mathematics skills and teaching skills. Due to the nonambiguous nature of this information, close-ended questions were appropriate. The last question of Section 1 allowed the participant to indicate whether or not he or she had viewed the online video. Based on this response, the participant was directed to complete either Section 2 or Section 3 of Survey 1.

Participants who indicated that they had watched at least one online video were directed to complete Section 2. In this section, the researchers wanted participants to describe their motivation behind watching the videos as well as how they were utilizing the information from the videos. In addition, participants could identify the features of the video that made it accessible to them. In effect, this section was specifically designed to answer the first research question. Due to the exploratory nature of this research question, the researchers utilized open-ended prompts.

Participants who indicated that they had not watched any online video were directed to complete Section 3. The purpose of Section 3 was to provide participants with an opportunity to describe why they had chosen not to view and comment on videos. Through participant responses, the researchers sought to identify the barriers to viewing online video, thereby answering the second research question. In addition, the researchers were curious as to whether the participants would view the online video if the barriers were removed. As with Section 2, open-ended questions were utilized due to the exploratory nature of this work.
Survey 2

The researchers created the second survey (see Appendix B) to gauge the number of participants who had watched the online video but without posting comments. This survey consisted of two close-ended questions. Due to the nonambiguous nature of this information, the researchers felt that the use of close-ended questions was appropriate.

IMAP Web-based Beliefs Survey

The Integrating Mathematics and Pedagogy (IMAP) Web-based Beliefs Survey was used to assess beliefs about mathematics, learning and/or knowing mathematics, and children’s learning and doing mathematics. Such beliefs are likely to impact teachers’ classroom practices (Ambrose, Clement, Philipp, & Chauvot, 2004). Unlike Likert-scale surveys, the IMAP Web-based Beliefs Survey requires teachers to respond to videos and learning scenarios, thus providing a context for evidence of beliefs to be revealed. The survey includes rubrics for scoring teachers’ open-ended responses. The specificity of the rubrics lends itself to inter-rater reliability (Ambrose et al., 2004).

Interview Protocol

The researchers were particularly interested in the participants’ perspectives regarding the accessibility of the videos, the process of watching the videos, and how the information from the videos impacted instruction. To this end, the researchers created an interview protocol (see Appendix C) to be utilized with teachers who watched all or nearly all of the videos. The interview protocol included 11 open-ended questions that were meant to guide the interview, recognizing that participant responses might prompt the interviewer to ask additional follow-up questions.

Online Comments

In addition to surveys and interviews, participants posted online comments to the video streaming site upon viewing each video. The researchers created one transcript for each video by copying participants’ comments verbatim into a Word document. Comments within the transcripts appeared in the order in which they were posted.

Procedures Used

In August 2008, the researchers met with third grade teachers at the identified elementary school to invite them to participate in the study as well as to collect initial data. This meeting occurred two days prior to the first day of the school year. Participants completed the IMAP Web-based beliefs survey (Ambrose et al., 2004) at this meeting.

During the 2008-2009 school year, one of the authors, hereafter referred to as the teacher, volunteered to teach the daily mathematics lessons in a third grade classroom. Each lesson was videoed and reviewed for potential editing and use in the project. In a typical lesson, the teacher presented students with a task or problem that engaged the students in problem solving. In solving the problem, students utilized manipulatives and/or drawings to represent their work. Depending on the problem, students either worked the problem individually and then shared their thoughts with a partner, or they worked as a group to solve the problem. Afterwards, the teacher selected students/groups to share their solutions, and the class compared and contrasted the different solution strategies. Through questioning, the teacher facilitated the discussion of the mathematics that emerged from the problem. Often, students summarized the lesson by responding to a writing prompt in their mathematics journals. During these lessons, the students were clearly engaged in each of the five Process Standards, namely problem solving, communication, connections, reasoning and proof, and representation (NCTM, 2000). As a result, the authors judged the teaching in this classroom to be standards-based. In addition, a mathematics education expert not associated with the researchers or their university reviewed the videos. This expert was an associate professor of mathematics education at a university in the northeastern region of the United States. Through her research and work within classrooms, she had developed a strong understanding of the process standards. After viewing classroom videos, the expert confirmed that the students were indeed
engaged in the process standards (NCTM, 2000). Therefore, the availability of videos of standards-based instruction overcame the obstacle of lack of standards-based instruction for viewing. Furthermore, this video represented an authentic classroom similar in context to that of the participants.

With the availability of video secured, the authors sought to address the issues of opportunity and time. What opportunities do teachers have to observe the happenings of someone else’s classroom? Where does a teacher find the time to observe a class or watch videos of a class? The authors hypothesized that by utilizing online streaming video teachers would have the opportunity to view classroom video at their convenience, therefore overcoming these obstacles.

In September 2008, the teachers at the school in which the video was being captured completed a training session conducted by two of the authors. The purpose of this training session was to train them on the use of the online video streaming system being utilized in the project. This training included watching a sample video followed by small group discussions regarding the contents of the video and a demonstration of how to post comments to the video. All teachers agreed to participate and received a detailed handout describing the process of using the online video streaming system. In addition, participants signed an agreement of confidentiality, stating that they would not share their user names and passwords with persons not participating in the project.

<table>
<thead>
<tr>
<th>Video</th>
<th>Purpose</th>
<th>Process Standard Emphasized</th>
<th>Mathematical Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Demonstrate writing in the math classroom</td>
<td>Communication</td>
<td>Representing equations</td>
</tr>
<tr>
<td>2</td>
<td>Demonstrate problem solving with manipulatives</td>
<td>Problem solving Representation</td>
<td>Composition and decomposition of numbers</td>
</tr>
<tr>
<td>3</td>
<td>Demonstrate how to let students correct each other rather than having the teacher as the authority figure in the classroom</td>
<td>Reasoning &amp; Proof Problem Solving</td>
<td>Comparing 4-digit numbers</td>
</tr>
<tr>
<td>4</td>
<td>Demonstrate the use of problem solving to introduce mathematics &amp; emphasis on process</td>
<td>Problem Solving Reasoning &amp; Proof</td>
<td>Multiplication (equal-sized groups)</td>
</tr>
<tr>
<td>5</td>
<td>Demonstrate collaborative groups &amp; facilitation of classroom discourse</td>
<td>Communication</td>
<td>Multiplication and the Commutative Property</td>
</tr>
<tr>
<td>6</td>
<td>Demonstrate generating classroom discourse &amp; utilizing student ideas to lead the lesson</td>
<td>Communication</td>
<td>Multiplication (equal-sized groups)</td>
</tr>
<tr>
<td>7</td>
<td>Demonstrate the importance of allowing students to use pictures to represent mathematical ideas</td>
<td>Representation</td>
<td>Multiplication (equal-sized groups)</td>
</tr>
<tr>
<td>8</td>
<td>Demonstrate the use of literature to introduce a mathematical topic</td>
<td>Connections</td>
<td>Multiplication (array model)</td>
</tr>
<tr>
<td>9</td>
<td>Demonstrate the importance of laying the expectations for working in a group during problem solving</td>
<td>Problem Solving</td>
<td>Division</td>
</tr>
<tr>
<td>10</td>
<td>Demonstrate the use of problem solving to introduce a mathematical topic</td>
<td>Problem Solving</td>
<td>Division (partitioning model)</td>
</tr>
<tr>
<td>11</td>
<td>Demonstrate the use of student-generated problem-solving strategies for leading discussion &amp; teacher’s decisions regarding which problem-solving strategies to showcase first</td>
<td>Problem Solving</td>
<td>Combination problems</td>
</tr>
</tbody>
</table>
After the training session, the researchers began posting videos online. A new video was posted approximately every two weeks. The video posting process began with the selection of the lessons for editing. Since the study and the lessons were occurring simultaneously, it was not possible to have the sequence of edited videos planned prior to the start of the study. Instead, the lessons were selected and videos were edited as the study progressed. In selecting lessons for potential editing, the teacher reflected weekly on the most recent lessons, identifying lessons to be edited based on their potential for demonstrating different means for engaging students in the Process Standards. In this sense, videos were being used as exemplars (Carter, 1999). Table 2 contains a description of the purpose of each video utilized in the study along with the Process Standard being emphasized and the mathematical content of the lesson. Initial videos were selected to demonstrate strategies that could be utilized in teachers’ classrooms without significantly changing the current instructional mode. For example, the first video highlighted the use of a writing prompt, an instructional technique that could easily be incorporated into any lesson. As the videos progressed, the emphasis shifted toward an end goal of teaching through problem solving, an instructional mode that would require significant changes in most of the participants’ classrooms.

With the lesson selected and the purpose of the video identified, the researchers reviewed the lesson video to identify how to edit the video. The goal in editing was to produce a video clip that allowed participants to examine the featured aspect of the lesson without having to watch the entire lesson. For example, in the first video featuring student responses to a writing prompt, it was not necessary for the edited video to include other parts of the lesson such as the warm-up for the lesson or the actual time spent with students writing. Instead, the video was edited to showcase the teacher introducing the writing prompt, the students displaying and sharing their work via a document presenter, and the teacher utilizing the work to establish expectations for student writing. As a result of the editing process, video clips were typically under 10 minutes. Edited video clips were then posted to the online video streaming website.

With each video that was made available for viewing, the teacher posted an initial comment that described the content of the video, how it linked to the grade-level objectives, and the content in the video on which to focus. This initial comment supported participants in understanding the context of the lesson. Once the initial comment was posted, the researchers sent an e-mail to participants, alerting them that a new video had been posted for viewing. In order to participate in the project and earn CEU’s, participants were expected to go online, view the video, and post a comment. The posted comments enabled the researchers to track who was viewing the videos. Worth noting is the fact that it was possible for participants to view videos without posting a comment. In these instances, the online video streaming program tracked how many views were made in which the viewer did not post a comment. It was not possible, however, to know who had viewed the video.

After five videos had been posted (approximately half-way through the project), the researcher e-mailed participants, asking them to complete Survey 1 (see Appendix A). Surveys were placed in participants’ school mailboxes along with an envelope in which to place the survey. Four days later, the researcher visited each participant to collect the survey.

At the conclusion of the school year, participants responded to Survey 2 (see Appendix B) as well as the IMAP Web-based Beliefs Survey (Ambrose et al., 2004). In addition to these surveys, one of the researchers interviewed the two participants that had viewed and commented on every video posted utilizing the Interview Protocol (see Appendix C). Each interview lasted approximately 20 minutes. Interviews were audio recorded and then later transcribed verbatim by the researchers. Finally, the researchers copied the participants’ online video comments into a Word document to create the video transcripts.

Data Analysis

Since Survey 1 contained responses to open-ended questions, the researchers utilized qualitative methods for analyzing the data. The researchers independently reviewed the responses using open coding (Charmaz, 2002; Strauss & Corbin, 1990). The researchers then met to compare and agree upon the codes that emerged from the data. With the agreed upon codes in place, the researchers independently reviewed and coded the survey responses a second time. Finally, the researchers met to compare analyses and to reach consensus regarding any discrepancies. A similar process was employed for analyzing the interview transcripts. Responses to Survey 2 represented categorical data. Frequencies were recorded based on the responses.

Responses to the IMAP Web-based Beliefs Survey were analyzed using the rubrics provided with the survey (Ambrose et al., 2004). This analysis yielded ordinal scores, ranging from 0 to 4 for each participant (pre and
post) for each of seven beliefs statements. The researchers recorded the resulting scores in a table and examined the table for trends or patterns that were present in the data.

Finally, the comments posted by participants on the online video streaming site were reviewed using open coding (Charmaz, 2002; Strauss & Corbin, 1990). The researchers then met to compare the codes that had emerged from the comments. Once the researchers agreed upon the codes, they assembled a list of the codes with descriptors of each code (see Appendix D). Separately, the researchers utilized the agreed upon codes to code the participants’ comments. The researchers met again to agree upon the codes of the participants’ comments.

With the comments coded, the researchers separately examined the response codes in relation to the practical inquiry model (Garrison et al., 2004). As such, the practical inquiry model provided a lens for viewing the level of critical thinking evidenced within the participants’ comments. Through an examination of code descriptions and sample participant responses, the researchers independently matched response codes with the four phases of the model. Next, the researchers met to agree upon the match between response codes and the phases of the model. In addition, the alignment of codes with the practical inquiry model was sent to a colleague for review. This colleague had utilized the practical inquiry model in her research and had developed a deep understanding of its phases and their representations within online discussions. The colleague confirmed that the codes generated from the online comments appropriately aligned with the assigned phases of the practical inquiry model.

Finally, the researchers computed the percentages of responses falling in each of the four phases of the model. In doing so, the researchers noted that participants often posted a single comment that contained responses representing multiple codes and multiple phases from the model. In this case, the participants’ overall response was labeled according to the highest phase from the practical inquiry model. Researchers considered responses labeled as triggering or exploration to represent low levels of critical thinking. Alternatively, the researchers considered responses in the integration or resolution phases as representing high levels of critical thinking. In some instances, participants posted comments that simply summarized the events of the lesson. The researchers elected not to label these as representing high or low levels of critical thinking, as they did not exhibit the characteristics of critical thinking.

Results

In this section, the results of data analyses will be shared. The results will be organized around the research questions. In addition, limitations of the study will be shared.

What properties or qualities of online streaming video enable teachers to utilize it as a means for viewing a standards-based elementary mathematics classroom?

Data taken from responses to the initial survey were examined to answer this question. At the point in the study when this survey was completed, five of the ten participants had utilized the online video-streaming program. All five of these participants agreed that the technology had allowed them to participate more in the project than they might have been able to do without it. When asked about the features of the technology that enabled them to participate, three of the five participants indicated time as a feature of the online video streaming that allowed them to view the videos “on their own time.” Of interest, though, is that the convenience factor was valued for different reasons. One teacher saw the convenience as important because it did not require her to be out of her own classroom. In contrast, a second teacher noted that being able to watch the video on her own time allowed her to watch the video without being rushed.

Follow-up interviews with two of the participants confirmed that an appealing characteristic of the online video streaming technology was its convenience. One participant stated the following:

I come [sic] in early in the morning so I would have time and peace and quiet to turn it on and... view it. . . . I’d be writing notes and taking things down and writing stuff so that I could try it with my kids.

The other participant stated the following:

And I could repeat however many times I needed to see it which then allowed me to zero on different aspects of it. So, it really enhanced what I was able to get from the video and get from the lesson she was teaching. . . . So I’d watch it about 4 times ‘cause there’s a lot going on and each time I watched it
for different perspectives on it. . . . Except not always did I sit down and do it all four times at once. Sometimes I’d watch it at least 2 times the first time and then it may be a day before I went back and watched it again because things had to work around in my mind as I was thinking about it. Regardless of the underlying reasons, from these responses one may conclude that one property of the online video streaming that enabled the participants to view standards-based instruction was that it provided access to the videos at the teacher’s convenience.

**What are the barriers that prevent teachers from viewing video via online video streaming?**

As with the previous question, data taken from the initial survey were utilized to answer this question. When the initial survey was administered, approximately mid-way through the project, five out of the ten teachers had not utilized the online video streaming technology for the purposes of viewing the videos. When asked for the main reasons for opting not to participate, all five of the participants noted time as the issue. These responses, however, fell into two categories.

*CATEGORY 1: NOT A PRIORITY*

For three of the participants, the time issues seemed to indicate that participating in the project was not a priority. For example, one participant wrote, “Time constraints. Would love to participate, but have other paperwork to get done for job requirements.” It would appear that the online accessibility and convenience factor that attracted others to participate did not appeal to these participants.

*CATEGORY 2: PERSONAL TECHNOLOGY PROBLEM.*

For the remaining two participants, time was given as a reason for being unable to participate in viewing the videos. Both of these participants, however, indicated that problems with technology access at home also prevented them from participating. For example, one participant wrote, “1. No time during day to fully watch video. 2. Trouble with computer at home.” The other participant seemed to indicate a sincere desire to view the videos. This participant wrote, “I do not have the internet at home. I am waiting for the holidays so that I have uninterrupted, quiet, quality time to view the observations.”

At the conclusion of the study, nine of the participants completed Survey 2. (Note: One participant was sick and therefore unable to complete the survey.) Results can be found in Table 3. As indicated here, by the end of the project, all but one participant had utilized the online video streaming for viewing video of the standards-based classroom. This would seem to indicate that by the end of the project the characteristics of the online video streaming had overcome previously cited obstacles. One interesting aspect revealed itself in this survey, however, and that was the frequency of participants posting comments. Three participants reported that they had watched videos but never commented while one participant posted comments sometimes.

<table>
<thead>
<tr>
<th>Comment Frequency</th>
<th>Number of Videos Viewed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td><strong>Always</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>Sometimes</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>Never</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>Did not watch videos</strong></td>
<td>1</td>
</tr>
</tbody>
</table>

**What level(s) of critical thinking are demonstrated in online video comments?**

In responding to this question, the researchers examined a total of 43 comments and categorized them as either high or low in terms of critical thinking based on the practical inquiry model (Garrison et al., 2004). As an example, Table 4 provides the transcript for the “2000 – 1” video that was filmed on October 30, 2008 (video 2
from Table 2). In this video, the teacher asked the students to represent and solve $2000 - 1$ utilizing the base-10 blocks. Prior to this lesson, students had had opportunities to compose and decompose four-digit numbers and had modeled addition and subtraction of four-digit numbers, with and without regrouping. They had not, however, modeled subtraction involving multiple zeros. In the video excerpt, participants had the opportunity to view the introduction of the problem by the teacher, a limited amount of group interaction as students worked the problem, and one group presentation of their strategy for solving the problem. In addition, the group fielded student questions. In total, the video was just over eight minutes long.

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Comment</th>
<th>Code(s)</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sydney</td>
<td>I can tell that the students have a true understanding of base-ten blocks and how they represent numbers. They also understand place value and how to trade cubes for flats, flats for sticks, and sticks for units. The teacher only poses the question and lets the students use the base-ten blocks to figure out the problem. She is only making sure they have the correct supplies and asked questions to guide them but not give them the answer. The students explain the answer and then evaluate each other with questions. It is evident that students must have a good understanding of place value and how to use base-ten blocks to work addition and subtraction problems.</td>
<td>5,5</td>
<td>High</td>
</tr>
<tr>
<td>Julie</td>
<td>I do have the problem of giving the students too much information when they are stuck. I can see that you should ask the students more questions to keep them thinking, and chances are they will discover the solution themselves.</td>
<td>6H</td>
<td>High</td>
</tr>
<tr>
<td>Paige</td>
<td>These students have a great understanding of base ten blocks and how to trade. With very little prodding, they were able to show understanding of the problem, and gave a good explanation of the problem to classmates. How much time is spent practicing with base ten blocks before doing this type of problem?</td>
<td>5,4</td>
<td>High</td>
</tr>
<tr>
<td>Shannon</td>
<td>The group really had a great understanding of place value and were able to explain their answers to the other students when asked &quot;How did you use the flats and units?&quot; I agree with [Julie] and need to ask more questions to have students think more about the problem and solution, rather than just giving them more information. In this video, [The teacher] let the students do the &quot;teaching&quot;, only prodding them with questions and having the students figure out the solution and explaining their reasons for their answer.</td>
<td>5, 3, 6H, 8</td>
<td>High</td>
</tr>
<tr>
<td>Jessica</td>
<td>I saw an opportunity for the students to share what they were doing with the teacher while they were working. This is a way for more students to share with the teacher, especially since only one group shared with the class. [The teacher] kept the students moving along with the activity without interrupting their thought process. She also encouraged the students to keep trying when they faltered. I am unsure when to step in or not. I want to give the students the time they need to explore and I am afraid that I might interrupt their process.</td>
<td>8, 6H</td>
<td>High</td>
</tr>
</tbody>
</table>

Within the table, the comments of five participants are provided along with the coding and classification of the overall statement. The first teacher to view and post a comment for the video was Sydney. In this comment, Sydney focused both on describing the actions of the teacher as well as on the understandings of the students. The statements related to students’ understandings were coded with “5 – Reflecting on students’ mathematical thinking/processes” in recognition that she had provided evidence of why she believed the students understand
Barlow, McCrory, & Blessing

base-ten blocks and place value. Other statements such as, “The teacher only poses the question and lets the students use the base-ten blocks to figure out the problem,” were descriptive of the video and therefore not coded. By reflecting on students’ mathematical understandings and providing support for this reflection, Sydney’s comment fell in the integration category of the practical inquiry model. Therefore, the comment was classified as high.

The second participant to comment on the video was Julie. In her comment, Julie identified an issue within her own instructional practices that resulted from watching the video. In addition, she described how the instructional practice should be corrected and what the impact would be. In doing so, this comment was coded with “6H – Self Reflection – Thinking about changes she needs to make to her own practices.” By proposing changes to be made in her own practice, Julie’s comment may be classified as being in the resolution phase of the practical inquiry model. Therefore the comment was classified as high.

Paige was the third participant to view and comment on the video. Like Sydney, Paige stated that the students understood the base-ten blocks and how to trade. She justified this statement noting that the students worked with little prodding and that they provided good explanations. This statement was therefore coded with “5 – Reflecting on students’ mathematical thinking/processes.” Paige also asked a question about the students’ work with base-ten blocks that occurred prior to the video. This question was coded with “4 – Question for Instructor” which fell in the triggering phase of the practical inquiry model. Although this aspect of the comment was at the low level in terms of critical thinking, the entire comment was categorized as being at the high level based on the initial part of the comment.

Shannon provided the next comment on the video. Her response contained elements of not only codes 5 and 6H but also 3 and 8. By agreeing with Julie, Shannon referenced something another teacher said which is categorized as integration according to the practical inquiry model. In addition, she provided justification for the teacher’s actions in the video which is also at the integration level. This comment was categorized as high in terms of critical thinking.

Finally, Jessica’s comment also provided justification for the teacher’s action, thus receiving a code of 8. In addition, she reflected on uncertainties within her own instructional practices, which received a code of 6H. As before, both of these indicated high levels of critical thinking and thus the comment was categorized as high.

Across all video transcripts, the participants posted a total of 43 comments. Of these comments, the researchers categorized 38 comments (88%) as representing a high level of critical thinking. The researchers categorized two of the online comments (5%) as representing a low level of critical thinking. The first of these responses follows

I used stories to introduce a math concept. I found your idea to use a visual of the story useful. I would have the class discuss the math concepts within the story, but did not have a visual ready to use also.

This participant has identified a teacher action that she believes to be useful, but without providing a justification as to why this action is useful. The comment received the code “6L – Self Reflection – Identifying her own teaching practices in the video.” Without providing justification, this code falls in the exploration phase of the practical inquiry model, which is considered low in terms of critical thinking.

The other statement categorized as low level in terms of critical thinking came from Julie who described the video and then posed a question.

I did have problems hearing some of the children’s comments. I kept hoping to hear one of them use the expression "groups of", and [the student] came through with flying colors with his comments. Have the students been taught the commutative property of multiplication, yet, or is this leading into it?

Julie’s description of the video received no code. Her question that was directed toward the teacher in the video was coded with 4, representing a low level of critical thinking.

Finally, the researchers decided not to code three of the online comments (7%) as either high or low. These responses provided a summary of the lesson without elements of high or low critical thinking. As an example, one participant wrote, “The students are working with enthusiasm. I noticed that there is a lot of discussion in the groups.” This participant has described occurrences from the video without indicating why they were of interest to her, why they were important, or how these observations allowed her to think about her own practice.
Does viewing instruction via online video streaming support change in teachers’ beliefs about teaching and learning mathematics?

To answer this question, researchers examined the results of the pre- and post-administrations of the IMAP Web-based Beliefs Survey. Table 5 provides the percentages of each score for each of the beliefs statements.

Table 5. Results of the IMAP Web-based Beliefs Survey

<table>
<thead>
<tr>
<th>Belief Scores*</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belief 1 – Mathematics is a web of interrelated concepts and procedures (and school mathematics should be too).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>78%</td>
<td>0%</td>
<td>11%</td>
<td>11%</td>
<td>---</td>
</tr>
<tr>
<td>Post</td>
<td>22%</td>
<td>67%</td>
<td>11%</td>
<td>0%</td>
<td>---</td>
</tr>
<tr>
<td>Belief 2 – One’s knowledge of how to apply mathematical procedures does not necessarily go with understanding of the underlying concepts.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>67%</td>
<td>11%</td>
<td>22%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Post</td>
<td>33%</td>
<td>33%</td>
<td>0%</td>
<td>22%</td>
<td>11%</td>
</tr>
<tr>
<td>Belief 3 – Understanding mathematical concepts is more powerful and more generative than remembering mathematical procedures.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>0%</td>
<td>33%</td>
<td>22%</td>
<td>44%</td>
<td>---</td>
</tr>
<tr>
<td>Post</td>
<td>0%</td>
<td>56%</td>
<td>0%</td>
<td>44%</td>
<td>---</td>
</tr>
<tr>
<td>Belief 4 – If students learn mathematical concepts before they learn procedures, they are more likely to understand the procedures when they learn them. If they learn the procedures first, they are less likely ever to learn the concepts.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>22%</td>
<td>11%</td>
<td>44%</td>
<td>22%</td>
<td>---</td>
</tr>
<tr>
<td>Post</td>
<td>0%</td>
<td>0%</td>
<td>33%</td>
<td>67%</td>
<td>---</td>
</tr>
<tr>
<td>Belief 5 – Children can solve problems in novel ways before being taught how to solve such problems. Children in primary grades generally understand more mathematics and have more flexible solution strategies than adults expect.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>44%</td>
<td>22%</td>
<td>33%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Post</td>
<td>22%</td>
<td>11%</td>
<td>11%</td>
<td>44%</td>
<td>11%</td>
</tr>
<tr>
<td>Belief 6 – The ways children think about mathematics are generally different from the ways adults would expect them to think about mathematics. For example, real-world contexts support children’s initial thinking whereas symbols do not.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>44%</td>
<td>11%</td>
<td>44%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Post</td>
<td>22%</td>
<td>44%</td>
<td>22%</td>
<td>11%</td>
<td>0%</td>
</tr>
<tr>
<td>Belief 7 – During interactions related to the learning of mathematics, the teacher should allow the children to do as much of the thinking as possible.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>44%</td>
<td>56%</td>
<td>0%</td>
<td>0%</td>
<td>---</td>
</tr>
<tr>
<td>Post</td>
<td>33%</td>
<td>0%</td>
<td>44%</td>
<td>22%</td>
<td>---</td>
</tr>
</tbody>
</table>

*0 = No evidence of holding belief, 1 = weak evidence of holding belief, 2 = evidence of holding belief, 3 = strong evidence/evidence of holding belief, 4 = consistently strong evidence of holding belief
--- The analyses of IMAP beliefs 1, 3, 4, and 7 do not allow the option of values to exceed 3.
Scores of 0 and 1 indicate that the participant either failed to provide evidence or provided weak evidence, respectively, of holding the designated belief. A score of 2 indicates that the participant provided evidence of holding the belief. For some beliefs, the highest score possible is a 3, indicating that the participant provided strong evidence of holding the belief. For other beliefs, the highest possible score is a 4. In this case, a 3 indicates that the participant provided strong evidence of holding the belief in some instances whereas a 4 indicates that the participant provided consistently strong evidence of holding the belief. It should be noted that a score of 0 does not necessarily mean that the participant does not hold the belief. Rather, it means that the participant failed to provide evidence of holding the belief within the contexts presented on the survey.

A review of Table 5 reveals that with the exception of Belief 3, participants provided stronger beliefs in each of the statement on the post-survey as compared to the pre-survey. These shifts in belief scores are particularly noteworthy for Beliefs 4, 5, and 7.

Limitations

Before discussing the results, the limitations of the study should be described. First, due to the qualitative nature of this research study there is the potential for researcher bias. The researchers have worked, however, to eliminate this bias by conducting analyses independently followed by discussion to move toward agreement. In addition, credibility of the findings is offered through the use of the practical inquiry model (Garrison et al., 2004), a model that has been used in similar settings for similar purposes and has with it descriptors of its phases. Furthermore, analyzing the open-ended responses from the IMAP Web-based beliefs survey with its detailed rubrics results in high inter-rater reliability, thus reducing the potential of bias.

Recognizing that qualitative research is not designed to produce generalizable results, the researchers have sought to strengthen the transferability of the results by providing thick descriptions of the procedures and analyses associated with the work.

Discussion and Conclusion

To support teachers in establishing standards-based classrooms, teacher educators have identified videos as a mechanism for helping teachers observe standards-based instruction (LeFevre, 2002; Seago & Mumme, 2002). In using videos, availability of classroom footage as well as time and opportunity for viewing the videos become barriers that must be addressed. This study examined the potential that online streaming video might hold in addressing these barriers as well as the support it provided for engaging teachers in critically thinking about instruction and the resulting impact on teachers’ beliefs about instruction.

The convenience factor of the technology used to disseminate the videos proved to be the primary characteristic that enabled teachers to view the video of standards-based mathematics instruction. This feature allowed them to view and comment at their own pace and on their own schedule, as there were no penalties for late or missing comments. For those who wanted to better themselves as teachers through observation, the technology eliminated many of the barriers facing them. This desire for growth could be seen in their survey comments. When asked for their main reason for their participation, one wrote, “I am participating to learn more about the standards and the problem-solving approach to teaching so I can be a better teacher.” Yet another demonstrated an attitude desirable in all educators: “I consider myself a lifelong learner and view this as a chance to learn more.” One of the five did mention the CEU’s as a main reason for their participation but also listed the gain of additional methods of mathematical instruction. These participants each demonstrated an earnest desire to grow as professionals and have not allowed time to be a constraint on that desire.

At the midpoint of the study, half of the participants had not utilized the technology for viewing videos. These participants cited time as the barrier, although this time factor was linked either to participation in the project as not being a priority or personal technology issues that prevented them from viewing the videos away from school. Interestingly, time was the most common theme in the writings of those that had utilized the technology for viewing videos and those that had chosen not to do so. This midpoint data seemed to indicate that the desire to participate may be the biggest motivation and constraint for both viewers and non-viewers, respectively. It also pointed to the need to provide teachers with information regarding avenues for accessing the internet outside of school as well as technological support for the teacher at his or her home.

By the end of the project, all but one participant had viewed videos, indicating that the characteristics of the
online video streaming technology had overcome the issues of time and opportunity. As such, online video streaming may be considered a viable option for engaging teachers in observations of standards-based elementary mathematics lessons. One must next consider the level of critical thinking exhibited in this online setting.

When considering the levels of critical thinking demonstrated by participants’ online video comments, it appears that online streaming video engages teachers in critically thinking about standards-based instruction. It is worth noting, however, that the interpretation of these results is limited by the failure of some participants to post comments after viewing video. The researchers can only hypothesize as to why participants did not post comments. Possible reasons might include lack of familiarity with the online posting process, insecurity related to having others read their comments, or even a lack of critical thinking regarding the video. Had all participants been required to post, similar results regarding the high levels of critical thinking might not have been obtained. Yet, for those teachers who appear to be motivated to think about practice, online video streaming may be a viable avenue for critically thinking about instructional practices. These results seem to support the results of Borko et al. (2008) who found that video was an effective means for facilitating teacher reflection on practice.

Given the high level of critical thinking demonstrated in the online setting, the strong impact of the learning experience on participants’ beliefs about mathematics instruction seemed to be a natural outgrowth of the experience. The strongest impact was seen for Beliefs 4, 5, and 7 which focus on developing conceptual understanding before procedural skills, allowing students to solve problems without being told how to do so beforehand, and allowing children to do as much of the thinking as possible, respectively. Given the emphasis in the selected videos on problem solving, student communication, and student representation of ideas (see Table 3), it seems logical that these changes in beliefs were supported by the opportunity to critically think about the instruction featured in this online setting.

**Recommendations**

In reflecting over the results of this study, the researchers provide the following directions for future research. First, the study should be replicated utilizing a larger sample. When working with this larger sample, technology support should be provided for teachers in the form of at-home technology support as well as awareness of technology availability outside of the home (e.g., public libraries). By addressing these technology issues with a larger sample, generalizable results may be obtained. In addition, future work should examine the reasons behind teachers’ failure to post online comments after viewing the videos. Of particular interest is whether or not this lack of posting is an indicator of a lack of critical thinking about the content of the videos. Finally, although this study examined the impact of the work on participants’ beliefs, future studies should take this a step further by following the participants into their classrooms to document impact on instruction. Should this future work confirm the findings of this study, the researchers suggest that online video streaming should become a part of professional development programs aimed at engaging teachers in critically thinking about instructional practices in the mathematics classroom.

**References**

Appendix A

Section 1
All information given on this survey is given on an anonymous basis. No personal information will be shared with the staff or any other parties. Any papers or reports generated from this survey will have any identifiable information removed.

Participation is optional but thoughtful, honest answers would be very much appreciated.

Your role at OE: □ 2nd Grade Teacher
□ 3rd Grade Teacher
□ Administration/Other

Age Range: □ 20-25 □ 36-40 □ 51-55
□ 26-30 □ 41-45 □ 56-60
□ 31-35 □ 46-50 □ 61+

Highest Degree Earned: □ Bachelors □ Masters □ Doctoral

Year Completed: ____________________

Years Experience Teaching: □ 0-5 □ 16-20
□ 6-10 □ 21-25
□ 11-15 □ 25+

Self Evaluation of Math Skills (Check One):

Lower □ 1 □ 2 □ 3 □ 4 □ 5 Higher

Self Evaluation of Math Teaching Skills (Check One):

Lower □ 1 □ 2 □ 3 □ 4 □ 5 Higher

Complete the following sentence by checking one of the following options:

I have watched and posted comments on ______ of the videos posted on the website for this study.

□ 0 □ 1 or more

If you checked the box by "0", please skip Section 2 and proceed to Section 3 on the back of this survey.

If you checked "1 or more", please proceed to Section 2 on the back of this survey. You do not need to complete Section 3.
Section 2

Is this your first exposure to a standards-based classroom?  
☐ Yes  ☐ No

What are the main reasons for your participation in the observations and reflections?

How have posting and reading other's comments affected your thoughts on the videos?

How has watching the video(s) influenced your teaching methods?

Has the use of this technology allowed you to participate more than you might have without it?  
☐ Yes  ☐ No

If yes, what in particular has made it more accessible to you?
Section 3

Have you ever observed a standards-based classroom? □ Yes □ No

What are the main reasons that you have opted not to participate in the observations/reflections?

If these obstacles were removed, how would your participation change?

Are you generally comfortable using technology like that being used in these exercises?

□ Yes □ No
Appendix B

Last 4 digits of your Social Security Number ______________ Date ______________

How many videos did you watch via the online program Voicethread? (Check one)

___ 0 videos  ___ 1 or 2 videos  ___ 3 or 4 videos  ___ More than 4 videos

Did you post comments when you watched the videos? (Check one)

___ Always  ___ Sometimes  ___ Never  ___ I did not watch the videos.
Appendix C

Did the online technology aspect of this project assist your participation? In what way?

What was your process for watching the videos?

How were information and ideas that you gained from the videos used in your classroom?

When you watched the videos, what were you looking for, specifically?

What was your primary motivation for participating in this research project?

How has your participation influenced your teaching?

Without mentioning names, why do you think the participation rate was low among the teachers?

What would you have like to have gotten out of this experience but didn’t?

If this project were to continue, would you to participate? Why or why not?

Would you be interested in having your own lessons videotaped?

Would you be interested in starting a lesson study program with your peers?
Appendix D

Coding Descriptors

1. Adapting an idea (High)
   - Indicating a plan to use something from the lesson in her own classroom
   - Indicating that she has already done something from the lesson in her classroom

2. Complementing the lesson (Low)
   - Indicating that she “liked” something about the lesson

3. Comment to other teacher (High)
   - Referencing something another teacher said
   - There is a clear indication that the response is linked to something another teacher has said.

4. Question for Instructor (Low)
   - A question is posed directly to the instructor in the video.
   - The question may be about the lesson itself or the students in the video.

5. Reflecting on students’ mathematical thinking/processes (High)
   - Using the context of the video as a means for thinking about their own students
   - Commenting on the students’ thought processes but providing more than a general “they understand it” sort of statement

6. Self-reflection
   - Identifying her own teaching practices in the video (Low)
   - Thinking about changes she needs to make to her own practices (High)

7. Suggestions (High)
   - Offering a suggestion as to how to improve the lesson or pedagogy or to address the students’ misunderstandings (Integration – High)

8. Justifications (High)
   - Providing support for the actions in the video
   - Giving justification for the appropriateness of the teacher’s actions and/or task selection in the video
Results of the Salish Projects:
Summary and Implications for Science Teacher Education

Robert Yager 1*, Patricia Simmons 2
1 University of Iowa
2 North Carolina State University

Abstract

Science teaching and teacher education in the U.S.A. have been of great national interest recently due to a severe shortage of science (and mathematics) teachers who do not hold strong qualifications in their fields of study. Unfortunately we lack a rigorous research base that helps inform solid practices about various models or elements of teacher preparation (Allen, 2003; Futrell, 2010; Sykes, Bird, & Kennedy, 2010; Wang, Odell, Klecka, Spalding & Lin, 2010). In reviewing research on science teacher education, Anderson and Mitchener (1994) found that “there is only a small amount of research on pre-service education and what does exist is rather limited in scope and usefulness” (p. 28). A broader review of 37 studies in teacher preparation in general conducted for the U.S. Department of Education (Wilson, Floden, & Ferrini-Mundy, 2001) concluded that “there is no research that directly assesses what teachers learn in their pedagogical preparation or that evaluates the relationship of pedagogical knowledge to student learning or teacher behavior” (p. 12). There have not been enough studies completed of sufficient quality in teacher preparation - in any subject matter area - to provide a confident sense of “what works” and why it works (Allen, 2003). Many studies in teacher preparation are case studies or very limited sample size investigations which make generalizations to theory applicable only to these samples, and comparisons among similar populations or programs very problematic (for a more comprehensive review, refer to the Handbook of Research on Science Education edited by Abell & Lederman, 2007).

Key words: Salish Projects, Science Education, Teacher Education.

Introduction

Setting the Context—National Science Education Standards on Teacher Education

Over four years of serious debate about science education reform and inquiry (1992-96) produced the National Science Education Standards (NSES), which have had an impact in teacher education programs as well as Professional Development projects. The impact now, however, is not as great as one would expect from the seven million dollars spent and the time it took to reach consensus. The Standards provided goals that frame science from Pre-K through grade 12. The first goal was called science for academic preparation for further study of science. This goal was the only one that teachers and schools considered when they prepared a science curriculum and chose a textbook (Harms & Yager, 1981). The stated goals in the Standards began with what can be called inquiry (as the first goal), and completely omitted “academic preparation” as a goal. Of further interest is the fact that “inquiry” also became the first form of content at every level. This inquiry goal indicated that PreK-12 science should educate students who are able to “experience the richness and excitement of knowing about and understanding the natural world.” The other three NSES goals for science teaching and learning were to produce students who were able to:

- Use appropriate scientific processes and principles in making personal decisions
- Engage intelligently in public discourse and debate about matters of scientific and technological concern; and
- Increase their economic productivity through the use of the knowledge, understanding, and skills of the scientifically literate person in their careers.

(National Research Council [NRC], 1996, p. 13)

* Corresponding Author: Robert E. Yager, robert-yager@uiowa.edu
Ways of achieving these four goals for school science were to be central to exemplary science teacher education programs. However, there was a lack of strong research supporting situations where, what is done in K-12 classrooms moves students to achieving these goals.

Needed emphasis for changing science teaching

The NSES began with visions of changing teaching. The Standards included a Summary Section for each section that identifies conditions needing less emphasis and with needed changes (the More Emphasis conditions). These provided descriptors elaborated in each section of the NSES and indicated the program needs for preparing new science teachers. In the case of teaching, there were nine changes that teacher preparation programs should address if the new teachers are to be ready to accomplish the visions espoused by the NSES leaders:

<table>
<thead>
<tr>
<th>Less Emphasis</th>
<th>More Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treating all students alike and responding to</td>
<td>Understanding and responding to individual student’s interests,</td>
</tr>
<tr>
<td>responding to the group as a whole</td>
<td>strengths, experiences, and needs of scientific knowledge, ideas,</td>
</tr>
<tr>
<td>Focusing on student acquisition of information</td>
<td>Guiding students in active and extended scientific inquiries</td>
</tr>
<tr>
<td>Presenting scientific knowledge through lecture,</td>
<td>Providing opportunities for scientific discussion and debate</td>
</tr>
<tr>
<td>text, and demonstration</td>
<td>among students</td>
</tr>
<tr>
<td>Asking for recitation of acquired knowledge</td>
<td>Continuously assessing student understanding (and involving</td>
</tr>
<tr>
<td>Testing students for factual information at the</td>
<td>students in the process)</td>
</tr>
<tr>
<td>end of the unit or chapter</td>
<td>Sharing responsibility for learning with students</td>
</tr>
<tr>
<td>Maintaining responsibility and authority</td>
<td>Supporting a classroom community with cooperation, shared</td>
</tr>
<tr>
<td>Supporting competition</td>
<td>responsibility, and respect</td>
</tr>
<tr>
<td>Working alone</td>
<td>Working with other teachers to enhance the science program</td>
</tr>
<tr>
<td>Focusing on student understanding</td>
<td></td>
</tr>
</tbody>
</table>

Needed changes in professional development programs

The second part of the NSES called for specific changes in Professional Development Programs. These were ways in which teachers should continue to grow and change. These descriptors included:

<table>
<thead>
<tr>
<th>Less Emphasis</th>
<th>More Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission of teaching knowledge into teaching</td>
<td>Learning science through knowledge</td>
</tr>
<tr>
<td>and learning skills by lectures</td>
<td>Collegial and collaborative learning</td>
</tr>
<tr>
<td>Separation of science and teaching knowledge</td>
<td>Long-term coherent plans</td>
</tr>
<tr>
<td>Individual learning</td>
<td>A variety of continuing professional development activities</td>
</tr>
<tr>
<td>Fragmented, one-shot sessions</td>
<td>Mix of internal and external expertise</td>
</tr>
<tr>
<td>Courses and workshops</td>
<td>Staff developers as facilitators, consultants, and planners</td>
</tr>
<tr>
<td>Reliance on external expertise Staff developers as</td>
<td>Teacher as intellectual, reflective Practitioner</td>
</tr>
<tr>
<td>educators</td>
<td>Teacher as producer of knowledge about teaching</td>
</tr>
<tr>
<td>Teacher as technician</td>
<td>Teacher as leader</td>
</tr>
<tr>
<td>Teacher as consumer of knowledge about teaching</td>
<td>Teacher as a member of a collegial professional community</td>
</tr>
<tr>
<td>Teacher as follower</td>
<td>Teacher as source and facilitator of change</td>
</tr>
<tr>
<td>Teacher as an individual based in a classroom</td>
<td></td>
</tr>
<tr>
<td>Teacher as target of change</td>
<td></td>
</tr>
<tr>
<td>Integration of science and teaching</td>
<td></td>
</tr>
</tbody>
</table>

Changing views of student assessment in science

The third call for change in the NSES was the area of Student Assessment. In a similar format, there were descriptors for conditions of less emphasis and more emphasis:
Less Emphasis
Assessing what is easily measured
Assessing discrete knowledge
Assessing scientific knowledge
Assessing to learn what students do what not know
Assessing only achievement
End of term assessments by teachers

Development of external assessments by measurement experts alone

More Emphasis
Assessing what is most highly valued
Assessing rich, well-structured knowledge
Assessing scientific understanding and reasoning
Assessing to learn what students do understand
Assessing achievement and opportunities to learn
Students engaged in ongoing assessments of their work and that of others

Teachers involved in the development and use of external assessments

Broadening the views of science content

One major problem in science education is the discipline segregation that separates physics, chemistry, biology, and earth/space science. Hurd (1986, 1991) argued that this discipline focus only exists in high schools and in undergraduate science areas at colleges and universities. He insisted that most current research focuses more generally on big problems that encompass the whole of science. Research in science arises from real problems and relates to multiple disciplines; it is also more and more tied to technology (and the design world), making these separations among the science disciplines, engineering, technology and design more problematic when addressing science education (AAAS, 2009).

The National Science Education Standards defined the discipline structure as three areas, namely, physical science, life science and earth/space science. A fourth component of science content in the Standards was inquiry (both a form of content as well as the methods of science and science teaching). Four other facets of content illustrated this broader view:

A. Technology: A focus on the design world instead of only the natural world. Both science and technology engage many of the same procedures. They differ in that the desired results and the designs are known already in technology—but the results of investigating in the science world are only known after investigations are completed.

B. Science for meeting personal and scientist challenges: This illustrates the use of problems as the beginning place and the organization of science instruction.

C. History and Philosophy of Science: This includes Sociology of Science and a world view of what science is as a human activity over time and within varying cultures.

D. Science concepts and processes in concert: This is the first and over-arching form of content. The Standards were the first to illustrate the importance of holistic thinking in place of the concepts of science (in the disciplines) and specific acts of inquiry. The eight facets of content are: Unifying concepts and processes in science; science as inquiry; physical science; life science; earth/space science; science and technology; science in personal and social perspective; and history and nature of science.

The fourth major section of the NSES generated the most debate and interest—defining specific content. Unfortunately many educators ignored aspects of the first parts and skipped to the content—the “stuff” of the curriculum. Once more, the focus was on inquiry per se! Overarching ideas and concepts took precedence over the minutiae that typify too many science classes. These changes in defining science content were to be central in all science teacher preparatory programs.

Key Findings of Salish I: Science Teacher Education at Ten Universities

Salish was an exploratory study conducted to uncover knowledge about the relationship between secondary science and mathematics teacher preparation, new teacher knowledge, beliefs, and performances; and, student learning outcomes. It was through these kinds of efforts that the science and mathematics education communities could address the needs of students, teachers, teacher educators, and other stakeholders working to establish a common vision for excellent instruction and systemic, long-lasting reform. The Salish I research project was funded by the U.S. Department of Education in 1993 and completed in June 1997. Ten diverse universities were chosen by the Office of Educational Research and Improvement. A sample of ten teachers were selected as new graduates from the universities; later 10 additional teachers were chosen to complete the sample over four years of funding.
A project focus on changes in teacher knowledge and beliefs was matched to performances with what was espoused in the preparatory programs. The research examined progress during the preparatory program for one sample (pre-service teachers) and another (beginning in-service teachers) through their first four years of teaching.

A. Student Outcomes (Students of Salish teachers)

- Students were much more likely to believe they could express their opinions about classroom instruction than believed they could actually play a role in the decision making about that instruction.
- Student perceptions of their classroom learning environments were associated with the level of community affluence and gender.
- Students in middle socioeconomic status communities believed they had fewer opportunities to voice their opinions about instruction than did students from both communities of higher and lower socioeconomic status.
- Science classes having a majority of females displayed more peer verbal interactions than did classes with gender balance. In classes with mostly females, there were more opportunities for evaluating the appropriateness of instruction.
- Popularly held views of students, classrooms, and schools were overly simplistic. The results indicated that every student, classroom, and school was unique and interactions among them very complex.
- Collecting student data was extraordinarily problematic. Problems include logistical and legal concerns. These problems led to a high attrition rate of research participants.

B. New Teachers (Salish participants)

- Teachers graduated from their teacher preparation programs with a range of knowledge and beliefs about:
  - how teachers should interact with subject content and processes;
  - what teachers should be doing in the classroom;
  - what students should be doing in the classroom;
  - philosophies of teaching; and
  - how they perceived themselves as classroom teachers.
- New teachers described their practices as very student-centered.
- Observed teaching practices contrasted starkly with teacher beliefs: while teachers professed student centered beliefs, they behaved in teacher-centered ways.
- Classroom practices of third year teachers converged more closely with their beliefs; their observed actions became more student centered and their beliefs became more teacher-centered.
- New teachers reported a lack of coherence among the various features of their programs.
- High demands on teachers’ time caused many problems with data collection which led to a high attrition rate of research participants.

C. Preparation Programs

- Each new teacher candidate completed a unique teacher preparation program because of differences in their backgrounds and experiences.
- Although formal program features reflected wide variations, common experiences for certification included:
  - a major in the content area (ranging from 21-60 semester hours);
  - a subject-specific methods course;
  - an educational psychology course; and
  - a field-based student teaching/internship experience ranging from 10 to 36 weeks.
- New teachers often perceived little or no connection between what was advocated and what was practiced in their content and teacher education courses.
• Faculty in science, mathematics, and teacher education viewed teacher preparation programs as lacking coherence.

D. Linkages (Students, Teachers, and Programs)

• Linkages were evident between:
  - informal and formal preparation program features; a subject-specific methods course;
  - new teachers’ knowledge and belief systems and classroom performances, and performance of their secondary school students.

• Students taught by new teachers with scientific research experiences or prior careers perceived their science classes as relevant to their personal lives.
• Students taught by new teachers with scientific research experiences or prior careers saw science and mathematics as tentative or uncertain.
• Students taught by teacher-centered teachers thought their science classes were relevant to the world outside of school.
• Students who behaved in student-centered ways were taught by new teachers who held a coherent student-centered philosophy of teaching.
• Student-centered actions were not observed in classes taught by new teachers whose philosophies of teaching were not coherent with their practices.
• Students who believed that they shared control of the learning environment were taught by new teachers with a teacher-centered philosophy of teaching.
• Conceptual teachers were concerned about their subject content and value reflection of professional involvement.
• New teachers with student-centered beliefs completed programs that included at least nine semester credit hours of subject-specific methods: courses.
• New teachers who had practice with student-centered classrooms completed programs which included at least 30 weeks of student teaching experience.
• New teachers holding student-centered beliefs were likely to have completed teacher preparation programs in which they:
  - engaged in cooperative learning; a subject-specific methods course;
  - were assessed through papers and evaluations of actual teaching performance in the field
  - were part of a formal cohort in teacher education; and
  - had strong, close personal relationships with faculty.

• Teachers who held student-centered, beliefs were more likely to have completed a longer student teaching experience. When teachers completed nine or more credit hours of subject-specific methods, they were more likely to be student-centered in their classroom practices.
• New teachers holding teacher-centered beliefs about subject content held negative impressions of their teacher education study, while those holding student-centered beliefs about subject content held more positive impressions of their teacher education study.

E. Project Accomplishments

Two of the major Salish goals were to uncover relationships between preparation and teacher and student outcomes, and to learn how to study these relationships more formally. Another goal was to operate collaboratively and learn about the processes and benefits of collaboration. The multiple goals and the nature of the research study itself led to a Project that was extremely challenging and usually rich in potential impact. There were other major accomplishments of the Salish effort that promised to contribute to improving the quality of secondary science and mathematics teacher preparation:

• the study data and findings guided teacher preparation program reforms in the participating universities;
• project participation was a powerful professional development experience for both Faculty and Research Associates;
• the project modeled collaborative research;
• participating in Salish moved forward science and mathematics educators’ understandings of the relationships between teacher preparation and outcomes and how to study these relationships; and
• the Salish project contributed to a national interest and dialogue about the quality of teacher preparation programs in science and mathematics.

Key premises and Findings of Salish II

The ten basic premises of Chautauqua ISTEP (Robinson & Yager, 1998) (also known as Salish II) were linked to the Salish I conclusions, the Thinking Movement, the National Science Education Standards (NRC, 1996), and the template for “best practices” in teaching and learning. These premises were:

A. Most Teacher Education Programs (TEP) did little to promote logical thinking (most successful students were only attentive and conscientious about remembering information).

B. All reforms in teacher education programs should be based on the National Science Education Standards (the kinds of classroom teaching and professional development efforts needed to promote the reforms are carefully described in NSES).

C. The NSES called for limiting the quantity of content in secondary schools; the NSES also recognized eight facets of content, including life, physical, and earth/space science (the three traditional area of content), science inquiry, science and technology, science for meeting personal and societal challenges, the nature and history of science, and unifying and using science concepts and processes.

D. The Chautauqua model for improving TEP (Robinson & Yager, 1998) project urged a focus on the reform agenda (NSES) in terms of content, teaching, and thinking.

E. The thinking skills component for the Chautauqua TEP effort should be an integral part of the whole instructional and action research package; it should not be a stand-alone or as one distinct facet of the workshop (thinking, or thinking skills, emerged as important from the Salish research but little was done with the research or gathering specific data to document thinking skills in most programs).

F. Assessment should be central to the Chautauqua effort; again, the NSES provided rich information.

G. The Chautauqua for Teacher Education Programs attempted to model effective instruction, curriculum development, and assessment as one way of illustrating changes that could occur on the campuses in the programs and experiences for pre-service teachers.

H. New teachers and experienced teachers who understand the NSES and the thinking research should be employed as vital partners in the instruction for workshops for teachers.

I. The instruction in the CTEP workshop, the models provided, the plans for implementing change must exemplify the basic principles of science, namely, questioning, explaining, testing the explanations for validity, and sharing evidence with peers.

In summary, the aspects of teaching thinking emphasizing learning and understanding via the processes of critical thinking, decision-making, applications (Tishman & Perkins, 1997) were used within the programs themselves.

Salish Research on Provisional or Alternative licensure programs

A third effort extending from the Salish I research was an examination of differences between science teachers licensed through a campus-based program and those teachers given provisional programs (most preparation completed on-the-job with major input from the existing teacher cadre) (Robinson & Yager, 1996). Some generalizations from this effort included the following:

• Teachers from alternative licensure programs tended to remain more closely tied to curriculum guides and textbooks.

• Teachers from alternative programs tended to be much more science discipline oriented.

• Teachers who did not complete more typical college programs tended to minimize the importance of campus programs and stress their better science preparation - and often their experiences in other careers.

• Teachers prepared in alternative programs were often more interested in assistance from other teachers and administrators.

• Teachers from alternative programs were often less involved professionally.

• Teachers from alternative programs found it difficult to pinpoint specific features from their preparatory programs that affected their teaching.

• Teachers from alternative programs often cited their experiences in other careers as helpful in the classroom. These experiences provided new contexts and reasons for science learning.

• Teachers from alternative programs were quick to cite limitations of their collegiate experiences - even those related to the science and mathematics courses they had completed.
• Teachers from alternative programs often held negative views about specific help they requested from college teacher education programs. They found the staff to be inflexible — and often unable to help their transitions to the classrooms.
• Alternative teachers were critical of college experiences in the sciences - described as a collection of more facts formatted directly for their use in teaching.
• Alternative certification programs in which candidates gained the most content knowledge and knowledge about teaching reading and mathematics were the programs in which they had frequent opportunities to observe several master teachers, and then discuss both the content and the pedagogical strategies.

Impact of Salish Projects

Teacher Education Program Renewal

The requirements for universities participating in the various Salish Projects to belong to the Salish cohort stimulated some universities to convene faculty teams with a wide span of potential program influence. Universities invested their own financial and personnel resources to participate in the Project; commitment to applying the research results was secured “up front,” teams were visible on-campus, and the visibility created expectations. The teams selected topics or areas of concern for which they were already accountable for program performance.

For example, three universities established new science teacher education programs and looked to the faculty team to evaluate the effectiveness of these programs. The perceived association with the Salish I Research Project lent exceptional credibility to the plans of the university teams that were formed to change their university programs. One residual for the new teams was a greater reliance on data-based decision making. Salish team, members admitted that many of the program modifications they made in the past (before Salish) were not based on evaluation and research data gathered systematically over time.

Inter-University Projects: Common Features

Among the very important features of successful projects (such as the Salish series) that brought together universities from all regions of the nation were the following:

A. The Project epitomized a learning community, i.e., a “safe place where they could say, explore, and disagree about anything without [adverse] consequences” and where peers were encouraged to expose problems and learn from one another.
B. University teams bridged science education and teacher education and administration; teams identified common areas of concern for what all members were committed to address.
C. Resources (identified as funding, instrumentation, and expertise using particular research techniques) were available to carry out team activities.
D. The Project was characterized by product requirements and ambitious timelines that were motivating rather than overwhelming.

Insights from Salish Final Conference

Analysis of the discussions held at the Salish Final Conference in May, 1998, revealed the clues and keys for reforming the practice of educating science pre-service students. They are arranged under the categories including: reasons for reform, how to further the change process, and an elaboration of research evidence required for effectiveness in teacher pre-service and in-service education.

A. Reasons for reform

• Impacting pre-service teacher preparation facilitated the implementation of standards- based curricula and practice in mathematics and science teaching;
• The incorporation of thinking research into teacher preparation enabled teachers to examine and experience constructing knowledge through one’s own thinking processes, and gave teachers the tools for providing their students with opportunities to think;
• The strong imprinting in K-16 education led people to teach the way they were taught regardless of the effects of pre-service methods classes.
B. Furthering the change process

- Developing trust between change agents and those involved in essential tasks took time to develop.
- Creating a sense of urgency and a sense of vision were helpful to start collaboration as long as urgency did not lead to “band-aid fixes.”
- Persuading scientists to use the research evidence that was collected and available informed their instruction.
- Defining relevant arguments for change among people who were not necessarily involved in science teacher education (e.g., the general public, legislators, scientists) helped the case for science teacher education.
- Justifying the change process with the added perspectives from social justice issues for underrepresented groups within science education at every level strengthened the argument for science teacher education.

Using video offerings that showed similar problems in science education at universities built their reputations with their selectivity of only the best students (e.g., The Private Universe, Annenberg tapes, and tapes from the Derek Bok Center) helped change the common view held by science professors that student deficiency was “the problem.”

C. Recommendations for follow-up actions

- Document what was working currently in pre-service science education.
- Substantiate change in programs with ongoing evidence that students were responding in the manner hypothesized.
- Refine further instruments such as the Nature and Implications of Science Teaching (NIST) to assess understanding by practicing teachers, pre-service teachers, and students about the nature of science.
- Learn more about the people being prepared for science teaching.
- Determine why attrition was so high in the first five years of science teaching. Provide specific support structures to moderate attrition.
- Establish the need for best practices in mathematics and science courses at the undergraduate level (most of which have not changed in format over 30 years, Blunck, Giles, and McArthur, 1993; Robinson and Yager, 1996).
- Make accurate comparisons and contrasts between the situations of U.S. and International science education that illustrate both the products and the processes that create the learning product in children (as begun by the TIMSS studies).
- Develop plans to institute and measure progress in inquiry at all levels K- graduate school (Melear, Hickok, Goodlaxson, and Warne, 1998).

Implications of Salish Findings of Conclusions and Implications of Salish Findings

All of the research and the visions included in the National Science Education Standards produced arguments for teacher education programs that showed the most promise for the kind of quality science teachers envisioned. For universities with a semester organization the following plan is recommended as providing the most promise for success in preparing science teachers for the future.

- A strong science component consisting of a major science area (30 + s.h.) and a supplementary area (at least 15 s.h.).
- Specific work in the history, philosophy, sociology of science (6 s.h.).
- An introduction to the design world (technology) and its ties to the natural world (6 s.h.).
- Experiences (one semester each) with applications of science, including work with current issues (guiding questions, possible explanations, selection of “best fit” solutions, corrective actions. (12 s.h.)
- A science and a technology research experience.
- A methods sequence with a practicum experience in schools followed with full time student teaching (over 4 semesters).
- University general education requirements for Bachelor Degrees sequence (about 30 s.h.).
- General Education (philosophy of education, educational psychology, special education, diversity, action research).
- (10 s.h.)
The ideal program cannot be completed in a typical Bachelor’s program. For undergraduates, it is usually necessary to complete one summer session in addition to the 8 semesters or 4 academic years. Since many students decide on teaching after completing undergraduate degrees, they can enroll in MAT or M.S. programs. These programs allow persons with strong undergraduate science degrees to complete the needed courses and field experiences in one full year and two summers.

Historically at the undergraduate level, more interest has been focused on the level of teaching rather than the level of learning of students. A focus toward learning must be developed and applied by collaboration among scientists, science educators, and pre-service students (and all students). Dialogue with a person who regularly practices active learning strategies for support of progressive teaching tactics is very important for both 1) ideas to assist in development of the lesson plans, and 2) for making adjustments after trying the practice for the first few times. Mechanisms for reflective practices must be set into cooperative action. The various disciplines have different cultures that require productive communication to accomplish change in which many people have ownership.

Differences in some states for middle vs. high school teaching and some variations among the traditional science disciplines continue to be separated as departments in colleges and universities, even though there is little research supporting these kinds of specific recommendations. The recommendations offered from these projects provide a framework for achieving the kind of teaching and continuous learning required for effective science teachers. These recommendations take into account the reforms recommended in the National Standards and elevate thinking beyond defining pedagogical knowledge and increasing requirements in the basic science in most colleges. In summary, as a community of science teacher educators and science educators, we must continue to improve the quality of our teacher education programs based upon rigorous research about teaching, learning, and institutional change, so we can address the needs of our science teachers and prospective teachers in the 21st Century.

References


Teacher Education and Learning to Teach (TELT) (1986). Michigan State University, East Lansing, MT.


Determining the Factors That Affect the Objectives of Pre-Service Science Teachers to Perform Outdoor Science Activities

Ersin Karademir¹*, Sinan Erten²
¹Eskişehir Osmangazi University
²Hacettepe University

Abstract

The purpose of this study is to determine whether pre-service teachers have an aim to perform outdoor education activities within the scope of science and technology course; by which factors this aim is affected, through The Theory of Planned Behaviour and the opinions of pre-service teachers. Accordingly, the study was designed as mixed research method. With the aim of defining the factors that affect the objectives of pre-service teachers to perform outdoor education activities within the scope of science courses, ‘Outdoor Science Activities Performing Scale’, improved by Karademir (2013) was used. The eventual scale was applied to 1513 pre-service teachers studying at science teaching department. Additionally, qualitative data obtained from pre-service teachers through structured interview forms were evaluated together with quantitative data. Providing diversity in method, this enhanced the explanatory features of the data.

Key words: Outdoor science education, the theory of planned behaviour

Introduction

A teaching programme, expected to have a dynamic form, is a process including evaluation and it should not only be limited within the school but should also be used out of school (Pehlivan, 1998). In realizing the course objectives; as well as in-school education, regular learning activities that are expected to be accomplished must be conducted in order to enhance the learning experiences of individuals. These learning activities called as ‘outdoor education activities’ refer to all planned, organized activities that are helpful in achieving the course objectives, organized within the context of the course and applied out of school (Karademir, 2013). According to Binbaşoğlu (2000), outdoor activities are described as planned, programmed and regular studies carried out within the guidance of the teacher and the information of school management in order to develop students’ personality in relation to their interests and wishes and to the objectives of the in-school and out-school education. The aim of outdoor education is to change learning environment and by this way to improve the interest and success of students’ in science (Dori & Tal, 2000; Laçin-Şimşek, 2011). Besides positive effects of outdoor education activities, there are various factors to carry out activities (Karademir, 2013). Although experimental studies related to outdoor education are many, it is also essential to determine the variables that carrying out these activities depend on (Peleg & Baram-Tsabari, 2009; Siegel, 2007; Kısa-Tekkumru, 2008; Bozdoğan, 2007; Güler, 2011). Therefore, by using the theory of planned behaviour, it is aimed to determine how and depending on what outdoor education activities will come out. According to the theory of planned behaviour; in order for behaviour to come out, the intention towards behaviour should occur first (Ajzen, 1991; Knabe, 2012). The intention is under control of attitude towards behaviour, subjective norms and perceived behaviour control. That is, when an outdoor activity is desired to be performed in this way, the reasons of this will be defined. It is also important that relations of factors appeared with the theory of planned behaviour are in accordance with teachers’ opinions.

* Corresponding Author: Ersin Karademir, eekarademir@gmail.com
The Theory of Planned Behaviour

The theory of planned behaviour is a theory introduced by Ajzen (1985) and it has been used in various disciplines for long years. The purpose of the theory of planned behaviour (TPB) is to predict to what extent a particular behaviour will be performed or not. According to TPB, behaviours of individuals are under control of some factors and in order for a behaviour to come out, the intention towards that behaviour should be formed (Ajzen, 1991). And the intention is due to the difficulty or ease that the person concerning to perform the behaviour attributed to it; to his attitudes; and to the persons or institutions of importance for him (Teo & Lee, 2010). In short, according to this theory; if an individual evaluates a behaviour positively and thinks that social pressures of importance will support him to do that behaviour, he will have an aim to perform that behaviour and this aim will be effective in describing his behaviours (Ajzen, 1985; Kocagöz-Sayın, 2010).

In ‘beliefs’ part of the model are behavioral, normative and control beliefs; in ‘base’ are attitude, subjective norm and perceived behavioral control, which form the basic part (core). Behavioral, normative and control beliefs help us to understand what directs the behaviour and what can support it. (von Haeften, Fishbein, Kasprzyk & Montano, 2001; Fishbein & Cappella, 2006).

Behavioral beliefs consists a combination of perceived behavioral expectancy and assessment, and effective together in emerge of the attitude towards behaviour. Expressing the social pressure of external environment on the individual, normative beliefs are under control of personal motives and normative person, institution or organization; and these two express subjective norms. Control beliefs are the combination of the difficulty or ease of behaviour perceived by individual. These two together describe perceived behaviour control (Ajzen, 2006). Attitude towards behaviour, subjective norms and perceived behavioral control, affected by ‘beliefs’ part of the model, explain together the intention towards behavior and also the behaviour itself, indirectly. When TPB model in figure 1 is closely examined, it is seen that peoples’ social behaviours are under control of certain factors, they stem from some certain causes and they come out in a planned way (Erten, 2000, 2002; Karademir, 2013).

In order for behaviour to be performed by one, first “Intention Towards Behaviour” must be formed. Factors that affect “Intention Towards Behaviour” are “Attitude Towards Behaviour”, “Subjective Norms” and “Perceived Behavioral Control” (Bamberg & Schmidt, 1993). And these factors are influenced by “Behavioral (attitudal) Beliefs”, “Normative Beliefs” and “Control Beliefs”. At the same time, these beliefs form the results of the behaviour- to-be performed. With the effect of “Intention Toward Behaviour”, behaviours may be formed or change. That is, the behaviour is directly under control of “Intention Towards Behaviour”. Another factor that can directly affect the behaviour is “Perceived Behavioral Control”, but this is not true for every time or case. “Intention Towards Behaviour” is described by “Attitudes Towards Behaviour”, “Subjective Norms” and “Perceived Behavioral Control”. These factors are under the influence of beliefs as well (Erten, 2000).

![Figure1. The theory of planned behaviour model (Erten, 2000)](image-url)
Explanatory Dimensions of the Theory of Planned Behaviour

**Attitude Towards Behaviour**, in the theory of planned behaviour, the term “attitude” is seen as attitude towards behaviour. When looked at the context of related attitude, it is described with the personal evaluations of the outcomes mentioned in beliefs regarding the behaviour. Individuals believe that performing the related behaviour will lead them to some outputs or results (Fishbein & Ajzen, 1975; Ajzen, 1988, 1991; Ajzen, Timko & White, 1982). So, attitude is in relation to the outcome of the behaviour. The individual may adapt a positive attitude if he/she believes that the behaviour will produce a positive result or vice versa (Glanz, Rimer & Viswanath, 2008). In other words, it is the probable result of the behaviour that determines the behaviour. That is, the outcome feeds the behaviour (Baltaş, 2009).

**Subjective Norm** describes the social pressure perceived towards behaviour. It is the combination of the expectations of people who are important for him and his desire to fulfill these expectations. Subjective norms, in short, reflect the socio-psychological evaluation of individuals to perform a behaviour and expresses the social pressure the individual feels on himself whether or not to perform a behaviour. That is, how the behaviour will be met by individual’s social milieu is called subjective norm. If a person believes that reference groups which are important for him expect him to perform behaviour, he will feel a social pressure on himself to do so (Fishbein & Ajzen, 1975; Ajzen 1985, 1991).

**Perceived Behavior Control** expresses how easy or difficult behaviour is for an individual. It is the estimation of individual’s internal and external efficacy to perform a specific behaviour, and is also the combination of this competence and belief. Perceived behavioral control variable has a separate place in the model, therefore the route that perceived behavioral control follows towards behaviour emerges in a several different ways. The first of these, perceived behavioral control, describes the behaviour through the intention towards behaviour; and the second directly describes the behaviour without the mediation of intention towards behaviour (Ajzen 1985, 1991).

**Relationship Between the Theory of Planned Behaviour and Outdoor Science Education**

To gain awareness in science teaching, to increase students’ interests in science, to provide enriched science environments are among the primary tasks of science and technology teachers. Possible outdoor activities that can be carried out with this purpose have great importance in helping students to discover nature, to have social and concrete experiences (Griffin, 2004; Tal, Bamberger & Morag, 2005). It is essential to query due to what realization of these highly important outdoor activities are. Outdoor activities in science education depends so many factors; like difficulty of activities, their effects on students, the attitude and role of the person to do the activity, who demands the activities, etc. (Karademir, 2013). What factors are effective in determining these factors and outdoor learning activities can be identified through the theory of planned behaviour. Besides, it is very important to find out factors which play role in performing a behaviour and the factors that affect behaviour in pre-service teachers who will carry out activities must be put forward at first. Therefore, it is highly important to determine what factors are effective in this regard before performing outdoor learning activities. The theory of planned behaviour that will be used in identifying these factors emphasizes the importance of attitudes in performing behaviour; to what extent it is easy or difficult, how the person gets influenced by the people, institutions or organizations in performing activities (Karademir, 2013).

The purpose of this study is to examine pre-service teachers’ behavioral purposes in performing outdoor activities by using the theory of planned behaviour and through the opinions of teachers. Accordingly, the prior purpose is to define pre-service teachers’ attitude towards the purpose of the behaviour, subjective norms and what perceived behavioral control variables are. The relations of these variables with behavioral purposes are evaluated together in order to determine the possibility of this behaviour to come out. In addition, through the opinions of pre-service teachers’, factors that are effective in the occurrence of this behavioral purpose are defined. With regard to this purpose, following questions were searched for answers:

1. How, within the scope of science and technology lesson, should factors that affect pre-service teachers’ intentions to perform outdoor activities be defined through the use of the theory of planned behaviour?
2. How is the relation between pre-service teachers’ intentions to perform outdoor learning activities and subjective norm; perceived behavioral control and attitude towards behaviour? And what level these relations should be explained?
3. What are pre-service teachers ‘ideas about the practicality of outdoor learning activities in science courses and effects of these activities on students?
Method

Research Model

This study was designed as mixed research method. Mixed research model is a method applied in collecting, analyzing and using data ‘to mix with’ each other. And to figure out a research problem, qualitative and quantitative techniques are used together (Creswell, 2011; Creswell & Plano-Clark, 2011). Mixed research is a highly popular method in social sciences and is known itself as a research method (Hanson, Creswell, Creswell, Plano-Clark & Petska, 2005). In mixed method, in a single study that data is obtained synchronically or sequentially, qualitative and quantitative data is evaluated together both in collecting and analyzing data, and is related to each other (Creswell, Plano Clark, Guttmann & Hanson, 2003). In this study, a combination of data was applied by evaluating qualitative data with quantitative ones. From mixed patterns, “Explanatory Sequential Design” was preferred in this study. At this pattern, qualitative data is used as following and explaining quantitative data (Creswell, 2011). Through the use of evaluation scale developed regarding the theory of planned behaviour, quantitative data was obtained. Additionally, in order for practicality and results of outdoor activity to be determined constructed interview form was applied. The data obtained from this part was used in explaining qualitative data.

Data Collection Tools

1. Outdoor science activities performing scale

Within the context of the theory of planned behaviour, in order to determine pre-service teachers’ behaviour of performing outdoor activities, Outdoor science activities performing scale, developed by Karademir (2013) was used (see: Appendix-1). This scale is developed by certain rules of TPB. According to TPB; dimensions of scale is certain. Pre-studies for items are performed for each dimension of scale. In related scale, there are 50 items concerning both beliefs and basic part of model. Items about the basic part of model (attitude toward behaviour, subjective norm, perceived behavioral control and intention) are the same with pilot study and these dimensions have three item. So, reliability and validity studies are performed for beliefs part of model. For reliability; Croanbach alpha coefficient of the scale was determined as 0,897. While preparing the outline of the scale, three expert opinions were taken into consideration to provide validity. One of the experts is science educator and experienced on the TPB. Another expert is assessment specialist. Third one is science educator. After expert opinions, scale was arranged with Turkish Language expert. With factor analysis carried out during pilot study, the construct validity was provided and inappropriate clauses were eliminated. Factor weights of items that is under [0,30] are removed from scale. Remaining items and factor weights are given at the table 2. The scatter of items according to dimensions, during and following pilot study, is presented in table 1. It is seen at table 1; KMO and Bartlett’s values are acceptable for analysis. KMO values between 0,80-0,90 is known as very good and acceptable for analysis (Akgül & Çevik, 2003).

<table>
<thead>
<tr>
<th>Dimensions of Scale</th>
<th>Items (before)</th>
<th>Items (after)</th>
<th>Croanbach Alpha</th>
<th>KMO</th>
<th>Barlett</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioural Expectations</td>
<td>16</td>
<td>8</td>
<td>.89</td>
<td>.897</td>
<td>p&lt;0,001</td>
</tr>
<tr>
<td>Behavioural Evaluations</td>
<td>16</td>
<td>8</td>
<td>.90</td>
<td>.901</td>
<td>p&lt;0,001</td>
</tr>
<tr>
<td>Person, institutions or industries</td>
<td>8</td>
<td>7</td>
<td>.85</td>
<td>.802</td>
<td>p&lt;0,001</td>
</tr>
<tr>
<td>Motivation</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Behavioural Difficulties</td>
<td>13</td>
<td>8</td>
<td>.91</td>
<td>.896</td>
<td>p&lt;0,001</td>
</tr>
<tr>
<td>Behavioural Easies</td>
<td>14</td>
<td>8</td>
<td>.95</td>
<td>.932</td>
<td>p&lt;0,001</td>
</tr>
</tbody>
</table>

The expected values - - .70 and above Close to “1” p<0,001

2. Constructed Interview Form

Regarding the opinions of pre-service teachers, constructed interview form has been applied in order to find out the outcomes of activities for students (the reason of why they would like to perform outdoor activities when appointed as teachers) and the practicality of outdoor activity (the ease or difficulty of activity or for whom it will be used).
Table 2. Dimensions and factor values of the scale

<table>
<thead>
<tr>
<th></th>
<th>Factors of scale</th>
<th>PBEx.</th>
<th>PBEv.</th>
<th>SN</th>
<th>PBEa.</th>
<th>PBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Permanent learning occurs at students</td>
<td>.660</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Experiential learning occurs at students</td>
<td>.620</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Visual learning occurs at students</td>
<td>.551</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Students learn the information through concrete experiences</td>
<td>.750</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Students gain direct experience</td>
<td>.770</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Students become aware of relationship science between nature</td>
<td>.683</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Lessons will be reinforced better</td>
<td>.561</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Students become aware of their productivity.</td>
<td>.715</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Occurring the permanent learning at students</td>
<td>.483</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Occurring experiential learning at students</td>
<td>.771</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Occurring the visual learning at students</td>
<td>.779</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Learning the students the information through concrete experiences</td>
<td>.643</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Gaining the students direct experience</td>
<td>.609</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Being aware of relationship science between nature</td>
<td>.575</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Being lessons reinforced better</td>
<td>.732</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Being aware of students’ productivity</td>
<td>.643</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Expectation of parents to do outdoor science activities from me</td>
<td>.662</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Expectation of Ministry of Education authorized to do outdoor science activities from me</td>
<td>.471</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Expectation of related institutions to do outdoor science activities from me</td>
<td>.709</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Expectation of other teachers to do outdoor science activities from me</td>
<td>.715</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Expectation of non-governmental organizations to do outdoor science activities from me</td>
<td>.655</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Expectation of municipality to do outdoor science activities from me</td>
<td>.698</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Expectation of school management to do outdoor science activities from me</td>
<td>.721</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Will be difficult by transportation impossibilities</td>
<td>.719</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Will be difficult by parents</td>
<td>.860</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Control of students is very difficult</td>
<td>.541</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Will be difficult by school management</td>
<td>.620</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Will be difficult by distance of institutions</td>
<td>.841</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>If time is a problem it will be difficult</td>
<td>.746</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>If accommodation and payment is problem it will be difficult</td>
<td>.723</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Crowded classrooms will make activity so difficult</td>
<td>.651</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Universe- Sample

Sample Group (Pre-service teachers): Since this study has been conducted in all regions of our country, ‘pre-service teacher universe’ consists of all pre-service science teachers studying at all faculty of educations. Sample group, on the other hand, is formed out of 1513 pre-service teachers selected randomly from the universe. In related sample method, every unit in universe has equal and independent chance to be chosen as sample (Büyüköztürk et. all, 2010). Demographic features of the sample group are given at the table 3.

Table 3. Demographic features of pre-service teachers

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>%</th>
<th>Region</th>
<th>University</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>1145</td>
<td>75,7</td>
<td>Aegean</td>
<td>Uşak Uni.</td>
<td>157</td>
<td>10,4</td>
</tr>
<tr>
<td>Male</td>
<td>368</td>
<td>24,3</td>
<td>Mediterranean</td>
<td>Çukurova Uni.</td>
<td>186</td>
<td>12,3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Black Sea</td>
<td>Kastamonu Uni.</td>
<td>185</td>
<td>12,2</td>
</tr>
<tr>
<td>Class Level</td>
<td></td>
<td></td>
<td>First Class</td>
<td>Marmara</td>
<td>181</td>
<td>12,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Second Class</td>
<td>Inner Anatolia</td>
<td>507</td>
<td>33,5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Third Class</td>
<td>Eastern Anatolia</td>
<td>576</td>
<td>38,1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fourth Class</td>
<td>Yüzüncü Yıl Uni.</td>
<td>249</td>
<td>16,5</td>
</tr>
<tr>
<td>Total</td>
<td>1513</td>
<td>100,0</td>
<td></td>
<td></td>
<td>1513</td>
<td>100,0</td>
</tr>
</tbody>
</table>

Study Group:

It is the group of 26 senior students studying at science teaching programme to whom constructed interview forms was applied in order to determine pre-service teachers’ perceptions of outdoor science activities and intentions towards behaviour. 26 pre-service teachers involved in this group study at a state university in Inner Anatolia Region. 16 of the students in the group are female and the remaining 10 are male.

Analysis of Data

Within structural equation modeling, model fit indexes of obtained data were found by calculating path values (path analysis). Data were classified with SPSS (Statistical Package for the Social Sciences) and analyzed with AMOS (Analyses of Moment Structures). Structural Equation Modeling (SEM) is a statistical technique used to test models in which there is a causal correlation between observed variable and latent variable, and it has multiple variables that is formed with the combination of analyses like variance, covariance analysis, factor analysis and multiple regressions. Structural equation modeling is especially used in such sciences as psychology, marketing, educational sciences, etc. to evaluate the relations between variables and to test models (Tüfekçi & Tüfekçi, 2006). Qualitative data of this study was analyzed using ‘descriptive analysis technique’. In this technique, data is summarized and interpreted under pre-determined headings. In related analysis, quoting directly from persons’ opinions from the sources of data will be useful in terms of the reliability of the study (Altunışık et. all, 2007).
Figure 2 shows structured equation modeling formed according to TPB. In the context of this structure, data were uploaded to AMOS programme for structured equation modeling. In this model, there are six endogenous and five exogenous variables. Endogenous variables are normative, control and behavioral beliefs. That is, exogenous variables in beliefs part of the model are; the difficulty of behaviour, the ease of behaviour, motive toward subjective norm, persons- institution or organizations, behavioral expectation and behavioral evaluation. Each of these dimensions is measured with scale. Exogenous variables are explained through endogenous variables. These exogenous variables are perceived behavioral control, attitude towards behaviour, subjective norm, intention towards behaviour and behaviour. Path analysis technique was used with data uploaded to AMOS.

Findings

In this study, data has been collected from pre-service science teachers in two different ways. In the first part, by using the scale, quantitative data has been collected and analyzed. And in the second part, qualitative data has been collected from pre-service teachers by using interview forms. Both qualitative and quantitative data will be shared separately in this part.

Quantitative Findings of Pre-service Teachers

According to Table 4, showing outcomes of path analysis carried out with data belonging to pre-service teachers, fit values are found to be at the acceptable level (RMSEA=0.067, CFI=0.894). According to the results of obtained data moderate-level relation \[ r = 0.47 \] between perceived behavioral expectation and attitude towards behaviour; a low-level relation \[ r = 0.35 \] between perceived behavioral assessment and attitude towards behaviour was detected. The percentage of the two variables to explain the attitude towards behaviour is \( R^2 = 0.58 \). That is, \%58 part of the attitude towards behaviour is disclosed by perceived behavioral assessment and behaviour expectations (behavioral beliefs). In terms of the purpose of the behaviour, subjective norm, perceived behavioral control and attitude towards behaviour explains \% 80 of the intention. Additionally, while there is no significant correlation between the perceived behavioral control and the behaviour; a mid-level relation between the purpose towards behaviour and the behavior itself. While the relation between pre-service teachers’ intentions and attitudes to perform outdoor science activities is at mid-level \( r = 0.55 \), a high-level relation \( r = 0.70 \) is seen between the expectations of reference persons. What this means gets clear with the effect of the proposition that ‘peoples’, whom I care, expecting me to perform outdoor activities when I’m appointed as teacher’ on ‘I intend to do outdoor science activities to my students when I’m appointed’ proposition. In other words, saying that ‘I intend to do outdoor science activities when I’m appointed as teacher’ stems from people, institutions and organizations of importance for pre-service teachers. When these persons, institutions and organizations are considered, we see propositions of school management [0.94]” and “related
institutions [0.54]” under normative beliefs. It depends on school management’s and related institution’s demands whether or not pre-service teachers intend to carry out outdoor activities in the future.

Table 4. Pre-service teachers’ structural equation model findings

That the effect of attitude on behaviour is \( r = 0.55 \) means; “I highly approve’ to carry our outdoor science activities with my students when I am appointed”; “it has a mid-level effect on intending to do outdoor activities in science courses when I am appointed as a teacher”. In other words, pre-service teachers approve of performing outdoor activities as well as intending to do these activities. That is, they show the intention of behaviour both through their own attitudes and through the persons, institutions and organizations that are important for them. That means pre-service teachers show intention towards behaviour under control of both attitudes and expectations of references. Additionally, no relation was detected between behavioral intention which is seen as the combination of the ease or difficulty of behaviour and both the intention and behaviour \( r_{\text{intention}} = -0.07; r_{\text{behaviour}} = 0.09; p > 0.05 \). When examined within this respect, it is seen that behaviour is related only with the intention towards behaviour \( r = 0.47 \) and only a little part of the behaviour is explained \( R^2 = 0.23 \). In other words, pre-service teachers are under effect of both reference persons and personal attitudes considering performing outdoor science activities. But, it is seen that the probability of the intention towards behaviour to change into behaviour is low \( R^2_{\text{intention}} = 0.80; R^2_{\text{behaviour}} = 0.23 \).

Qualitative Findings of Pre-service Teachers

According to the answers of interview form used for pre-service teachers, findings come out under two main themes. Categories and sub-themes belonging to each main theme are stated in Table 5. Also, it is presented through direct excerpts of pre-service teachers’ opinions.
Table 5. Themes, sub-themes and categories of qualitative findings

<table>
<thead>
<tr>
<th>Theme</th>
<th>Sub-theme</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>The results of performing outdoor learning activities for students</td>
<td>Advantages for students</td>
<td>Permanent learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Morale, motivation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gaining experience</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hands-on learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Socialization</td>
</tr>
<tr>
<td></td>
<td>Disadvantages for students</td>
<td>Delay in curriculum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unsuitable for achievements</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low application</td>
</tr>
<tr>
<td>Feasibility of Outdoor Education Activities</td>
<td>Positive effects</td>
<td>School management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Students’ request</td>
</tr>
<tr>
<td></td>
<td>Negative effects</td>
<td>Financial problems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shortage of parents</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unsuitable for curriculum</td>
</tr>
</tbody>
</table>

Findings of “The results of performing outdoor learning activities for students” Theme

According to data obtained from pre-service teachers, the theme called “the results of performing outdoor learning activities for students” comes out under two sub-themes. According to these sub-themes, when pre-service teachers want to do an outdoor activity, this has both “advantages” and “disadvantages” for students. Some of participants’ opinions concerning these advantages and disadvantages are as in following:

Researcher: What kind of advantages will an outdoor science activity provide for you or your students?  
Participant 13: I think outdoor activity will increase student’s curiosity and also will make permanent learning possible.

Researcher: What kind of problems can you or your students have in carrying out an outdoor science activity?  
Participant 13: In my opinion, the main problem is the lack of time and to fail to make sure that every student takes part in activities.

Researcher: What kind of advantages will an outdoor science activity provide for you or your students?  
Participant 23: Since it provides students to get information through direct experiences, teaching-learning process becomes more efficient. It gives students the opportunity for a more enjoyable teaching-learning process. When considered for teachers, seeing that they take part in student’s efficient learning will make them happy and peaceful.

Participant 19: Of course I would like to organize such activities. I find them very useful. The reason is that the more activities are related to courses, the better subjects are learnt and objectives are realized. Apart from their contribution to me and my students about courses; they also provide motivation, interest in subjects and consciousness of organization.

Researcher: What kind of problems can you or your students have in carrying out an outdoor science activity?  
Participant 23: In remote villages, besides transportation and financial burden, the attitudes of families may be problem as well. But, none of these is an obstacle for a good and idealistic teacher. For instance, if desired, photos and video records taken at previous experiences may help us to overcome this trouble.

Findings of “Feasibility of Outdoor Education Activities” Theme

The opinions of pre-service teachers’ about what positive or negative factors they may be exposed to when they want to perform outdoor science activities are shared within this theme. Their opinions about the related theme are as in following:
Researcher: What kind of positive or negative conditions can you encounter if you want to realize an outdoor science activity? What can support or hinder you in this regard?

Participant 13: Although they help in-school activities, my school may not be in favour of organizing such activities as they don’t want to take responsibility for outdoor activities. I think, my own efforts and insistence will be determining in this regard.

Participant 17: The school that I appointed to and its conditions are important at first. Therefore, transportation may be a problem. Also there may be trouble with school management, too.

Discussion

When looked at under which variables the purpose towards behaviour is, that pre-service teachers’ self-attitudes towards their own ‘trues’ is close to the effects of subjective norms may stem from that they trust themselves more and that they can’t still leave subjective norms. Their desire to organize outdoor education activities depends on their own attitudes. According to the result of the study, one of the important highlights is to increase the efficiency of pre-service teachers’ (individuals) attitudes. One of the important reasons of this may be pre-service teachers’ attitudes towards science and teaching profession. In many research, that pre-service teachers’ attitude towards teaching profession, science or environment is high supports it (Saracoğlu et all, 2004; Terzi & Tezci, 2007; Kahyaoglu & Yangın, 2007; Sadik & Sari, 2010). Both in their opinions and quantitative data, pre-service teachers stated that with outdoor activities, students will develop socially, and learning through experiences will be more effective. Studies emphasizing that students discover information easily when they are socialized and learn better through direct experiences seem to support this conclusion (Türkmen, 2010; Griffin, 2004; Chin, 2004). It has come out that while performing outdoor science activities, teachers may face some difficulties. Such factors as transportation problems, school’s conditions, etc. may cause trouble for these activities. In this study, Tanrıverdi (2009) deals with similar results and he emphasizes that in order to realize environmental-contented objectives, appropriate time, place and activities must be provided. Şimşekli (2004) states that in realizing environmental objectives, parents and school management is also influential. And this is in line with the findings about the effects of students’ parents and school management on teacher. According to Erten (2001), that a person is thoroughly integrated to a group, in other words feels him under a high social pressure, shows that hinders the development of his attitude and thus will make his attitude free from purpose.

Conclusion

Pre-service science teachers wish to carry out outdoor science activities in the future. Their intention towards this behaviour stems both from their own attitude (attitude towards behaviour) and from the people, institution and organizations (subjective norm) they take as credentials. That the behaviour is easy or difficult (perceived behaviour control) has no effect on the behaviour. If, in the future, pre-service science teachers want to perform outdoor science activities, they will do this mostly as the people, institutions and organizations want them to do so. Besides, their own attitudes will be effective on this. The ease or difficulty of the outdoor science activity they would like to carry out does not affect the intention of the behaviour. Pre-service science teachers emphasized that beyond their difficulty to be carried out; outdoor learning activities can only be performed if they wish. They described the difficulties of performing outdoor learning activities as financial problems and troubles with transportation. Pre-service science teachers also stated that realizing an outdoor science activity will make permanent learning possible, will increase students’ curiosity and will provide socialization. They stated that these activities have positive effects on students’ learning experiences and that learning can be permanent by doing so. However, according to pre-service teachers, “transportation facilities”, “crowded classes”, “accommodation problems” decreases the possibility of ‘performing outdoor activity’ behaviour. Also their answers to the related interview questions support these results. According to Pre-service teachers’ point of opinion, it is seen that outdoor science activities will be useful for students. But their prospective school’s facilities and management are among the factors that can make it hard to carry out these activities.

If we want to perform an outdoor activity, the first thing to do is to improve individual’s attitudes. So, during courses at school, instead of “passive” ones, the information given should be related to and applicable in daily life. In addition, since the information given in artificial context has little permanency, they should be suitable to natural environment as much as possible and if necessary examples should be provided from nature itself. In order for pre-service teachers to use outdoor activities in science courses more effectively when they are appointed, elective courses must be taught at Faculty of Educations.
Acknowledgement

This study is derived from the PhD thesis of Karademir (2013) prepared in the supervision of Assoc. Prof. Dr. Sinan Erten.

References


Appendix 1: The English Version of Scale

Dear pre-service teacher,
Please, carefully read the items and answer in scale named “Outdoor science activities performing scale” Purpose of this scale is to determine the factors affecting the realization of outdoor activities. Each part of the scale is different and intended for a particular purpose. Thank you for your contribution and sincere answers.

Res. Asst. Ersin KARAĐEMİR

<table>
<thead>
<tr>
<th>Gender</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Department</td>
<td>Science Teaching</td>
<td>Primary Teaching</td>
</tr>
<tr>
<td>University (write to blank)</td>
<td>⟹</td>
<td></td>
</tr>
<tr>
<td>Mother’s education level</td>
<td>Elementary</td>
<td>Secondary</td>
</tr>
<tr>
<td>Father’s education level</td>
<td>Elementary</td>
<td>Secondary</td>
</tr>
<tr>
<td>Family income status</td>
<td>0–500</td>
<td>501–1000</td>
</tr>
<tr>
<td>Living place (parents)</td>
<td>City</td>
<td>District</td>
</tr>
</tbody>
</table>

Have you ever been in outdoor activity throughout your education life? If your answer is “yes”, please write the blank below.

Yes ☐ No ☐
Outdoor science activities performing scale

K1 – In the future when I am assigned as a teacher; If I want to perform outdoor activity at science and technology lesson with my students; this (will make)

<table>
<thead>
<tr>
<th></th>
<th>Impossible</th>
<th>Very possible</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
</tbody>
</table>

1. Permanent learning occurs at students
2. Experiential learning occurs at students
3. Visual learning occurs at students
4. Students learn the information through concrete experiences
5. Students gain direct experience
6. Students become aware of relationship science between nature
7. Lessons will be reinforced better
8. Students become aware of their productivity.

K2 - In the future when you are assigned as a teacher; If you want to perform outdoor activity at science and technology lesson with your students, what you’ll find an extremely important following outcomes?

<table>
<thead>
<tr>
<th></th>
<th>Not important</th>
<th>Very important</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
</tbody>
</table>

1. Occurring the permanent learning at students
2. Occurring experiential learning at students
3. Occurring the visual learning at students
4. Learning the students the information through concrete experiences
5. Gaining the students direct experience
### K3 – In the future when I am assigned as a teacher; If I want to perform outdoor activity at science and technology lesson with my students, that (will be);

<table>
<thead>
<tr>
<th></th>
<th>Impossible</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Will be difficult by transportation impossibilities</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2.</td>
<td>Will be difficult by parents</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3.</td>
<td>Control of students is very difficult</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4.</td>
<td>Will be difficult by school management</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5.</td>
<td>Will be difficult by distance of institutions</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6.</td>
<td>If time is a problem it will be difficult</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>7.</td>
<td>If accommodation and payment is problem it will be difficult</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>8.</td>
<td>Crowded classrooms will make activity so difficult</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

### K4 – In the future when I am assigned as a teacher; If I want to perform outdoor activity at science and technology lesson with my students, that (will be);

<table>
<thead>
<tr>
<th></th>
<th>Impossible</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Will be easy by enough transportation possibilities</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2.</td>
<td>Will be easy by parents’ allow</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3.</td>
<td>Regular control of students is very easy</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
4. Will be easy by supporter school management

5. Will be easy by reachable distance of institutions

6. If there is enough time for activity it will be easy

7. If accommodation and payment is smooth it will be easy

8. Optimal student in classrooms will make easy

K5 – Mark the most suitable one in the following.

<table>
<thead>
<tr>
<th>Expectation</th>
<th>Parents</th>
<th>Ministry of Education authorized</th>
<th>Related institutions</th>
<th>Other teachers</th>
<th>Non-governmental organizations</th>
<th>Municipality</th>
<th>School management</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Impossible</td>
<td>Very possible</td>
<td>1 2 3 4 5 6 7</td>
<td>Impossible</td>
<td>Very possible</td>
<td>1 2 3 4 5 6 7</td>
<td>Impossible</td>
</tr>
</tbody>
</table>
K6- I am generally ready to do expectations of the people that are important for me.

<table>
<thead>
<tr>
<th>Vary bad</th>
<th>Bad</th>
<th>A little bad</th>
<th>Neither good nor bad</th>
<th>A little good</th>
<th>Good</th>
<th>Very good</th>
</tr>
</thead>
</table>

When I am assigned as a teacher; to perform **outdoor activity** at science and technology lesson with my students;

When I am assigned as a teacher; to perform **lesson with book** at science and technology lesson with my students;

When I am assigned as a teacher; to perform **laboratory activity** at science and technology lesson with my students;

<table>
<thead>
<tr>
<th>Vary easy</th>
<th>Easy</th>
<th>A little easier</th>
<th>Neither easy nor difficult</th>
<th>A little difficult</th>
<th>Difficult</th>
<th>Very difficult</th>
</tr>
</thead>
</table>

In the future when I am assigned as a teacher, if I perform **outdoor activity** at science and technology courses, this will be;

In the future when I am assigned as a teacher, if I perform **lessons with book** at science and technology courses, this will be;

In the future when I am assigned as a teacher, if I perform **laboratory activity** at science and technology courses, this will be;

<table>
<thead>
<tr>
<th>Impossible</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Very possible</th>
</tr>
</thead>
</table>

Expectation of the people that is important for me, to perform **outdoor science activities** from me

Expectation of the people that is important for me to perform **lessons with book** from me

Expectation of the people that is important for me to perform **laboratory activities** from me
When I am assigned as a teacher, I purpose to perform outdoor science activity at science and technology courses.

K10

When I am assigned as a teacher, I purpose to perform the lessons with books at science and technology courses.

When I am assigned as a teacher, I purpose to perform laboratory activity at science and technology courses.

K11

My teachers performed outdoor activities at science courses when I was a student.

K12

Other teachers at school performed outdoor activities at science courses when I was a student.
Sevgili Öğretmen Adayı,

Fen ve teknoloji dersinde “Okul Dışı Öğrenme Etkinliklerini Gerçekteştirme Ölçeği” olarak hazırlanan bu ölçeekte bulunan maddeleri lütfen dikkatlice okuyarak cevaplayınız. Bu ölçekte amaç sizlerin verdiği cevaplar doğrultusunda okul dışı etkinliklerin gerçekleşmesini etkileyen faktörleri belirlemektir. İlgili bölümlerden her bir birbirinden ayrı ve belirli bir amaca yönelikir. Vereceğiniz samimi cevaplar ve çalışmama olan katkılarınızdan dolayı size teşekkür ederim.

Araş. Gör. Ersin KARADEMİR

<table>
<thead>
<tr>
<th>Cinsiyet</th>
<th>Bayan</th>
<th>Erkek</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sınıf</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Bölüm</td>
<td>Fen Bilg. Öğrt.</td>
<td>Sınıf Öğrt.</td>
</tr>
<tr>
<td>Üniversite</td>
<td>(yazınız)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anne durumu eğitim</th>
<th>İlkokul</th>
<th>Ortaokul</th>
<th>Lise</th>
<th>Üniversite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baba durumu eğitim</td>
<td>İlkokul</td>
<td>Ortaokul</td>
<td>Lise</td>
<td>Üniversite</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aile durumu gelir</th>
<th>0–500</th>
<th>501–1000</th>
<th>1001–1500</th>
<th>1501 ve üstü</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yaşadığı Yer</td>
<td>İl</td>
<td>İlçe</td>
<td>Köy</td>
<td></td>
</tr>
</tbody>
</table>

Öğrenim hayatınızda fen derslerinizde hiç okul dışı etkinlik yaptınız mı?
Evet, ise aşağıda belirtilen boşluğa isimlerini yazınız.

Evet | Hayır
### Okul Dışı Öğrenme Etkinlikleri Gerçekleştirmme Ölçeği

<table>
<thead>
<tr>
<th>K1 –Öğretmen olarak atandığında fen ve teknoloji dersinde öğrencilerime okul dışı etkinlik yaparak olursam:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Öğrencilerde kalıcı öğrenme gerçekleşir.</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>2 Öğrencilerde Yaşantı yoluyla öğrenme gerçekleşir.</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>3 Öğrencilerin gørerek öğrenmeleri sağlanır.</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>4 Öğrenciler bilgileri somut yaşamta yoluyla öğrenir.</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>5 Öğrenciler doğrudan tecrübe kazanır.</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>6 Öğrenciler fenin doğayla olan ilişkilerinin farkına varır.</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>7 Dersler daha iyi pekiştirilmiş olur.</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>8 Öğrenciler üretkenliklerinin farkına varır.</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>K2–Öğretmen olarak atandığımızda öğrencilerinizle fen ve teknoloji dersinde okul dışı etkinlik yaparak olursunuz bu durumda ortaya çıkabilecek aşağıdaki sonuçlardan hangilerini ne derece önemli bulursunuz?</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Öğrencilerde kalıcı öğrenmenin gerçekleşmiş olmasını</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>2 Öğrencilerde Yaşantı yoluyla öğrenme olacağını</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>3 Öğrencilerin gørerek öğrenmelerini sağlasırsın</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>4 Öğrencilerin somut yaşamta yoluyla öğrenmesini</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>5 Öğrencilerin doğrudan tecrübe kazanmalarını</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>6 Öğrencilerin fen ve günlük yaşam ilişkisini gözlemlemesini</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>
7. Derslerin daha iyi pekiştirilmesini sağlaması

8. Öğrencilerin üretkenliklerinin farkına varaması

### K3 – Öğretmen olarak atandığında öğrencilerimle fen ve teknoloji dersinde okul dışı etkinlik yapmak istediğimde, bu;

<table>
<thead>
<tr>
<th></th>
<th>Hem mümkün değil</th>
<th>Biraz mümkün değil</th>
<th>Ne mümkün değil</th>
<th>Biraz mümkün</th>
<th>Mümkün</th>
<th>Oldukça mümkün</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ulaşım imkânsızlıklarından dolayı zor olacaktır</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Velilerin izin verme sıkıntısından dolayı zor olacaktır</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Öğrencilerin kontrolünü zorlaştıracaktır</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Okul idaresi sorun çıkarcagaından zor olacaktır</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Kurumların uzak olmasından dolayı zor olacaktır</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Zaman konusunda sıkıltı yaşanırsa zor olacaktır</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Konaklama ve ücret sıkıltısı yaşanıcağından zor olacaktır</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Sınıfların kalabalık olması etkinliği zorlaştıracaktır</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### K4 – Öğretmen olarak atandığında öğrencinizele fen ve teknoloji dersinde okul dışı etkinlik yapmak istediğinizde, bu;

<table>
<thead>
<tr>
<th></th>
<th>Hem mümkün değil</th>
<th>Biraz mümkün değil</th>
<th>Ne mümkün değil</th>
<th>Biraz mümkün</th>
<th>Mümkün</th>
<th>Oldukça mümkün</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ulaşım imkanlarının yeterli olmasından dolayı daha kolay olacaktır</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Velilerin izin vermesinden dolayı daha kolay olacaktır</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Öğrenci kontrolünün düzenli olmasından dolayı daha kolay olacaktır</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. Okul idaresinin destek olmasından dolayı daha kolay olacaktır

5. Kurumların ulaşılabilir uzaklkta olmasından dolayı daha kolay olacaktır

6. Etkinliğe yeterince zaman ayrılmışından dolayı daha kolay olacaktır

7. Konaklama ve ücret sıkıntısının çözülmüş olmasından dolayı daha kolay olacaktır

8. Sınıfların ideal sayıda öğrenciye sahip olmasından dolayı daha kolay olacaktır

<table>
<thead>
<tr>
<th>K5 – Aşağıda bulunan ifadelerden size en uygun olanını işaretleyiniz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velilerin, öğretmen olarak atandığında derslerine girdiğim öğrencilere fen ve teknoloji derslerinde okul dışı etkinlik yaptırıramamı beklemeleri</td>
</tr>
<tr>
<td>Milli Eğitim yetkililerin, öğretmen olarak atandığında derslerine girdiğim öğrencilere fen ve teknoloji derslerinde okul dışı etkinlik yaptırıramamı beklemeleri</td>
</tr>
<tr>
<td>İlgili kurumların, öğretmen olarak atandığında derslerine girdiğim öğrencilere fen ve teknoloji derslerinde okul dışı etkinlik yaptırıramamı beklemeleri</td>
</tr>
<tr>
<td>Diğer öğretmenlerin, öğretmen olarak atandığında derslerine girdiğim öğrencilere fen ve teknoloji derslerinde okul dışı etkinlik yaptırıramamı beklemeleri</td>
</tr>
<tr>
<td>Sivil Toplum Kuruluşlarının, öğretmen olarak atandığında derslerine girdiğim öğrencilere fen ve teknoloji derslerinde okul dışı etkinlik yaptırıramamı beklemeleri</td>
</tr>
<tr>
<td>Belediyelerin, öğretmen olarak atandığında derslerine girdiğim öğrencilere fen ve teknoloji derslerinde okul dışı etkinlik yaptırıramamı beklemeleri</td>
</tr>
<tr>
<td>Okul Yönetiminin, öğretmen olarak atandığında derslerine girdiğim öğrencilere fen ve teknoloji derslerinde okul dışı etkinlik yaptırıramamı beklemeleri</td>
</tr>
</tbody>
</table>
K6- Önem verdiğim kişilerin benden olan beklentilerini genelde yapmaya hazırım.  

<table>
<thead>
<tr>
<th>Çok kötü bulunur</th>
<th>Çok kötü bulunur</th>
<th>Çok kötü bulunur</th>
<th>Çok kötü bulunur</th>
<th>Çok kötü bulunur</th>
<th>Çok kötü bulunur</th>
<th>Çok kötü bulunur</th>
<th>Çok kötü bulunur</th>
</tr>
</thead>
<tbody>
<tr>
<td>İyi</td>
<td>İyi</td>
<td>İyi</td>
<td>İyi</td>
<td>İyi</td>
<td>İyi</td>
<td>İyi</td>
<td>İyi</td>
</tr>
<tr>
<td>Değil</td>
<td>Ne mümkün değil</td>
<td>Ne mümkün değil</td>
<td>Ne mümkün değil</td>
<td>Ne mümkün değil</td>
<td>Ne mümkün değil</td>
<td>Ne mümkün değil</td>
<td>Ne mümkün değil</td>
</tr>
<tr>
<td>Biraz mümkün</td>
<td>Biraz mümkün</td>
<td>Biraz mümkün</td>
<td>Biraz mümkün</td>
<td>Biraz mümkün</td>
<td>Biraz mümkün</td>
<td>Biraz mümkün</td>
<td>Biraz mümkün</td>
</tr>
<tr>
<td>Mükmün</td>
<td>Mükmün</td>
<td>Mükmün</td>
<td>Mükmün</td>
<td>Mükmün</td>
<td>Mükmün</td>
<td>Mükmün</td>
<td>Mükmün</td>
</tr>
<tr>
<td>Olukça mümkün</td>
<td>Olukça mümkün</td>
<td>Olukça mümkün</td>
<td>Olukça mümkün</td>
<td>Olukça mümkün</td>
<td>Olukça mümkün</td>
<td>Olukça mümkün</td>
<td>Olukça mümkün</td>
</tr>
</tbody>
</table>

K7  
Oğretmen olarak atandığında derslerine girdiğim öğrencilere fen ve teknoloji dersinde **okul dışı etkinlik** düzenlenmemi;  
Oğretmen olarak atandığında derslerine girdiğim öğrencilere fen ve teknoloji dersini **ders kitabı destekli** yürütmemi;  
Oğretmen olarak atandığında derslerine girdiğim öğrencilere fen ve teknoloji dersinde **laboratuar uygulamaları** yapmamıyı;  

<table>
<thead>
<tr>
<th>Çok kolay olacak</th>
<th>Çok kolay olacak</th>
<th>Çok kolay olacak</th>
<th>Çok kolay olacak</th>
<th>Çok kolay olacak</th>
<th>Çok kolay olacak</th>
<th>Çok kolay olacak</th>
<th>Çok kolay olacak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zor</td>
<td>Zor</td>
<td>Zor</td>
<td>Zor</td>
<td>Zor</td>
<td>Zor</td>
<td>Zor</td>
<td>Zor</td>
</tr>
<tr>
<td>Ne kolay ne zor</td>
<td>Ne kolay ne zor</td>
<td>Ne kolay ne zor</td>
<td>Ne kolay ne zor</td>
<td>Ne kolay ne zor</td>
<td>Ne kolay ne zor</td>
<td>Ne kolay ne zor</td>
<td>Ne kolay ne zor</td>
</tr>
<tr>
<td>Biraz zor</td>
<td>Biraz zor</td>
<td>Biraz zor</td>
<td>Biraz zor</td>
<td>Biraz zor</td>
<td>Biraz zor</td>
<td>Biraz zor</td>
<td>Biraz zor</td>
</tr>
<tr>
<td>Biraz kolay</td>
<td>Biraz kolay</td>
<td>Biraz kolay</td>
<td>Biraz kolay</td>
<td>Biraz kolay</td>
<td>Biraz kolay</td>
<td>Biraz kolay</td>
<td>Biraz kolay</td>
</tr>
<tr>
<td>Kolay</td>
<td>Kolay</td>
<td>Kolay</td>
<td>Kolay</td>
<td>Kolay</td>
<td>Kolay</td>
<td>Kolay</td>
<td>Kolay</td>
</tr>
</tbody>
</table>

K8  
Okulda derslere girdiğim öğrencilere gelecek dönemlerde fen ve teknoloji dersinde **okul dışı etkinlik yaparak olursam**; bu;  
Okulda derslere girdiğim öğrencilere gelecek dönemlerde fen ve teknoloji dersini **ders kitabı destekli** yürütecek olursam; bu;  
Okulda derslere girdiğim öğrencilere gelecek dönemlerde fen ve teknoloji dersinde **laboratuar uygulamaları yaparak olursam**; bu;  

<table>
<thead>
<tr>
<th>Hiç mümkün değil</th>
<th>Hiç mümkün değil</th>
<th>Hiç mümkün değil</th>
<th>Hiç mümkün değil</th>
<th>Hiç mümkün değil</th>
<th>Hiç mümkün değil</th>
<th>Hiç mümkün değil</th>
<th>Hiç mümkün değil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mümkin</td>
<td>Mümkin</td>
<td>Mümkin</td>
<td>Mümkin</td>
<td>Mümkin</td>
<td>Mümkin</td>
<td>Mümkin</td>
<td>Mümkin</td>
</tr>
<tr>
<td>Biraz mümkün değil</td>
<td>Biraz mümkün değil</td>
<td>Biraz mümkün değil</td>
<td>Biraz mümkün değil</td>
<td>Biraz mümkün değil</td>
<td>Biraz mümkün değil</td>
<td>Biraz mümkün değil</td>
<td>Biraz mümkün değil</td>
</tr>
<tr>
<td>Ne mümkün</td>
<td>Ne mümkün</td>
<td>Ne mümkün</td>
<td>Ne mümkün</td>
<td>Ne mümkün</td>
<td>Ne mümkün</td>
<td>Ne mümkün</td>
<td>Ne mümkün</td>
</tr>
<tr>
<td>Biraz mümkin</td>
<td>Biraz mümkin</td>
<td>Biraz mümkin</td>
<td>Biraz mümkin</td>
<td>Biraz mümkin</td>
<td>Biraz mümkin</td>
<td>Biraz mümkin</td>
<td>Biraz mümkin</td>
</tr>
<tr>
<td>Mümkin</td>
<td>Mümkin</td>
<td>Mümkin</td>
<td>Mümkin</td>
<td>Mümkin</td>
<td>Mümkin</td>
<td>Mümkin</td>
<td>Mümkin</td>
</tr>
</tbody>
</table>
Önem verdiğim kişilerin öğretmen olarak atandığında fen ve teknoloji dersinde *okul dışı etkinlik yaptırmamı benden beklemeleri*;  

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Önem verdiğim kişilerin öğretmen olarak atandığında fen ve teknoloji dersini *ders kitabı destekli yürütmemi benden beklemeleri*;  

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Önem verdiğim kişilerin öğretmen olarak atandığında fen ve teknoloji dersinde *laboratuvar uygulamaları yaptırımamı benden beklemeleri*;  

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**K9**

Öğretmen olarak atandığında derslerine girdiğim öğrencilere fen ve teknoloji dersinde *okul dışı etkinlik yaptıramayız* amaçlıyorum;  

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Öğretmen olarak atandığında derslerine girdiğim öğrencilere fen ve teknoloji dersinde *ders kitabı destekli ders yürütmevi amaçlıyorum*;  

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Öğretmen olarak atandığında derslerine girdiğim öğrencilere fen ve teknoloji dersinde *laboratuvar uygulamaları yaptıramayız* amaçlıyorum;  

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**K10**

Öğrenci oldugum yıllarda derslerime giren öğretmenlerim fen ve teknoloji derslerinde okul dışı etkinlik yaptırdı.  

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**K11**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**K12**

Okuldaki öğretmenlerim önceki öğretim yıllarında öğrencilerle fen ve teknoloji derslerinde okul dışı etkinlik yapıtdılar.  

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Teachers’ Remarks on Interactive Whiteboard with LCD Panel Technology

Ömer Koçak¹, Aslan Gülçü²
¹Erzincan University
²Atatürk University

Abstract

This study investigated the opinions of teachers about using interactive whiteboards with an LCD panel that was installed in classrooms within the FATIH educational project. The study was conducted at six high schools in which installation of interactive whiteboards with an LCD panel in classrooms was completed and teachers who received training in order to use these whiteboards. One hundred and twenty one teachers participated in this study. The data was gathered using open-ended questions. Qualitative data obtained with open-ended questions was analysed using phenomenographic analysis method. Teachers were positive about using interactive whiteboards with an LCD panel in education. Teachers stated that the interactive whiteboard with an LCD panel was used throughout whole course. "Visualization" of an interactive whiteboard with an LCD panel is often expressed to as an acclaimed feature by teachers. The needs to remedy the lack of software and technical problems have been stated by the teachers.

Key words: Interactive Whiteboard, Interactive Whiteboard of LCD panel, FATIH Project, Teachers Thoughts, Teachers

Introduction

Today, significant changes and improvements occur in the field of information technologies. Using developing technology in teaching-learning process is inevitable. The individuals, teaching and learning under these circumstances, need to be equipped with skills such as reaching information fast, organizing, evaluating and presenting the information (Akkoyunlu, 1995). The teacher is one of the important factors in providing efficient learning in the teaching-learning process (Baki, Yağlıkaya, Özpınar & Uzun, 2009).

When organizing a learning and teaching environment, teachers should take into consideration the needs and expectations of the students, have certain skills and knowledge to benefit from the technology (Akkoyunlu, 2002). All kinds of tools and equipment that are used in order to degrade the level of content when it is instructed to the students are involved in education technology. Teachers use lots of educational materials in the learning-teaching process such as traditional blackboards, overhead projectors, computers, videos, animation and educational software (Akpinar, 2004). One of these technologies is interactive whiteboard technology that has started to be used frequently. The interactive whiteboards, which were first produced in 1991, started to be used in education towards the end of the 1990s. Smart board and electronic boards are alternative names for interactive whiteboards (Şad, 2012). Many countries have started to conduct studies in order to use interactive whiteboards in education. England was the first country to use interactive whiteboards in education and this country made great investments to equip schools with interactive whiteboards (Armstrong, Barnes, Sutherland, Curran, Mills & Thompson, 2005). With “the Movement of Increasing the Chances and Improving the Technology”, the Turkish abbreviation of which is FATIH, which was put into practice in 2010 to involve this technology in learning-teaching process, it is planned to give an interactive LCD panel board to 570,000 classrooms, to prepare the network substructure and to give tablet PC to teachers and students (MEB, 2012).

Interactive whiteboards generally consist of a touch sensitive screen, computer and projection device (Shenton & Pagett, 2008). Today, interactive whiteboards with various features are being produced by numerous

* Corresponding Author: Aslan Gulcu, aslangulcu@gmail.com
companies. Within the scope of the FATİH project, a mechanism consisted of 3 apparatuses were placed in classrooms. On the right of the mechanism is a stable traditional board, on which chalk is used, a mobile blackboard, on which board markers are used, and there is interactive LCD panel board to its left.

The advantages and disadvantages of using an interactive whiteboard in education have been researched by many researchers. Interactive whiteboards are increasing the quality of education and making lessons enjoyable, motivating and interesting. It will be beneficial to use interactive whiteboards in education despite technical malfunctions (Elaziz, 2008). Interactive whiteboard technology will be the junction point of pedagogy and technology (Smith, Higgins, Wall & Miller, 2005).

According to the results of the research done by Lewin, Somekh and Steadman (2008) in England between 2004-2006; teachers and students adopted a positive attitude to the use of interactive whiteboards in education, it is determined that there is an increase in the success of the students, teachers are trying to improve new pedagogic methods to provide a better understanding of their lessons. In the two classes constituted in the study carried out by López (2010); the difference in the level of success between the digital learning class in which the interactive whiteboard is used and the traditional class is analysed, and the obtained result is that the success of students in the digital learning class are higher than the students in the traditional class.

Bulut and Koçoğlu (2012) analysed the opinions of teachers on interactive whiteboards; it was noted that adequate education should be given to teachers, and it was recommended that the use of interactive whiteboards will increase students’ attention to the lesson. In another study Paragină, Paragină and Jipa (2010) expressed that the interactive whiteboard is more beneficial in terms of visual learning and practicing was reached, and educational software, the development of online resources are necessary and it is important for teachers to attract the attention of students. In a similar study conducted by Isman, Abanmy, Hussein, Saadany and Abdelrahman (2012); it was noted that the use of interactive whiteboards increases the motivation and success of the students and facilitates understanding, and it was noted that teachers need professional support to use interactive whiteboards more efficiently.

Türel (2012) researched the negative approaches, needs and problems of teachers regarding interactive whiteboards; it was noted that interactive whiteboards make teachers and students more passive, make learning dependent on computers, installation and technical malfunctions take time, it became harder to control the class, and teachers do not have enough information about the features of interactive whiteboards.

In this study teachers’ views regarding the use of interactive whiteboards in education by considering the studies in the literature were examined. The research questions to obtain these views were as follows:
1) What is teachers’ level of use of technological devices?
2) What is teachers’ level of technology use in the teaching-learning process?
3) What are teachers’ views about the hardware components of interactive whiteboards?
4) What are teachers’ views about the use of interactive whiteboards in education?
5) In which part of the lesson are interactive whiteboards used mostly?
6) What is the necessity of using LCD interactive whiteboards?
7) What are the positive and negative aspects of interactive whiteboards?
8) Which features of interactive whiteboards are used more and less?

Method

Model of the Study

Phenomenographic research method, which is one of qualitative research methods, is used in this study. With phenomenographic research method, how the individuals present their feelings and perceptions that they create about the concepts in their minds with their own expressions is analyzed. It is expressed as “the method of monitoring the essence”. Phenomenography aims to create categories as a result of turning perceptions about the events into expressions (Demirkaya & Tomal, 2008; Şimşek 2012).

Participants

This study consisted of 121 teachers who work at schools where interactive whiteboards have already been installed and used in Erzincan. Table 1 shows the number and schools of the teachers who participated in the study.
Table 1. Schools and Number of Teachers

<table>
<thead>
<tr>
<th>School</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>A High School</td>
<td>19</td>
</tr>
<tr>
<td>B High School</td>
<td>20</td>
</tr>
<tr>
<td>C High School</td>
<td>19</td>
</tr>
<tr>
<td>D High School</td>
<td>22</td>
</tr>
<tr>
<td>E High School</td>
<td>27</td>
</tr>
<tr>
<td>F High School</td>
<td>14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>121</strong></td>
</tr>
</tbody>
</table>

Data Collection Instruments

In the phenomenographic research method, the data is collected via group interviews, observations, paintings, open-ended questions or historical documents (Erten, Kiray & Sen-Gumus, 2013; Yildiz-Duban, 2013). In this study, data was collected through open ended questions.

Validity and Reliability

The consistency between the results of different measurements by using a means of measurement shows the reliability rate of that means. Reliability is directly related to quantitative researches. In the qualitative researches, the reliability depends of the accuracy and comprehensiveness of the data (Uzuner, 1999). The validity is the ability of the means to measure the feature, which is desired to be researched, without involving other features ( Şimşek, 2012). The open-ended questions used in our study were created by a domain expert and researcher by researching the litterateur. The validity and reliability of 11 open-ended questions were evaluated by three domain experts and their present status was acquired by making the necessary regulations.

Data Analysis

The qualitative data acquired in this study were analysed by using phenomenographic analysis method. The data acquired with written materials in phenomenological analysis process are firstly transcribed. Transcript is acquired by analysing the identifications made by different individuals about the same concepts and assembling the same or similar expressions under identification categories (Demirkaya & Tomal, 2008). In this process, a domain expert and a researcher is worked with. Pre-classifications were made after the responses of the teachers were read a few times by the researcher. The classifications were carried on by basing on these pre-groups acquired together with domain expert and categories were created.

Findings

The question ‘What are the technological devices that you use in everyday life?’ aims to obtain information about teachers’ technology use tendencies. Table 2 shows the devices that they use, their frequency and percentages.

Table 2. The Distribution of the Technological Devices the Teachers use in their Daily Lives

<table>
<thead>
<tr>
<th>Device</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer</td>
<td>31</td>
<td>25.6</td>
</tr>
<tr>
<td>Computer - Smart phone</td>
<td>30</td>
<td>24.8</td>
</tr>
<tr>
<td>Computer - Cell phone - Tablet PC</td>
<td>26</td>
<td>21.5</td>
</tr>
<tr>
<td>Computer - Cell phone</td>
<td>22</td>
<td>18.2</td>
</tr>
<tr>
<td>None</td>
<td>3</td>
<td>2.5</td>
</tr>
<tr>
<td>Computer - Smart phone - Tablet PC - MP4</td>
<td>3</td>
<td>2.5</td>
</tr>
<tr>
<td>Computer - Tablet PC</td>
<td>3</td>
<td>2.5</td>
</tr>
<tr>
<td>Computer - Smart phone - Smart TV</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Computer - Smart phone - MP4</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Computer - Cell phone – Printer</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>121</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
It was stated that the vast majority of the students use computers, whereas the use of cell phones, smart phones and tablet PCs. 3 teachers stated that they do not use any technological devices.

Table 3 shows the frequency and percentage of the answers to the question ‘What are the technological materials that you use in your lessons?’

<table>
<thead>
<tr>
<th>Materials</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer – Interactive whiteboard</td>
<td>71</td>
<td>58.7</td>
</tr>
<tr>
<td>Computer – Projection – Interactive whiteboard</td>
<td>14</td>
<td>11.6</td>
</tr>
<tr>
<td>Computer – Projection – Tablet PC</td>
<td>9</td>
<td>7.4</td>
</tr>
<tr>
<td>USB Stick</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>MNE Visual Materials Smart Whiteboard</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Never</td>
<td>3</td>
<td>2.5</td>
</tr>
<tr>
<td>USB Stick</td>
<td>3</td>
<td>2.5</td>
</tr>
<tr>
<td>Projection</td>
<td>3</td>
<td>2.5</td>
</tr>
<tr>
<td>Computer – Projection – Tablet PC</td>
<td>2</td>
<td>1.7</td>
</tr>
<tr>
<td>Computer – Tablet PC – USB Stick</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Document Camera</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Models – Computer</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>TV – Overhead Projector</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>121</td>
<td>100</td>
</tr>
</tbody>
</table>

58.7% of teachers stated that they use “computers and interactive whiteboards”. Apart from this, computers, projection and interactive whiteboards are the other technological materials teachers used in their lessons. 3 teachers stated that they do not use any technological materials.

The teachers’ views on the hardware technology of interactive whiteboards were examined with the question ‘What are your views on interactive whiteboard technology?’ and the following views were obtained.

- It takes a lot of time to install.
- It is much more difficult to write on the screen than on a blackboard.
- It would be better if it could be controlled via a mouse or a remote control rather than the screen.
- Sound quality is not good.
- The touch-operated technology of the interactive whiteboard needs to be developed.
- Students cannot see the whiteboard clearly because of reasons such as brightness level, dimension, location and its external reflection.
- It tires students’ and teachers’ eyes.
- Technical problems occur (freezing, power cut etc.)
- It takes a lot of time to prepare material.

However, the majority of teachers stated that the present hardware is sufficient.

Most of the teachers stated that they look at the usage of interactive whiteboards in education in a positive light, to the question, ‘What is your view about the use of interactive whiteboards in education?’ It is viewed that interactive whiteboards visualize the lesson, motivate the students, save time and are suitable for the modern world. It is advised that teachers use interactive whiteboards much more.

61.1% of teachers replied, ‘Yes, and it is a necessity.’ to the question ‘Would you look for the condition of interactive whiteboards for the lessons in your classroom and if so, why?’ They stated that it is fast and fun; also it is time-saving and convenient. Although 37.2% of the teachers answered ‘No.’, they stated that it is required for the classroom environment.

The question, ‘Do you need the traditional blackboard besides the interactive whiteboard (why?)’ was asked and 72.7% of teachers stated that they need the traditional blackboard. They stated that they could write on it easily and they preferred it while lecturing. 15.7% of teachers stated that they do not need a traditional board. 11.6% of teachers stated that they sometimes need it.

The question ‘In which part of the lesson (the beginning, middle, end or most of the lesson) are interactive whiteboards used mostly?’ was asked with the aim of learning about the frequency of interactive whiteboard usage during lessons. 52.1% of teachers stated that they use it from the beginning to the end of the lesson. 21.5
of teachers stated that it depends on the lesson subject, that is, at the beginning, in the middle, at the end of the lesson or while summarizing the subject. However, 9.1% of teachers stated that they only use it at the end of the lesson or while summarizing the subject.

With the question ‘In which parts of the lessons (lecturing, activity, homework, problem-solving etc.) do you use interactive whiteboards?’ relevant data was obtained. 28.9% of teachers stated that they use it while teaching, doing activities, solving problems and giving feedback to homework. Nevertheless, 18.2% of teachers stated that they used it while teaching and problem solving. It was expressed that displaying the prepared documents was time saving, especially during problem solving. 9.1% of teachers stated that they used interactive whiteboards while teaching and doing activities, while 9.1% of teachers stated that they only used it while doing activities, and the rest of the teachers stated that they used it in various parts of the lessons, such as revising, getting students’ attention, teaching abstract terms, solving sample questions or making assessments.

Here are some views stated by teachers as the positive aspects of interactive whiteboards:

- Visualising,
- Time-saving,
- Motivation,
- Efficient education,
- Interesting,
- Rich content,
- It provides convenience.

Especially, ‘the visualising feature’ is the main positive feature expressed by the teachers. Time-saving, providing convenience and arousing motivation are also positive features stated by teachers. Having an internal sound system, providing rich content, students’ preference and providing fast and multiple options are the positive aspects of interactive whiteboards.

As far as the cons of interactive whiteboards are concerned, some teachers stated that it does not have any cons. Those are some negative aspects that teachers stated:

- Technical problems, lack of infrastructure,
- Time wasting,
- It tires the eyes and causes headaches.
- Usage out of purpose
- Software deficiency,
- It requires preparation,
- The touch screen does not work well.

Apart from those, some negative aspects of the LCD interactive whiteboard such as diminishing students’ writing skills, making students passive, causing laziness and restraining creativity are stated by the teachers.

It was asked that the teachers prioritise the features of interactive whiteboards that they used. The three most and least used features by teachers are shown in Table 4.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Numbers of Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The features used most</strong></td>
<td></td>
</tr>
<tr>
<td>Displaying film and video</td>
<td>40</td>
</tr>
<tr>
<td>Presentation and course book</td>
<td>23</td>
</tr>
<tr>
<td>Drawing</td>
<td>15</td>
</tr>
<tr>
<td><strong>The features used least</strong></td>
<td></td>
</tr>
<tr>
<td>Showing pictures</td>
<td>32</td>
</tr>
<tr>
<td>Connecting to the internet</td>
<td>31</td>
</tr>
<tr>
<td>Writing</td>
<td>16</td>
</tr>
</tbody>
</table>

Teachers stated the ‘Displaying film and video’ feature as the most used feature. ‘Presentation’, ‘Course book’ and ‘Drawing’ are the features indicated in the front ranks by the teachers. Whereas, the features indicated in the last ranks by the teachers are ‘Showing pictures’, ‘Connecting to the internet’, and ‘Writing’. Apart from these features, teachers stated that they used external resources and prepared documents.
Discussion and Conclusion

With this study, some remarkable outcomes about teachers’ thoughts related to the usage of interactive whiteboards have been revealed. Most of the teachers were positive about using interactive whiteboards with an LCD panel in education. They stated that the interactive whiteboard with an LCD panel was generally used throughout whole course.

Most teachers stated that they use technology actively in their daily life and they do not avoid technology. It could be said that teachers are in favour of technology use in education and they try to adapt technology to the lesson. This result supports the research by Kutluca and Ekici (2010). It can be concluded from the data obtained that the effect of teachers’ usage technology in daily life are related to their using technology in the lesson.

The structure of interactive whiteboards being sufficient although with such negative aspects as, due to the brightness and reflection, it cannot be seen by students, its tiring to both the teachers’ and students’ eyes were expressed by teachers. The necessity of improvement in touchable technology of the interactive whiteboard was frequently stated by teachers. It was stated that interactive whiteboard use in education is very positive from the point of ‘visualising’, but when it comes to cons, breaking down, deficient software and constant use would cause boredom and make classroom management difficult. As was stated by the teachers joining our research, the necessity of training for teachers to fully use interactive whiteboards could be seen as another suggestion/negative aspect (Altınçelik, 2009; Isman et al, 2012). Teachers indicated that interactive whiteboards are a necessity, although the traditional board cannot be abandoned. It has been thought that the technical difficulties and requirement of preparation for the lesson causes teachers to use the traditional board. Teachers have reacted positively to combining the interactive whiteboard and the traditional board.

The teachers stated that they generally used the interactive whiteboard during the whole lesson. Teachers indicated that they used interactive whiteboards while teaching, doing activities, solving problems and giving feedback to homework. It was indicated that it saved time, especially when writing questions. Visualising the lessons and providing multimedia devices are positive features stated by the teachers. ‘Providing convenience’, ‘Reaching the source of information from the shortcut’ and ‘Improving the students’ imagination’ were shown as positive aspects by the teachers. (Altınçelik, 2009; Isman et al. 2012). Interactive whiteboards make the lesson more entertaining and interesting and arouse the students’ motivation.

Although the majority of teachers stated that the interactive whiteboard did not have any negative aspects, lack of infrastructure and technical difficulties were expressed as the negative points. Although many teachers stated that interactive whiteboards saved time, some teachers stated that they wasted time because of technical and installation difficulties. Software, material and resource deficiency were stated as negative sides. In terms of health issues, tiring eyes, students’ not looking for a long time, causing headaches and the fear of them giving off radiation are the cons stated by the teachers.

Teachers stated that ‘Displaying film and video’, ‘Course-book’ and ‘Drawing’ are the features they used most. That result supports one of the positive aspects of the visualising feature of the interactive whiteboard. ‘Showing pictures’ and ‘Connecting to the internet’ are selected as the least used features. This outcome disputes the ‘The writing feature is the most commonly used’ obtained by Altınçelik (2009).

As a result, 121 teachers joined our study and the result that they have positive views about the interactive whiteboard is achieved. However, they indicated that technical difficulties and software deficiencies need to be resolved. Within the project ‘FATİH’ the teachers have been trained to use interactive whiteboards. However, it has been suggested that training be given for resolving the technical difficulties which teachers indicated as negative. Besides, it has been suggested that the required training be given in point of material creation and achievement.

References


