TEACHER LUST: ITS ANTECEDENTS AND ENACTMENTS IN A COLLEGIATE MATHEMATICS COURSE

by

ANDREW MICHAEL TYMINSKI

(Under the Direction of Denise S. Mewborn)

ABSTRACT

This dissertation examines Mary Boole's construct of teacher lust within a collegiate mathematics classroom. It presents the author's conception of the construct, describes its enactment within the classroom, proposes several antecedents that influence it effects, and examines the potential impact that raising awareness has on a teacher's practice. The analysis of my observations and interviews suggest there are two main forms of teacher lust: enacted and experienced. Enacted teacher lust is an observable teacher action that takes away an opportunity for students to think about or engage in mathematics for themselves. Examples of enacted teacher lust can include imposing mathematical knowledge or structure; directing and/or limiting student solution paths and strategies; or telling information in a manner that reduces the level of the task. Experienced teacher lust is the impulse to act in the manner described above, and precedes, but does not necessarily imply enactment. The antecedents of teacher lust can be found within several sources, both internal and external. From an internal standpoint, an instructor's beliefs and knowledge impact her interaction with teacher lust. Specifically, an instructor's pedagogical content knowledge seems to have a direct bearing on feelings of experienced teacher lust. There are also external forces that work in combination with the instructor's internal influences; students are the most significant of these factors. Instructors engage in acts of teacher lust in order to “help” students make mathematical connections and to curtail their seemingly unproductive activity. Compounding these issues are concerns with time on both macro and micro levels. Concerns for closure in a given class period and for covering a syllabus worth of material within a semester also impact how and when teachers engage in acts of teacher lust. There are conflicting results from my examination of how raising awareness of teacher lust can influence an instructor’s practice. It seems awareness of this construct is most likely to impact the practice of instructors who are in the early stages of their career.

INDEX WORDS: teacher development, mathematics education, beliefs, pedagogical content knowledge, teacher change

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ANDREW MICHAEL TYMINSKI

B.S. Elementary Education with extension in Mathematics Education, State University of New York College at Buffalo, 1992

M.Ed. Mathematics Education, University of Georgia, 2003

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EXAMINING THE CONSTRUCT OF TEACHER LUST: DISCOURSE AND ACTIONS IN THE COLLEGE MATHEMATICS CLASSROOM

by

ANDREW MICHAEL TYMINSKI

Major Professor: Denise S. Mewborn

Committee: Paola Sztajn
Deborah L. Ball
Edward Azoff

Electronic Version Approved:

Maureen Grasso
Dean of the Graduate School
The University of Georgia
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"Yo, Adrian! -- I did it!"

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CHAPTER 1 – The Problem Statement

Background

As a teacher educator, I would like teachers to have pedagogical goals that reflect a constructivist epistemology. For example, I want them to value the mathematics of their students, to work at developing mathematical thinking in their students, and to actively try to understand the way their students think about mathematics. I feel that this learning theory best describes the process of learning, and preparing teachers to develop classrooms where children are engaged in making sense of mathematics is one of my primary goals as a teacher educator.

In the methods courses I teach, I encourage my preservice teachers to choose and design tasks that will allow their students to make sense of and engage actively with mathematics. I know that for many of them, taking this approach to teaching mathematics is incongruent with the way they have experienced mathematics as learners. They find that this approach frequently creates situations where both they and their students struggle. Their students are not necessarily used to engaging in mathematics for themselves and they struggle to start, let alone complete, the problem at hand. This often results in students posing questions, or comments asking for help. These can be as vague and ambiguous as “Can you help me? I don’t know what to do”; or as specific as “I’m not sure what to do after this step, can you tell me?” There are mutual expectations from both parties. The students want to be able to solve the problem and expect the teacher to help them do so. Likewise, the teachers want to help their students be successful and expect to offer help. They can struggle with how to respond to student questions and how to best help their students.

One approach to resolving a student's confusion involves imposing a particular understanding onto the student in some way. This may involve preempting a student's chosen mathematical approach and then suggesting a solution path that the teacher knows will be fruitful. Another example would be telling a student exactly how to solve a problem, even though the student may have a different, yet valid approach. Expecting students to conceptualize an idea exactly as the teacher does is another example of how teachers can impose their own mathematics onto students.

In the teacher's view, these approaches are the best way to ensure the students will be able to solve the problem. This viewpoint could be the result of an epistemological belief, or it could also be the only way the teacher knows to help the student. An important point to be made regarding these situations is when teachers impose their ways of thinking onto their students without considering what their students do and do not understand, they run the risk of, at best, not communicating with students and, at worst, dismissing whatever valid mathematical thinking was happening in the children's minds.

Another approach to resolving a student's confusion is to determine how the student is thinking about the problem and then connect to the mathematics to his ideas. Steffe (1994) referred to this a making a second order model of a student's thinking. This may be accomplished through using questioning techniques that elicit student's thinking, employing scaffolding techniques, posing counter examples, or attaching conventional terminology to a student's ideas. These techniques allow the teacher to make sense of the student's mathematics, not to transmit the teacher's understanding of the mathematics to the child.

I hope teachers will respond to students' struggles and questions more in the vein of the latter approach rather than the former. Unfortunately, in the moment of teaching, these questions may be responded to instinctively and perhaps without reflection. Teachers can have a natural desire to impose their own understandings upon their students, even though this approach can be in opposition to their educational goals. When teachers act in this manner, when they feel and give in to the urge to tell students exactly what to do, or to attempt to make a student's understanding exactly like their own, they are giving into an attribute I will define as *teacher lust*.

Mary Boole (1931) first coined the term teacher lust. In teachers, she described the desire

> …to make those under him conform to his ideals…to regulate the actions, conduct, and thoughts of other people in a way that does no obvious harm, but is quite in excess both of normal rights and of practical necessity…to proselytize, convince, control, to arrest the spontaneous action of other minds…Lastly, he acquires a sheer automatic lust for telling other people 'to don't', for arresting spontaneous action in others is a way that destroys their power to learn at the same time what he is trying to teach them. (Boole, p. 1412)

This description is very appropriate to describe teachers' actions when they impose their own mathematical understandings on their students. Especially important is to note that Boole implied that a teacher acting in such a way is actually hindering students' learning. This study however, has made me realize this may not always the case. In either case, this construct is an important avenue to examine not only in mathematics but in education in general.

Rationale

A main goal of this study was to make *teacher lust* a more well-defined construct because of its applicability within the realm of discussing and facilitating teacher change. I hope teachers whose current mode of operation is to assume a stance as a keeper and provider of their mathematical knowledge will shift to a stance as a facilitator of children's mathematical understanding through teacher education or professional development experiences. When teachers attempt to operate in a way that places the focus of the mathematics on the student, they will inevitably feel the pull of teacher lust. But by naming, defining, and making teachers aware of teacher lust, teacher educators can help them to better battle its reactive effects and learn to become more reflective in how they respond to students' struggles.

During the past two years, through my work with the Center for Proficiency in Teaching Mathematics (CPTM), I have become more aware of teacher lust. Jeremy Kilpatrick first brought the term to my attention when referring to an incident we observed during our 2003 summer institute for middle school mathematics teachers,. A teacher educator was working alongside two inservice middle school teachers, observing and working with them on a geometric exploration in *Geometer's Sketchpad*. He was looking over her shoulder at her computer while she was struggling with the given task. After watching the teacher flounder for a while, he actually pushed the teacher/student aside, took control of the computer, and showed her how to use the software to solve the problem at hand.

When this episode was brought up during our afternoon debriefing session, Kilpatrick used the term teacher lust to describe what we all saw. As a result, it became a side theme of interest to the research team, and we continued to look for examples of teacher lust in both the 2003 and 2004 summer institutes. During our interview with the instructor of the institute, we asked him to recall this particular episode and to speak about it and about teacher lust in general.

> I've seen it going on in every class that I've ever taken in mathematics. Okay, and I came up through a time that faculty believed that students were only learning when the faculty member was talking. And I disagree with that because I think where I really learned was

> when I went back over the material and reconstructed things for myself; I did investigations. That's where the knowledge was solidified. [pause] Teacher lust is an idea for me; it's a behavior that teachers, instructors, faculty members, professors have for inhibiting student inquiry; or limiting it. (Jim Wilson interview, 2003)

Wilson's comments describe teacher lust as a barrier to students' mathematical inquiry.

We saw instances of teacher lust again during the next CPTM Institute. During the 2004 Summer Institute, the teacher educators who participated were not working alongside preservice teachers; rather they were only observing a preservice mathematics content course for elementary school teachers. Despite the fact that the teacher educators were instructed not to interact with the students of the lab class for any reason, after one lab class, a teacher educator approached a student and tried to further explain the mathematics from that class period. As a result of this interaction, the teacher educators were reminded prior to the next lab class meeting not to interact with the preservice teachers. In spite of this reminder, on another day, a different teacher educator wrote a note in a student's notebook in an attempt to clarify the student's understanding of a mathematical issue. Even though these teacher educators were not responsible for the mathematics instruction of these students, they still felt an overwhelming urge to tell what they knew or to direct student learning. These instances suggest that teacher lust can be experienced vicariously, by influencing teachers who are not observing students but not actively instructing.

Thinking about and discussing these incidents with other graduate students and professors helped me to become more aware of teacher lust. Perhaps more importantly, having a name to attach to what I felt allowed me to talk about the feelings I felt in myself while teaching or while observing other teachers. Once I had a name, I saw examples of teacher lust leaping out at me from many sources. Perhaps not surprisingly, I saw a great deal of it in the elementary education majors to whom I taught methods the following fall and spring.

We know a preservice teacher's prior schooling experiences can have an impact upon future teaching practices (Lortie, 1975); likewise, their experiences in college classrooms can also impact their beliefs regarding teaching. Thus, I have employed my awareness of teacher lust to help my preservice teachers become more aware of the phenomenon.

In a mathematics methods class I taught, I had my preservice elementary school teachers (PEST) solve the "hens and rabbits" problem: "In a yard, a farmer counts 22 animal heads and 56 animal legs. If he knows that he has only rabbits and hens in the yard, how many of each animal does he have?" I used a "think-pair-share" approach so they had an opportunity to work on the problem individually, in pairs, and then in groups of four. When the groups came to a consensus on a solution, I asked them to write it on an overhead transparency, and we looked at each group's solutions as a class. There were a few different approaches that were shared and discussed. One solution involved a guess and check strategy, another involved drawing a picture, and one strategy used a system of linear equations. In the next class period they were paired with a classmate to work with one third-grade student at a local elementary school. I asked them to pose the same problem to their student and to focus on eliciting and understanding the way that their child solved the problem. The following episode is indicative of what many of my PEST did as they tried to help their students solve the problem.

After the PEST posed the problem, the child sat and stared blankly at the teacher. It was obvious that the student was having difficulty with the problem. After much deliberation, the child decided to guess that there may be eleven of each animal. The teacher responded with "That is a good start, but now we need to decide how many legs that will give us. We know that rabbits have four legs and hens have two legs. Why don't you use these Unifix cubes to represent the legs and find out how many there are." The student began to count out cubes in pairs, counting out more than eleven pairs of cubes. The teacher interrupted to say, "Notice that you have counted out more than eleven pairs." and then purposely asked the student to recount, making sure that he stopped at eleven. "Next, we need to count out sets of four for the rabbits." The student was able to do so. When asked if the guessed answer was correct, the student said "No" but was unable to make suggestions about how to improve the next guess. The preservice teachers did not know how else to respond to this action, so they metaphorically took the child by the hand and walked him step by step through their solution to the problem.

This episode happened early in the semester and, as I observed several of my students acting in a similar manner, it occurred to me that I was observing examples of teacher lust. As a result of observing my preservice teachers working with children, I made it a point to talk explicitly about the idea of teacher lust in our next class. I couched the idea as "imposing our mathematics onto our students." I re-explained that the goal of that particular field experience was for them as teachers to understand how the students were making sense of the problem, not to show the students how they (the teachers) would solve the same problem. I encouraged them to think about ways to help the children engage without telling them what to do. As the semester progressed we occasionally revisited the idea of teacher lust, usually when one of my students brought it up in the context of asking how to "help children without doing it for them."

The following semester, I taught a second methods class to the same students. During this course, they had a four-week field experience. As I observed the small subset of students I was responsible for, the topic of teacher lust came up from time to time--sometimes the students broached the subject and other times I initiated the discussion. These conversations were a result of feelings of teacher lust experienced both by myself and by my students at different points in the field experience.

At the end of the second semester, I had my students design and present artifacts that represented their mathematical experiences in the two methods courses and what they had learned. Within these presentations, several of my students referred to teacher lust in some way. The most blatant reference was in a student's presentation of a street sign showing a picture of a teacher pointing, as if lecturing, at a student sitting in a desk. The picture was completed by a large, red "no" symbol around it. Below the picture she wrote "No Imposing Mathematics". (See Figure 1.)

Figure 1. Preservice teacher class artifact.

Research Questions

The experience with my preservice teachers helped me to understand the power of naming a construct such as teacher lust and how making teachers aware of this feeling can help them to make changes in their beliefs and their practice. Thus, I chose to investigate this phenomenon further by studying teacher educators teaching mathematics content courses to preservice elementary school teachers. One goal of this study was to influence the teacher educators' practice by making them explicitly aware of teacher lust and how it can impact their pedagogical choices. I also wondered if raising their awareness would have any direct effect on their students. That is, I wondered if making the instructors more aware of their own actions would affect the awareness the students have about teacher lust.

My study involved investigating instructor-learner interactions with a focus on the discourse of the classroom when questions were posed by the instructor or asked by the learners. I examined the dialogue for instances that could potentially lead to teacher lust. Then, I conducted interviews with the instructors, using pre-selected video samples from their classroom as prompts, to allow them to talk about the decisions they made in a particular moment of teaching. I hoped to find instances where teacher lust was felt by the instructor, to discuss whether or not she felt as though she gave in to it, to find what other responses she might have considered, what the consequences of her chosen response were, and what she thought may have come from making other choices.

Making instructors aware of teacher lust and how it can affect their classroom is the first step in allowing them to understand the construct and perhaps to exercise better control over it. Thus, I performed several sets of observations over time so that I could see if raising the awareness of teacher lust impacted an instructor's practice.

The research questions that I addressed in this study are:

1. What is my conception of teacher lust, and how is it evident during mathematics instruction?
2. What factors influence teacher educators to give in to teacher lust?
3. How does making teacher educators more aware of teacher lust help them to deal with the phenomenon?

CHAPTER 2 – Literature Review

This chapter reviews current literature on teacher lust, the theoretical framework in which I have set the research, and a brief summary of results within research on teacher education connected to my research questions.

Lust In The Literature

Boole (1931) introduced the term teacher lust, and since then other mathematics educators have invoked the term to describe their own experiences. Each of these references helps to paint a picture of what teacher lust can look like in different situations and helped me to define a framework for what constitutes teacher lust and what does not.

I begin with John Mason (2003), who wrote about his attempts in trying to effect change in teachers. This is especially germane, as I theorize that teacher lust is most evident when teachers attempt to teach in ways that are contrary to their previous modes.

> One of my guiding principles is that desiring other people to change says a great deal more about me and my desires than it does about them. What am I hiding in myself, or from myself, by focusing on others? Is it a wishful or blaming sentiment of 'if only they would…', by which I try to pass responsibility onto others? If so, then the real task is to work on myself, is it an evangelistic sentiment of 'I really enjoy, got benefit from…so others could (should?) do likewise', trying to urge my experiences on others? (p. 284)

Mason went on to refer to these feelings as a form of teacher lust. In his description we can see his desire to impose his values and ideas upon others. It is not something that is done with ill intent–quite the opposite. Mason simply wanted teachers to have the same rewarding experiences he had and thought that encouraging them to do things as he had done them would accomplish this goal. His use of the word "evangelistic" is especially interesting to me; it evokes the image of a preacher, pleading with his congregation for them to see the light as he has.

Hatfield (2001) wrote about his experiences in becoming a constructivist teacher and described a similar situation with his students. He recounted his experiences in teaching geometry through a lab setting where his approach was based upon theorems being discovered by his students in lieu of simply giving the theorems to them and the inner conflict that taking this new approach caused within him.

> I knew that I was effective at explaining and modeling, and despite my lust, most of my students seemed to be succeeding…I focused my efforts on getting students to know and appreciate the mathematics- but just as I knew its beauty, excitement, fulfillment. I treated mathematics like a finished display, like a classic Greek marble sculpture, rather than contexts for challenging experiences to be creative, generative, involved. I wanted their understanding to be like my understanding. (p. 194)

This example of lust again demonstrates that the instructor was aware of the construct, just as John Mason was. Going further, Hatfield alluded to his attempts not to give in to the joy he felt when he was "explaining and modeling" mathematics to his students. Also important to note is that he implicitly referred to the notion that acting in this mode, while enjoyable to him, was not necessarily in the best interests of his students' learning. He had educational goals for his students "to be creative, generative, involved" (p. 194) within the context of his chosen tasks, and yet he had to struggle with his teacher lust in order to produce this kind of engagement within the classroom.

Kilpatrick (1987) wrote of a general form of teacher lust within the mathematics classroom. He suggested that mathematics teachers are, "…especially likely to be afflicted with teacher lust, as, having just asked a student to explain something, they often jump in, with scarcely a pause, to provide a clearer explanation themselves". This form of teacher lust--telling what we know and demonstrating our knowledge to our students--can be evident in classrooms regardless of the epistemological stance a teacher holds.

It is germane at this juncture to discuss my choice to continue the use of the term teacher lust. I certainly am aware of the social connotation that using this terminology may evoke. In addition, using the term also automatically implies that teacher lust is bad. In addressing the social connotations, I submit a definition for lust that describes it as a "great eagerness or enthusiasm for something" (MSN, 2005). I believe that this definition captures the spirit of Mary Boole's (1931) original definition, and is applicable to the construct I describe within this study. In reference to the negative connotation of the word lust, I entered my study with the conception that teacher lust was something to be avoided, but the final verdict as to whether or not teacher lust is a good or bad thing will be discussed in detail within my results.

Theoretical Frame

Triangles of Operation

Teacher lust is a teaching action. And as such, it must be judged within the context of the particular classroom in which it occurs. Aside from the obvious effect students can have on a classroom, the act of teaching is also dependent upon two other main components of education: curriculum and learning theory. Each component has a direct effect on the other two. I conceptualize them as connected to each other in a triangle where each is linked to the other two.

The downward orientation to the triangle implies that learning theory and curriculum can work together to shape observable teaching actions.

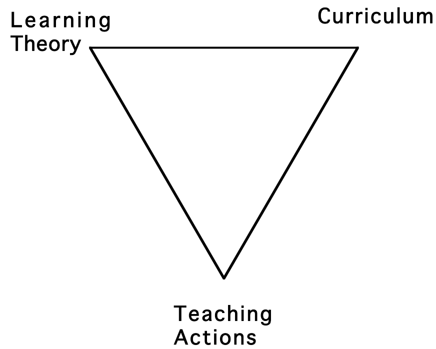

Figure 2. Generic form of a triangle of operation.

Learning theories have had a direct impact on American mathematics curricula. Conventional curricula are based largely upon the behaviorist theory. This was once the predominant view of American psychology, but psychological theories eventually shifted from behaviorism toward constructivism, and the response of mathematics education to this included the introduction of the "Standards" (NCTM, 1989, 2000), and from these, reform-based curricula. Just as curriculum is influenced by the learning theory it is based upon, the combination of a teacher's beliefs about learning and their employed curriculum will influence their classroom structure. Teachers embracing a behaviorist approach will often employ traditional teaching approaches and teach in what Boaler (1998) referred to as a closed classroom. Constructivist teachers employing reform-based curricula will have an open classroom structure (Boaler, 1998). In figure 3, I refer to the triangle connecting constructivism, standards-based curriculum, and reform teaching as the *open teaching triangle*. The triangle relating behaviorism, conventional curriculum, and traditional teaching is referred to as the *closed teaching triangle.*

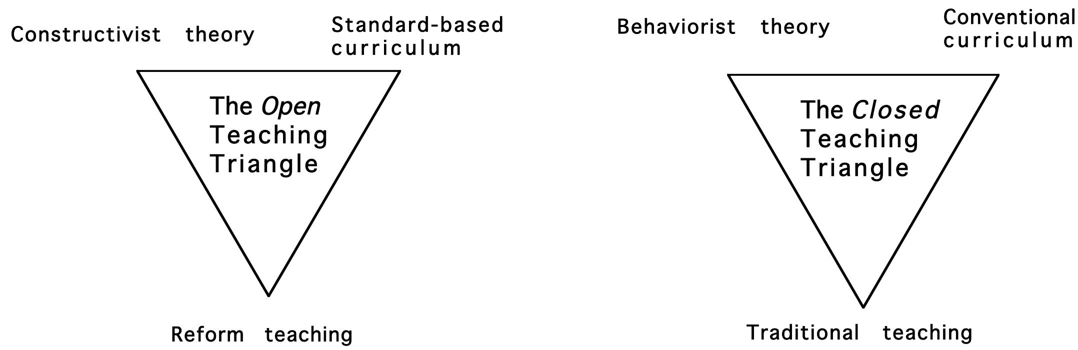

Figure 3. The open and closed teaching triangles.

Together, these two triangles form the extremes of a continuum of classrooms in which teaching actions can be situated. This is not to say that teachers always operate in the same manner; on the contrary, it is possible for teachers to shift fluidly along this continuum within a single lesson. Within my observations I looked for instances where the instructor made an observable shift from operations within the open teaching triangle to the closed teaching triangle, and marked these as potential instances of teacher lust. I then sought to understand the factors that influenced such shifts. In order to better frame this study I next turn my attention to describing each end of the continuum.

The Closed Teaching Triangle

Behaviorism was the prevailing psychology up through the 1960's. Based largely upon the work of Thorndike and Skinner, it greatly influenced educational methods. Behaviorism represents learning as a model of stimulus - response, where observable stimuli incite predictable, observable responses. Behaviorists believe knowledge originates outside of learners and can be directly transmitted to them verbally or through another form of sensory input. In this process the learner is a passive receptacle of knowledge and what is gained is an exact copy of reality (Labinowicz, 1980). They also believe that learning is linear and that new knowledge is amassed upon old. People who support the behaviorist view of learning posit that anything can be taught to anyone as long as it is broken down into simple steps and explained well. In doing this, a teacher would present small bits of information or skills in isolation from other related ones, so as not to confuse the student. This approach helps to discourage "intellectual conflict" within the learners, allowing them to be successful in acquiring the skill that is being taught (Labinowicz, 1980, p. 154).

A behaviorist teacher would explain a student's lack of understanding simply as a lack of sufficient exposure to the idea. That is, if a child could not perform an addition procedure correctly after the teacher has demonstrated it, then the teacher must show him the procedure again, and the student should practice it until it becomes an automatic response to seeing an addition problem. During this process it is important that the teacher give immediate feedback to the student based on the observable results of his work. She should praise the student if his actions were correct in order to reinforce the behavior. If the child is wrong, then the teacher must let him know this as well so that the child will alter his methods. Labinowicz offered the following simile, which I feel sums up the behaviorist learning approach: "The child is a passenger on a train traveling up a smooth and gentle grade, never clearly seeing where he is headed" (1980, p. 154). This statement emphasizes that the learner has minimal control over his own learning. He is simply along for the ride, all the while having no real idea *why* he is making the journey, only knowing that he needs to do so.

During most of the 20th century, the prevailing view of the educational process was influenced by Thorndike's work, which was in many ways the beginning of the behaviorist movement. His textbooks "emphasized a systematic approach to teaching arithmetic, with careful sequencing of tasks, designed to accumulate bits of knowledge. Drill on number facts and computation was dominant; little attention was paid to the interests of the child or to the practical uses of mathematics" (Senk & Thompson, 2003, p. 6). This approach, which states "mathematics should be taught by the force feeding on inert facts and procedures shorn of and real life context", is described by O'Brien as "parrot math" (1999, p. 434). Parrot math is a term I believe grows out of the 'I show and you mimic me' teaching process supported by the behaviorist viewpoint.

With this history in mind, I conceptualize the idea of traditional teaching as one that develops *instrumental understanding* in students. Instrumental understanding is on the far end of a continuum of understanding and is described as students having ideas that are held in isolation from each other with little or no connection between ideas (Skemp, 1976). Given that the behaviorist approach to teaching includes breaking down complex ideas into smaller pieces and then presenting them in isolation from each other, it is not surprising that instrumental understanding results. Traditional teaching focuses on developing procedural fluency without necessarily developing conceptual understanding of the procedures. Completing arithmetic exercises using the traditional algorithms is both valued and accepted. Definitions, procedures, and formulas are given to the child in formalized mathematical terms, which the student is expected to memorize, adapting their understanding to the textbook. Battista (1999) wrote, and I agree, that traditional school mathematics today is very similar to the mathematics experienced by adults when they were in school.

> School mathematics has been seen as a set of computational skills; mathematics learning has been seen as progressing through carefully scripted schedules of acquiring those skills. According to the traditional view, students acquire mathematical skills by

> imitating demonstrations by the teacher and the textbook. They acquire mathematical concepts by "absorbing" teacher and textbook communications. (1999, pp. 428-429)

Mason (1998) proposed another construct that is useful in describing this type of teaching. He depicted a dyad of working *through* problems and working *on* problems. In Mason's view, to work through problems is to "do individual questions one after another with little or no attention paid to what is the same and what different between them" (Mason, 1998, p. 2). A teacher who encourages his students to work through problems in this manner often gives assignments such as "Complete all of the even numbered questions on pg. 124." This approach stems from a behaviorist view and is supported by traditional curriculum materials. In contrast, working on problems involves thinking more about the connections, context, and application of a problem. We can examine textbooks to see how much generalization and specialization is done for the student; how much they are explicitly encouraged to do for themselves; and how much they are asked implicitly to do (Mason, 1998). In traditional teaching, mathematics is presented as a finished product that can be transmitted to students for memorization. It does not often call for the students to think mathematically. Doing so might engage the students in the intellectual conflict that behaviorism attempts to avoid.

The Open Teaching Triangle

In the preceding paragraphs I characterized teaching actions associated with the closed teaching triangle. What follows is a conceptualization of the open teaching triangle, its tenants, and approaches. Constructivism is an epistemological stance that has implications for learning theory that is largely influenced by the work of Piaget, Dewey, Vygotsky, and von Glasersfeld. Its philosophy is set in direct opposition to the behaviorist view of the learner as a passive receptacle of knowledge. Instead, constructivists assert that people are always actively constructing their own knowledge, regardless of the method of instruction. The process of construction is not linear, where new knowledge builds upon old; learning is seen as a reorganization of the learner's conceptions. These reorganizations are prompted through a state of perturbation, which is an intellectual disequilibrium in which current notions conflict with new experiences. Learning is the resolution of this disequilibrium as the learner goes through a process of accommodation to reorganize his conceptions. Steffe (in press) defined this reorganization as a modification of schemes, which can only take place in the presence of perturbation.

Also important to the theory of constructivism is its stance on the nature of reality and truth. Whereas behaviorists presuppose a reality that can be known and transferred, radical constructivists posit there is no universal truth, and instead, the notion of truth is replaced with that of "viable models." As von Glasersfeld wrote, "What matters is whether or not the particular conceptualization functions satisfactorily in the context of which it arises" (1985, p. 96). That is to say, for each individual, something is known as "true" so long as his concept of the idea holds for his experiences. Consequently, each individual maintains his or her own sense of reality and truth.

In applying this philosophy to mathematics education, constructivists promote a view of teaching and knowledge that is extremely different than behaviorism. Teaching with a constructivist approach does not involve teachers' attempts to impose their knowledge on the student, but rather places understanding the students' conceptions of mathematics as the focus of the work. Ernst von Glasersfeld echoed this sentiment:

> If then we come to see knowledge and competence as products of the individual's conceptional organization of the individual's experience, the teacher's role will no

> longer be to dispense "truth", but rather to help and guide the student in the conceptual organization of certain areas of experience. Two things are required to do this: on the one hand, an adequate idea of where the student is and, on the other, an adequate idea of the destination. (1983, p. 15)

In order to know where the student is, the teacher attempts to construct a model of the student's conceptions through a process of listening and questioning. The model is continuously revised through the course of the interactions with the student. In parallel, the teacher is choosing and posing additional questions that can help the student move to a higher level of understanding. The teacher also attempts to discover misconceptions in students' thinking. When found, the teacher's goal is to place the student into a state of perturbation, perhaps by offering a counter example, which will allow the student to reconfigure his knowledge through accommodation. "Reform-based curricula" were designed to align with and foster the vision of school mathematics offered by National Council of Teachers of Mathematics (NCTM). This vision was first presented in the 1989 *Curriculum and Evaluation Standards for School Mathematics* and was further defined with the release of the *Professional Standards for Teaching Mathematics* (1991), the *Assessment Standards for School Mathematics* (1995), and the 2000 release of the *Principles and Standards for School Mathematics* (PSSM). But these documents alone did not define a curriculum. They distilled ideas that are now associated with reform-based curricula and articulated in one document some of the fundamental tenets of the reform movement in mathematics education.

In the 1989 Standards the prevailing message was that all students need to develop *mathematical power,* a term that "denotes an individual's abilities to explore, conjecture, and reason logically, as well as the ability to use a variety of mathematical methods effectively to solve non-routine problems" (NCTM, 1989, p. 5). Further, NCTM presented five important goals for all students of mathematics: "(1) they learn to value mathematics, (2) they become confident in their ability to do mathematics, (3) they become mathematical problem solvers, (4) they learn to communicate mathematically, and (5) they learn to reason mathematically" (NCTM, 1989, p. 5). The 1989 Standards also proposed that instruction should move away from teaching mathematics with a heavy reliance on students memorizing facts and rules to an approach that places more emphasis on children employing technology and engaging actively in solving realistic problems (NCTM, 1989). This view is consistent with von Glasersfeld's notion that "Mathematical knowledge cannot be reduced to a stock of retrievable "facts" but concerns the ability to produce new results" (1983, p. 10).

But the NCTM Standards documents only present a vision of what mathematics teaching, learning, and curriculum might look like; they leave the realization and implementation of these ideas up to the education community. What would a classroom look like when employing reform curricula? Battista wrote this interpretation of this vision:

> In the classroom environment envisioned by NCTM, teachers provide students with numerous opportunities to solve complex and interesting problems; to read, write, and discuss mathematics; to formulate and test the validity of personally constructed mathematical ideas so that they draw their own conclusions. (1999, pp. 427-428)

Hiebert (1999) presented four features of primary school teaching methods that are consistent with a reform approach. Such teaching methods"(1) build directly on students' entry knowledge and skills; (2) provide opportunities for both invention and practice; (3) focus on the analysis of (multiple) methods; and (4) ask students to provide explanation" (Hiebert, 1999, pp. 13-14). Both Battista and Hiebert present a picture of classrooms in which children are actively thinking about mathematics, which implies that the teacher is a facilitator, rather than a dictator, of knowledge creation.

To summarize, reform teaching has at its heart the goal of developing both procedural and conceptual knowledge simultaneously, or what Skemp (1976) termed *relational understanding*. Relational understanding is having an "understood idea associated with many other existing ideas in a meaningful network of concepts and procedures" (Van de Walle, 2004, p. 24). In reform teaching, there is an emphasis on students developing their own knowledge so they may judge the validity of mathematical ideas for themselves. The authority does not lie in the teacher or the textbook but is collectively held by all members of the classroom. Students are encouraged to develop concepts, procedures, and definitions for themselves, with the teacher and technology acting as facilitators of their development.

Telling and Teacher Lust

Having described the pedagogical approaches associated with each of the triangles of operation, I next examine literature related to their implementation. What follows is a description of the construct of teacher lust as it is related to the discourse of the classroom.

Teacher lust has a direct connection to discourse. As teacher lust is primarily a verbal action that occurs within the classroom dialogue, I have different choices in framing it in terms of discourse. One way to connect teacher lust and discourse is in terms of telling. Telling can describe different sorts of actions depending upon what is being told, when it is being told, how it is being told, and why it is being told (Lobato, Clarke, & Ellis, 2005). I propose that teacher lust is related to the intent behind what is told within a classroom. I describe two different intentions of telling, one closely related to the closed teaching triangle and one associated with the open teaching triangle. These descriptions will help define the framework with which I analyzed my data.

Within the curriculum of the closed teaching triangle, the procedures, definitions, and formulas are presented to the student directly (either by the teacher or the textbook) for the purpose of students' replication and memorization. This instance of telling has been described in the literature as *traditional telling.* Traditional telling is commonly based upon Smith's definition (1996), which is based upon the results of research that examined teachers' beliefs, knowledge, and practice. In Smith's view, traditional telling is an action that is a result of teachers holding the following views:

- Mathematics is a static set of facts and procedures.
- The teacher's task is to provide easy to follow steps and procedures to solve the given problems and give students ample opportunities to practice said procedures.
- Students can and will learn simply by repeating the steps in the teacher's demonstrations until they can do so with little effort.
- The textbook is the source of authority for the classroom and for all of mathematics in general.

Smith suggested that teaching by telling is a pedagogical result of these beliefs and "refers directly to the central teaching action of demonstrating the proper sequence of steps in mathematical procedures" (1996, p. 391). Traditional telling plays a crucial role in the closed teaching triangle. Teachers operating in this mode seek to develop students who are fluent in performing calculations correctly. If this form of telling did not take place in the classroom, either through teacher talk or through the reading of the text, how would the students develop their procedural knowledge? Telling information is the logical means to accomplish the learning goal of the closed teaching triangle.

There are other facets of traditional telling that can play a role in the closed teaching triangle. Students are asked to work through many exercises, and they expect the teacher (or the textbook) will determine whether or not they have done them correctly. During the course of a typical class, teachers must also tell to maintain their roles as the keepers of knowledge. In this case, telling can range from giving students correct answers to responding to students with a judgment of validity (Chazan & Ball, 1999). This is also an important part of behaviorist learning theory because immediate feedback allows the teacher to reinforce preferred behaviors. In the closed teaching triangle, the textbook represents not only all of the answers but all of the questions that can be asked about mathematics as well. The teacher is forced into a position of telling the students if they are correct or not. Otherwise, how else would they know?

Lobato et al. (2005) offered "with traditional telling, the intention is typically that students will reproduce a procedure or definition" (p. 110). They also talk about the drawbacks of traditional telling and offer these six undesirable results of taking this course of action:

> [Teaching by telling] (a) minimizes the opportunity to learn about students' ideas, interpretations, images, and mathematical strategies; (b) focuses only on the procedural aspects of mathematics; (c) emphasizes the teacher's authority as the ultimate arbiter of mathematical truth rather than developing the student's responsibility for judgments of mathematical correctness and coherence; (d) minimizes the possibility of cognitive engagement on the part of the students; (e) communicates to students that there is only one solution path; and (f) represents premature closure to mathematical exploration. (p. 103)

These drawbacks are directly connected to the construct of teacher lust. As is offered, traditional telling shifts the focus off of students' mathematics and onto the mathematics of the teacher or the mathematics emphasized by the textbook's authors. It removes opportunities for students to engage actively in the mathematics at hand and limits student exploration. These facets are aligned with Mary Boole's (1931) original definition of teacher lust.

Within the open teaching triangle, telling takes on a much different role. The curricula are designed so that the teacher cannot be the sole keeper of knowledge. Although traditional telling may still be a small part of classroom instruction in the open teaching triangle, it certainly is not the primary mode of instruction. In order to describe the type of telling associated with standards based curricula, I return to the notion of what is told, when it is told, how it is told, and why it is told and illustrate how the following approaches stand in marked contrast to traditional telling.

The idea of what to tell in relation to the open triangle is similar to the closed teaching triangle and often stems from a teacher introducing new information to the class. The distinction between the two approaches however, is in the intent of the telling. In the closed teaching triangle, introducing facts is done with the expectation the students will mimic or memorize what is told. In the open teaching triangle, facts and ideas are presented as something to consider and not a prescription of what to do (Lobato et al., 2005). This approach, while still a form of telling, respects the mathematics of the students and encourages them to decide how this new information might best be used. This form of telling can serve as a perturbation. Another example of this type of telling is utilized in the process of problem solving in the classroom. Often times the teacher may need to introduce information to the students so they can continue with their problem solving approach. For instance, when I have had middle grade students solve a problem such as "How many different ways are there for a football team to score 15 points?" I often have to introduce scoring procedures and football-related terms to my class so the students can effectively engage in the problem.

Chazen and Ball (1999) offer other examples of telling that are appropriate within the open teaching triangle.

> Teachers may attach conventional mathematic terminology to a distinction that students are already making. They may return an issue to the classroom "floor": re-playing a comment made by a student or reminding students of a conclusion on which they have already agreed. (p. 2)

Underlying these examples is a tacit understanding that though the teacher is doing the talking; the students and their mathematics are the focus of the work. This is indicative of the tenants of constructivism and of the open teaching triangle.

This issue of when to tell is an important facet of working within the open teaching triangle. Premature telling can close off the avenues of exploration before students have an opportunity to fully engage with a problem. Teachers should thoughtfully consider the consequences of giving in to this action as it can limit the potential for students to construct knowledge. On the other hand, if telling is never done, the teacher runs the risk of placing all of the responsibility upon the student to make sense of the mathematics. Hiebert et al. (1997), wrote, "The hands-off approach is overly conservative. It overestimates students' ability to make sense of powerful ideas and ways of thinking that teachers can share with them" (p. 30).

One way to mediate these extremes is through the use of judicious telling. Judicious telling supports students' learning and reasoning by introducing pieces of important information at critical junctures. This allows teachers to bring their mathematical knowledge into the classroom, but in a way that augments their students' efforts to make sense of mathematics (Smith, 1996). "An important feature of the judicious telling model is that the teacher is no longer viewed as the sole source of knowledge, but still has some freedom to introduce new knowledge into the classroom" (Lobato et al., 2005, p. 107). This method of choosing when to tell respects the knowledge of the students and maintains the focus on their understanding of the material.

Chazan and Ball also suggested that telling can be an important tool when managing disagreements in the classroom. The open teaching triangle supports students' discussions of mathematical ideas, and managing these discussions is a large part of the teacher's role. In the process of classroom discourse, often times students get into heated debates about what is right. This type of "unproductive disagreement – disagreement unaccompanied by reflection" (Chazan & Ball, 1999, p. 8) needs to be mediated by the teacher so the discussion maintains its value and can be moved in a positive direction. Similarly, discussions can raise instances of "unreflective agreement among students; [where] the disagreement is between students and the mathematical community, represented by the teacher"(p.8). In this case, the teacher may need to introduce other ideas to serve as counter examples to students' misconceptions.

Mason's Six Modes of Interaction

Mason's six modes of interaction provide the final framing for this study. These interactions represent teacher actions and pedagogical approaches, which I associate with the open teaching triangle. He conceptualizes the interactions between expert and novice within the realm of mathematics as a triangle that relates tutor (teacher), student, and content such that one of these three "impulses" acts upon another while being mediated by the third (Mason, 1998). In Figure 4, the triangle shows the possible role of each impulse (tutor, student, and content). The impulse situated at the top vertex of the triangle acts (in the affirming role) on the impulse located at the bottom vertex (the responding role) with the third impulse, situated on the side vertex, acting as the mediator. For example in Figure 4, the teacher acts on the content and is mediated by the student.

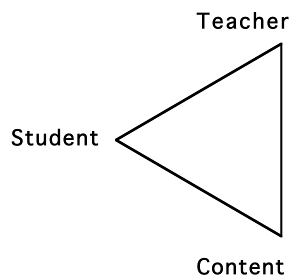

Figure 4. The generic form of Mason's impulses.

Simple combinatorics tells us that there are six distinct ways in which this can happen, which correspond to Mason's six modes of interaction: *Expounding, Explaining, Exploring, Examining, Expressing, and Exercising* (see Figure 5). He referred to these as the six Ex's. Each of these modes of interaction is important as each can and usually does occur within a single teaching lesson. My goal is to differentiate each of these modes from traditional telling and demonstrate how these modes of interaction can play a role in instruction in the open teaching triangle. Further, I explain how each of these modes interacts with teacher lust and how these modes of interaction were used to analyze my data.

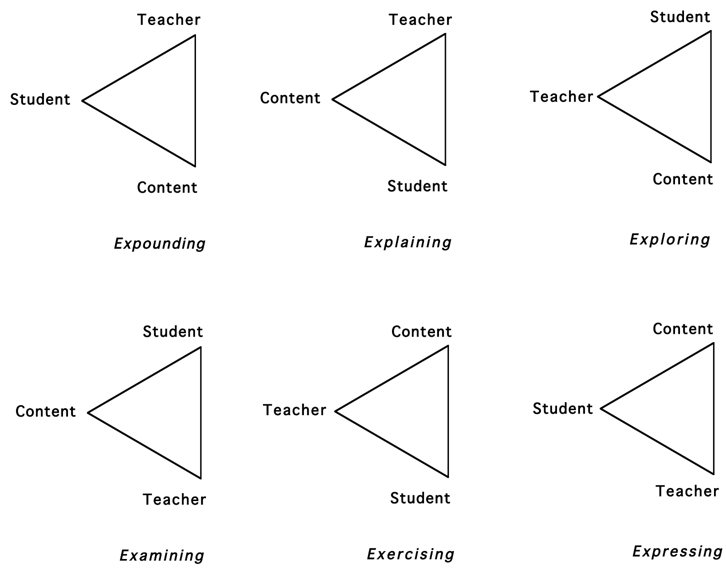

Figure 5. The six modes of interaction.

Expounding is a connection between the teacher and the content that is mediated by the student. In Mason's sense of the word, expounding does not include an authoritative slant. That is, the goal of the exposition is not "telling others what to do and how to do it, often without justification or purpose" (Mason, 2003, p. 4). Expounding is not simply talking at or to students; it is a moment where the teacher shares his connection to the mathematics with the students and does so in a way that connects to students' experiences and engages them in the discussion. In a sense, it is the moment where a teacher develops connections in his own content knowledge, as a result of presenting the material to an audience. The point of the exposition is to engage the students in thinking about their mathematics, not merely to communicate a procedure or fact. This is what makes expounding a plausible form of telling within the open teaching triangle. However, teachers who seek to operate within this mode can be susceptible to instead engage in acts of teacher lust. If the teacher is not connecting the material to the students' understandings and experiences, but rather is delivering it from his own mathematical viewpoint, he is not expounding. Mason referred to this as being in an *expository mode*, which "drags the students back into the teacher's world" (2003, p.7). Mason's description of the expository mode is akin to engaging in an act of teacher lust; the teacher is imposing their own understandings onto the students and expects them to directly assimilate the information. This implies that a teacher who intends to act in an expounding must not only connect with the content in a meaningful way for themselves, she must also ensure the students can understand the connection as well.

Explaining occurs when the content brings the student and teacher together. The teacher initiates this interaction but does not do so by imposing his mathematics upon the students. Instead, his goal is to make contact with the current understandings and conceptions of the students. This can be accomplished by questioning as well as by telling, as long as the intent is focused on the students' conceptions and is not an attempt to transmit the mathematics of the teacher. As long as the teacher actively tries to enter the world of the students and allows the focus to be on the students' understanding, he is acting in Mason's explaining mode. However, this mode of interaction can also result in teacher lust if the teacher instead reverts to traditional telling where the mathematics of the teacher or textbook is presented and the students are then asked to assimilate it.

When the students are acting directly on the content, they are in a state of *exploring*. The teacher then acts as the mediator between the students and the content. The role of telling during this interaction is based upon the concept of scaffolding. Telling, as a form of scaffolding, is to pose questions or ideas that help give the students enough structure so that they may engage in the problem while not reducing the level of the task. Over the course of time, these structures are gradually taken away until the students are able to perform the work alone. However, if done incorrectly the teacher's attempts to scaffold problems can lead to teacher lust. It is possible that attempts to help students engage can instead result in the teacher "doing" much of the work for the students. Similarly, scaffolding "hints" can be presented prematurely or at inopportune times and can reduce the level of the task by allowing the intended mathematics to "decline into procedures without connections to meaning" (Stein, Schwan Smith, Henningsen, & Silver, 2000).

Examining occurs when students interact with the teacher though the content. One form of this interaction is the method by which students "verify their own criteria against that of the expert, the teacher" (Mason, 1998, p. 6); in plain words, this is to engage in a form of assessment. Mason noted that this examination is not simply answering questions and having their validity judged. Rather, "it is the culmination of formal education in which the student shows that they have internalized not just the content, but the criteria by which understanding is judged" (1998, p. 6). This interpretation of examining was not as useful in my study, but Mason also used this mode of interaction to describe moments when a teacher chooses to follow up on an idea raised by a student in class. In this case, examining can be an impetus for the teacher to enter a state of expounding or explaining. However, examining can also give rise to incidents of teacher lust if the idea spurns the teacher to enter an expository mode and present information solely from his understanding.

Exercising is the act of teachers choosing and structuring tasks so that the content can act upon the students. The goal of this mode is to select and set up tasks that allow students to shift into an examining mode. This is different from simply setting a number of problems for routine practice. Task selection is an important factor in student learning and this mode of interaction can directly influence teacher lust. Overly structured tasks can remove agency for sense making away from the student. This can be a form of teacher lust.

Mason's definition of *expressing* is "that delightful moment when there is a welling up of energy and you cannot stop yourself from saying to someone, 'Look at this…'" (Mason, 1998, p. 6). In this mode the content takes over and acts upon the teacher. The exchange is mediated by the students but solely as witnesses to the expression; they are not expected to learn something from it. Expressing will often stimulate a teacher to shift into an expository mode. This mode of interaction can be taken as a possible description of teacher lust as the teacher is swept up in the moment of mathematics and needs to share his understanding. It is also possible, though rare, that a student is caught up in a moment of expressing. This can also trigger a shift in modes of interaction. Again, this might possibly influence the teacher to enter an expounding or explaining mode but also could serve as an impetus for teacher lust.

I used Mason's modes of interaction to form a framework to identify potential incidents of teacher lust within the classroom. I examined the classroom data and categorized teaching episodes with the six modes of interaction. Then, I examined the interaction and compared what I observed to the intended actions of the teacher, as revealed in interviews. I marked interactions as examples of teacher lust if it seemed that the teacher was attempting to act within one of Mason's modes but did not do so within the approaches associated with the open teaching triangle. This process allowed me to identify potential episodes of teacher lust to analyze and discuss with my participants. This methodology is detailed further in Chapter 3.

Related Literature

This study focused on the construct of teacher lust, its antecedents, and potential changes within teachers who are educated about the phenomenon. As this is a new undertaking for the field of mathematics education, I employed established literature to set my study within the context of current research. In the process of answering my research questions, I also utilized concepts from other research that further connects this construct to the field. This study on teacher lust is based within the topics of teacher knowledge, teacher beliefs, and teacher change. In the sections that follow, I present a brief overview of each of these concepts. The purpose is not to redefine these constructs. Rather, my goal is to offer a short summary of the literature in order to situate my results within it.

Teacher Knowledge

In his landmark article, "Those who understand: Knowledge growth in teaching" (1986) Lee Shulman proposed three distinct forms of teacher knowledge: content knowledge, pedagogical content knowledge, and curricular knowledge. Content knowledge is knowledge of the subject matter at hand. For mathematics instructors, adequate content knowledge involves an understanding *that* something is so as well as *why* it is so (Shulman, 1986). Pedagogical content knowledge includes

> …for the most regularly taught topics in one's subject area, the most useful forms of representations of those ideas, the most powerful analogies, illustrations, examples, explanations and demonstrations – in a word, the ways of representing and formulating the subject that make it comprehensible to others. (Shulman, 1986, p. 9)

Curricular knowledge is an understanding of the various materials that could be used for a particular level of instruction, as well as knowledge of situations in which each may be appropriate. Teachers use these different types of knowledge simultaneously when making pedagogical choices within the classroom. In a sense, these compose what Shulman described as an "intellectual biography – that set of understandings, conceptions and orientations that constitutes the source of [teachers'] comprehensions of the subjects they teach" (Shulman, 1986, p. 8). And, as knowledge impacts classroom actions, it is feasible that these domains of knowledge, which comprise mathematics teacher knowledge, will have some impact on the effects of teacher lust.

Fernandez's (1997) study on mathematical knowledge and its impact on how teachers react to unanticipated student responses is particularly relevant to my study. First, she examined how teachers used their knowledge when faced with unanticipated mathematical or pedagogical instances. Second, and perhaps more importantly, she asked teachers to do so using a "Standards-like" response (Fernandez, 1997, p. 1). Within my framework, this is akin to working within the open teaching triangle, and I hypothesized that these instances of unanticipated student response would be ripe with potential for teacher lust.

Fernandez described five categories of teacher responses to these instances: generating counter examples, following through with a student misconception, posing a similar yet simpler problem, making sense of and incorporating student approaches, and making sense and incorporating an "alternative" method. (The difference between the latter two is in the last approach, the teacher does not immediately understand the approach being offered by the student.) In her study, Fernandez also described teacher conflicts between acting within a traditional or standards paradigm, "situations in which the teachers describe struggles within themselves, between themselves and their students, or amongst students over whether to emphasize certain traditional or standards-like aspects of mathematics problem solving" (Fernandez, 1997, p. 21). This struggle can be associated with the feelings of teacher lust and a desire to revert to operating within the closed teaching triangle. Fernandez cited reasons such as a desire to "cover" conventional methods, a lack of success in "standards-like" approaches, and a lack of time as causing these conflicts within teachers. I was interested to see if similar antecedents were observed within my study of teacher lust.

Teacher Beliefs

A teacher's actions within the classroom can be dependant on, or at the least, related to, their beliefs. This statement is often supported with René Thom's quote, "all mathematical pedagogy, even if scarcely coherent, rests on a philosophy of mathematics" (1973, p. 204). If this statement has merit, then it makes sense to assume that beliefs can impact the construct of teacher lust. In this section I examine the difference between belief and knowledge and present the system of organization in which beliefs will be discussed within this study.

There has been a myriad of research done in the area of teacher beliefs. Much of it was summarized/synthesized by Thompson (1992). Within this chapter, Thompson discussed the differences between beliefs and knowledge. This distinction is important as these two concepts are often intertwined; the notion that teachers often treat their beliefs as knowledge compounds this fact (Thompson, 1992). Pajares (1992) presented four characteristics of beliefs that define the differences between the constructs: 1) existential presumption, the personal truths everyone holds that are beyond individual control; 2) alternativity, an attempt to create an ideal teaching environment; 3) affective and evaluative loading, the idea that beliefs have stronger affective components than knowledge; and 4) episodic structure, the impact of personal experience on belief. Each of these components suggests beliefs are a personal construct. Further, beliefs can be held with varying levels of conviction and the understanding that not all people may believe the same thing. In contrast, knowledge has the connotation of being universally accepted and is judged solely as being right or wrong.

Aside from the ideas behind what constitutes belief are the ways that mathematical teachers' beliefs can be described, categorized, and explained. The literature has provided me with several different ways that researchers have classified and explained the beliefs held by mathematics teachers on the nature of mathematics (Ernest, 1988; Lerman, 1990; Pajares, 1992; Thompson, 1992). This area of belief research is especially important to my work on teacher lust as my data suggested that beliefs regarding the nature of mathematics played a role in how teachers exhibited lust. I decided to employ Ernest's views on this subject. Ernest (1988) described three different conceptions of mathematics: the problem solving view, the Platonist view, and the instrumentalist view. Those who hold a problem solving view maintain that a process of enquiry generates mathematics. Mathematics is not a finished product but an expanding field of human creation and invention. Those who hold the Platonist view believe that mathematics is monolithic, "a static but unified body of knowledge," (p.10) which is discovered and not created. Those holding an instrumentalist view of mathematics believe that it is as a set of "unrelated but utilitarian rules and facts" (p. 10) that are to be accumulated and employed as tools.

Ernest's descriptions of different views on the nature of mathematics are well defined but difficult to apply based solely upon classroom observations. However, they are connected to the four main models of mathematics teaching offered by Kuhs and Ball (1986), which classify mathematical teaching approaches based upon research on learning and teaching as well as philosophies of education and mathematics.

> 1) Learner-focused: mathematics teaching that focuses on the learner's personal construction of mathematical knowledge; 2) Content focused with an emphasis on conceptual understanding: mathematics teaching that is driven by the content itself but emphasizes conceptual understanding; 3) Content-focused with an emphasis on performance: mathematics teaching that emphasizes student performance and mastery of

mathematical rules and procedures; and 4) Classroom-focused: mathematics based on knowledge about effective classrooms. (p. 2)

The learner-focused view is most closely associated with constructivism and with the problem solving view of mathematics. The role of the teacher in this approach is that of a facilitator and a poser of questions and explorations. Within the framework of this study, this approach is aligned with the open teaching triangle. The second view takes the content as the focus of the classroom, and encourages the students to develop understandings of ideas and processes. This approach is closely associated with the Platonist view of mathematics. Within the continuum of the triangles of operation, this mode would lie just to the right of the open teaching triangle. The focus of the teaching is still on the students' conceptions of mathematics, but the course is driven not by student inquiry but by a scope and sequence of mathematical content. This approach also contains underpinnings of constructivism. According to the authors, this approach differs from the other three in its "dual influence of content and learner. On one hand, content is focal, but on the other, understanding is viewed as constructed by the individual" (Kuhs & Ball, 1986, p. 15). The approach most aligned with the closed teaching triangle is the content focused with emphasis on performance. The emphasis on performance is a natural extension of an instrumentalist view of mathematics. In this mode of instruction the teacher is expected to "demonstrate, explain, and define the material, presenting it in an expository style" (Thompson, 1992). The classroom-focused model is not based upon any particular learning theory, but rather on the notion that students learn best when lessons are well structured and organized. This mode does not necessarily fit within the continuum of my framework. In Figure 6 I have connected Ernest's views on beliefs with Kuhs and Ball's conceptions of teaching approaches and placed them along the continuum between the open and closed teaching triangles.

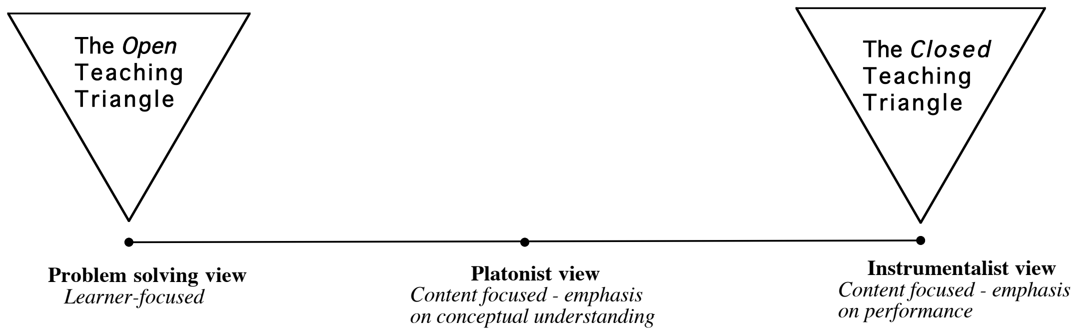

Figure 6. Connecting the triangles of operation with Ernest's and Kuhs and Ball's work.

It is important to note that a teacher's beliefs are not the only thing that drives instructional practice. Frequently, instructional practice is mediated by such external factors as time, perceptions of an administrator's expectations, a mandated curriculum, state testing, and students' reactions (Raymond, 1997; Skott, 2001; Thompson, 1992). The participants in this study were influenced by some of these factors, and there was a clear relationship to the manifestation of teacher lust.

Teacher Change

One goal of this study was to examine the potential for change in my participants' dealings with teacher lust as they became more familiar with and aware of the construct. However, I did not engage them in a formal act of professional development to instigate this change. Rather my intent was to raise their awareness of the construct, discuss instances of it within their practice, and examine this effect on the instance of potential change. Cuban (1988) differentiated between first-order and second- order change. First order change is a minor change in the teacher's practice. Second-order change is more significant, as it involves a change in a teacher's thinking, teaching, or learning. Given the short time frame of the study, it was unlikely I would observe second-order changes within my participants. What I expected to observe instead were indicators of such shifts. In light of this fact, I present a brief summary of the research connected to teacher change as it pertains to characteristics of teachers in transition.

Richardson and Placier's summary of the work on teacher change describes several researchers' stage theories. The various phases found within these stage theories can serve as points of reference as progress toward change is assessed. Two of the stage theories presented are especially relative to my study–those developed by Deborah Schifter, and by Wood, Cobb, and Yackel.

Schifter's theory (as cited in Richardson & Placier, 2001) addressed four distinct stages of teacher approaches that reflect their development toward becoming constructivist teachers. These four stages are as follows:

> 1) an ad hoc accumulation of facts, definitions, and computational routines; 2) student-centered activity, but with little or no systematic inquiry into issues of mathematical structure and validity; 3) student-centered activity directed towards systematic inquiry into issues of mathematical structure and validity; 4) systematic mathematical inquiry organized around investigation of "big" mathematical ideas. (p. 912)

These stages can be placed on the continuum between the open teaching and closed teaching triangles. Stage four would be closely associated with the open teaching triangle, and stage one would be associated with the closed teaching triangle.

Schifter's ideas can be augmented with the work of Wood, Cobb, and Yackel (1991), who presented three stages of development of the role of teacher from (a) teaching mathematics as a procedure-oriented subject to (b) encouraging student sense making and attempting not to impose his or her way of doing mathematics to (c) not having to impose knowledge onto students. The interplay between the second and third stages in Wood et al's work describes the tension teachers experience as they attempt to place the focus on students' mathematical sense making. This struggle can be equated with the feelings of teacher lust.

Having a theory to identify stages and examine instances of change is useful but was not enough to describe my participants' possible shifts. It is also germane to examine factors that can act as an impetus for change. Some of these factors are experiential. Richardson and Placier (2001) cited biographical studies that proposed the notion of critical incidents in a teacher's life, which can act as motivation to change. Similarly, Mewborn and Tyminski (2004) suggested that preservice teachers can recall specific and vivid experiences from their own educations and reflect on them in productive ways. These experiences can allow teachers to break with Lortie's (1975) "apprenticeship of observation" and serve as motivation to change their practice.

Other impetus for change can be internally developed. Goldsmith and Schifter (1997) cited Vygotsky's idea that "significant change is linked to the acquisition of new mediating tools and signs" (p. 44). They employed this notion to suggest that teachers' language development is an important indicator and needed component for change.

> Without teachers developing new ways to describe classroom practice it is often difficult for them to consider how particular classroom events might relate to developing a pedagogy of mathematics teaching. (Certainly, however, acquiring a different vocabulary without having the opportunity to experience their classrooms in a new way will not help teachers to develop their practice. There must be a strong connection among thinking, talking, and doing.)" (1997, p. 45)

This was important to my study, as I introduced the term teacher lust into my participant's lexicon. I also engaged them in discussion and reflection on how teacher lust was connected to their practice. I hoped that giving them a way to describe these feelings and allowing them to discuss and reflect on their experiences would influence how they dealt with teacher lust in the future.

CHAPTER 3 - Methods

This chapter describes the process by which I selected my participants and also provides a narrative description of them. I also explain my data collection methods and the process I underwent in analyzing my data.

Participants

Participant Selection

Participant selection for this study was a crucial part of my overall research design. I wanted to select instructors that fit the following:

- Taught a mathematics content course for K-8 inservice or preservice teachers in Fall 2005.
- Operated within the open teaching triangle.
- Were geographically located within reasonable driving distance.

I justify each of these choices as follows.

Selecting instructors who taught a mathematics content course versus those who taught a methods course was an important distinction. Although teacher lust is certainly felt by instructors teaching a methods course, I thought a mathematics content course would be a more fertile environment to study. The questions that are raised within the moment of engaging in mathematics problems within a methods class are more likely to be dealt with directly, as the focus of the course is not on doing mathematics, but on thinking about how to teach the mathematics to children. If the instructor is aware of her feelings of teacher lust, she may feel more justified to give in to the teacher lust felt in that situation. However, in a content course, the focus is on the students understanding and doing mathematics for themselves. In this case, I think the instructor is less likely to be able to justify making the choice to give into teacher lust.

My choice to study courses for K-8 teachers was also carefully considered. One main reason for this choice is that my area of classroom teaching expertise lies within the K-8 field. I was confident that the course material would be well within my mathematical understanding, thus freeing me up to focus on how things were being presented, while not having to focus on understanding the material myself. This would not have been as true if I were studying an instructor of a graduate level course in numerical analysis, for example. A second reason to study this level of mathematics was that I am extremely interested in teaching these types of courses in the future. So, I would also be learning a lot about these courses themselves and how the instructors plan for them.

As was mentioned in Chapter 2, it was crucial to find participants who were mainly operating within the open teaching triangle. Instructors who operate mainly within the closed teaching triangle do not, in general, experience teacher lust in the manner in which it has been defined for this study. Therefore, I needed to make sure that I chose participants who reflected the tenets of the open teaching triangle. I wanted to find participants whose students would be asked to do mathematics problems in class and encouraged to discuss them with their peers and the instructor. I wanted participants who viewed the focus of their work as making sense of what their students did and did not understand.

I used purposeful selection (Patton, 2002) in order to choose my participants. I began by making a list of potential educators based upon recommendations from two mathematics education faculty members, taking into account instructor course schedules, proximity, and reputation of their epistemological stances. I narrowed that initial list down to five instructors.

One was in the mathematics education department, and four taught in the mathematics department. After compiling that list I sent emails to the five different instructors, asking them if I could visit their classrooms with the intent of looking for sites for my dissertation study. Four of the five instructors were agreeable to my visiting his classroom. I then spent the beginning part of the fall semester doing informal visitations within these classrooms to ascertain for myself how viable they would be as potential environments for teacher lust. After each visit, I talked informally with each instructor about the class and what type of classroom I was looking for in my study. Each of these four instructors was willing to discuss my research further.

The next stage of selecting participants came in the form of an initial interview. I approached all four candidates with a more formal description of my research and obtained consent for their participation. In the course of describing the project to them, I described my research as examining classroom discourse and teacher response to student questions. I did not talk about teacher lust specifically, as I did not want to place a potential taint on my participants' actions. I then conducted an opening interview (See Appendix A) with each participant, the goal of which was to collect background data on her teaching experience, the number of times she had taught the course I would be observing, her views of the purpose of the course, and her expectations for the students. I also asked questions designed to examine her beliefs regarding mathematics and teaching, as well as how she prepared to teach the class on a daily basis, and her views on office hours. After transcribing each of these interviews, I used the information within them to narrow my list of four participants to two. Descriptions of each of my four potential participants follow. These narratives were written from their interview responses. Within each description I also present my reasons for deciding whether or not to further pursue research within their classroom.

Participant Description

Sam

Sam held a doctorate in physics and had been an instructor of physics and mathematics for about 30 years. For the past four years, he had been working with preservice elementary school teachers. He was teaching the preservice elementary geometry course for the fourth time. We began the interview by discussing his goals for the course. Sam's goal was to develop students whose knowledge allows them to analyze the mathematical work of children. He wanted his course to help them obtain, "a deep enough understanding of the material so that they can be very flexible and have various points of view on a problem…The last thing you want the students to go out saying is 'here's *the* way to do it.' It doesn't leave too much room for creativity, [and] certainly doesn't help a student who is struggling and has a good idea," (Sam, interview 10/7/05). He tries to develop intuitive understandings within his students as well as procedural knowledge. In the geometry course he uses models to help students develop the intuitive understanding he feels they need.

When I asked him to describe what I would see in his classroom, he replied that there were days he would lecture for the entire period but that there were also times he would break up his lecture by assigning problems for the students to work on and then try to bring everything back together at the end of class. On rare occasions he would have the students working in small groups during the entire class session. Within the class Sam saw himself as the moderator of discussion, but he acknowledged that there was an authoritarian slant within this role because in his words, "I am the guy who knows the stuff" (Sam, interview 10/7/05). He seemed to see himself as the source of knowledge within the classroom and believed that his job was to give his students that knowledge. I give as evidence the following response in reference to his role in class.

> I think probably the major role is to be the figure that can give you information in a somewhat efficient way. Certainly mathematics is not something you can intuitively discover all by yourself. It has taken hundreds of years to develop this stuff; thousands of years to develop the ideas and we can't expect somebody to come up cold and invent it. On the other hand we want them to be creative and to be able to learn as much as they can, so I would say encourage them to develop themselves to learn, but I don't want them wasting a lot of time trying to discover something when it is not intuitive. (Sam, interview 10/7/05)

I ended the interview by asking Sam some questions designed to examine his beliefs about mathematics learning and teaching. The first question asked him to choose from a list of activities (working on an assembly line, watching a movie, cooking with a recipe, picking fruit from a tree, working a jigsaw puzzle, conducting an experiment, building a house, or creating a clay sculpture (Cooney, Wilson, Albright, & Chauvot, 1998) and to decide which one was most like learning mathematics. Sam chose working a jigsaw puzzle because he felt it was a good way of approaching a problem. "There are a lot of different strategies [that you can use], and in fact you probably use all those different strategies in order to put it all together" (Sam, interview 10/7/05). I then asked him how he best learned mathematics, and he said the process was a combination of both listening to experts and doing problems himself. He continued to say that he thought this was the way his students learned as well. "I try to assign regular problems that they work on–one or two writing assignments a week. [I] try to have them so they are doing that and listening to my ranting and ravings in front of the classroom, and hopefully they are learning something from both" (Sam, interview 10/7/05).

We then talked about the process of teaching mathematics. I asked him to choose from a list of activities (news broadcaster, entertainer, doctor, orchestra conductor, gardener, coach, missionary, or social worker) and tell me which one was most like teaching mathematics. Sam chose coach because, "a coach is someone who tells you, helps you learn a skill, and also learn the game you are trying to play. I think a lot of it is encouraging and showing how to do things, but ultimately they have to do it themselves" (Sam, interview 10/7/05).

Based upon his responses to his role in class and his views about teaching and learning mathematics, I decided not to select Sam's class for further research. His quote regarding students discovering rather than inventing mathematics reflects a Platonist view of mathematics. This would align him with the classification of "content focused with an emphasis on conceptual understanding" within Kuhs and Balls' (1986) scheme. His quotes also reflect what I saw within his classroom during a preliminary visit. During the 50-minute class, there was no significant student talk for the first 40 minutes of class. The only one doing any talking was Sam. To me, Sam appeared to be a person who relied on traditional telling as his main method of instruction and as such I would not classify him as operating within the open teaching triangle. This disqualified him as a potential participant.

Eric

Eric was an associate professor of mathematics within the mathematics department. He had extensive experience teaching college level mathematics courses, having served in this capacity for the past 32 years. Within the last five years, his teaching assignments had changed from a focus on pure mathematics courses to his current work teaching mathematics content courses for preservice and inservice elementary school teachers. During the semester of the study, Eric was teaching a section of the algebra course for preservice elementary school teachers. In working with this population of students, Eric's goal was for them to acquire a "more sophisticated view of mathematics," and to be able to "abstract [a given] problem in some way" (Eric, interview, 10/6/05). When I asked him to explain what he meant by a student having the ability to abstract a problem, he offered the example of students being able to use pictures to solve a problem such as "If a serving of ice cream is 2/3 of a cup and you eat 2 cups of ice cream, how many servings did you eat?"

For Eric, preparation for class involved writing notes and choosing examples that he thought the students would like. He collected homework nearly every day from his students and used it as a means to see what problems, if any, the students were having with the material. In addition to addressing potential issues raised by the homework, Eric chose problems to pose during class that would address the given topic of the day's lesson. Occasionally he used some of the class activities from the textbook, though he did not have his students work in groups when doing them. Instead, he chose to walk up and down the rows as students worked individually to get a feel for whether or not they were "getting" the material. When I asked him why he did not have the students work in small groups, he replied, "I guess sometimes what would happen is that they would start working in groups and one person would get it and they would stop. So, some person in the group would have done it the right way and so it would be over. Versus, when they are working sort of individually then they are less likely to stop when somebody else [gets it]" (Eric, interview 10/6/05). When describing his role in the classroom, he defined himself as the leader. "I definitely have to be the leader and try to steer it towards some goal. I'm sort of the problem poser certainly" (Eric, interview 10/6/05). He saw himself as the authority in the classroom, though he maintained that he made a point to tell his students that authority alone cannot be a justification for why something is done. Within his class, he said I would see his students taking notes on what he would be doing at the board, sometimes asking him questions, and hopefully asking others questions as well.

Eric said that learning mathematics is a cross between working a jigsaw puzzle and conducting an experiment. "Of course, [when working] a jigsaw puzzle you are trying to figure out how things fit together and that has something to do with mathematics. And when you are conducting an experiment you are trying to determine of something is true" (Eric, interview 10/6/05). In his view the best way to learn mathematics is by doing problems. In fact, he said that trying to learn passively, like from reading an article, would put him to sleep. He also believed that his students learned from doing problems and talking to each other about them. For him, teaching mathematics was most like being a doctor, "in the sense that you diagnose what people do and do not understand. You try to explain what's going on, you diagnose a problem, or what is wrong, or why a particular solution to a problem is diseased (laughing) in a sense," (Eric, interview 10/6/05).

Eric was not one of the participants in my study, largely because of his class schedule. The course he was teaching had a four-week field experience built into the middle of the semester, and his students were going to be in the field for the first two weeks of my data collection period. Within the given time frame, I did not think I would be able to see enough of his class to accurately portray his experiences with teacher lust. However, I think Eric would have been a very interesting participant. His beliefs on mathematics seemed to lie somewhere between Platonist and a problem-solving view. In terms of Kuhs and Ball's (1986) conceptions, Eric would fall within the classification of content focused with an emphasis on conceptual understanding. He professed a genuine desire to have his students understand mathematics in a sophisticated manner and was especially proud of his reputation as an instructor who encouraged discussion within the classroom. "I get high ratings for that, and I kind of pride myself on encouraging other people in that class, and in other classes, to ask questions. I may have even said in the past things like 'there is no such thing as a stupid question'" (Eric, interview, 10/6/05). It would have been interesting to see the tension within his desires to be the leader and the authority in the classroom and to simultaneously facilitate discussion and discourse play out in the classroom within the context of teacher lust.

Elizabeth

Elizabeth was a recent PhD graduate and was a temporary assistant professor in a mathematics department with a heavy proportion of her time assigned to instruction. Her position had a goal of promoting better collegiate teaching. As a graduate student, she taught for five semesters at the college level, including one semester teaching a content course for elementary teachers. Elizabeth said that her current course, the number course for elementary school teachers, was not really like the course she taught as a graduate student. Elizabeth's goals for her students included having a flexible understanding of mathematical ideas and being able to reason through the different procedures and algorithms and connect them to other areas of mathematics. Further, she wanted them to have an idea that mathematics is something that makes sense, and to understand that, "many of the things that we have in mathematics we have arrived at through reasoning and other things like conventions we need for a reason as well" (Elizabeth, interview 10/6/05). Her goal for herself was "to be better at encouraging students to think for themselves while still indicating that there is a body of mathematical knowledge out there that has to be respected" (Elizabeth, interview 10/6/05). Elizabeth contended that she would know from the types of questions her students ask if she had been successful in reaching her goals. Questions that pertain to multiple explanations or interpretations, rather than questions asking for 'the answer' or the rule would serve as evidence for her.

Class preparation was an involved process for Elizabeth. She planned along topic ideas rather than for a particular class period and began by reading the textbook and the activities it contained. Elizabeth was using the textbook commonly used with all of the mathematics courses for elementary and middle grades preservice teachers. As she read, she made decisions as to which ideas were most important for her class and which activities would highlight those ideas best. Elizabeth decided how much "set up" a particular problem required and either prepared a presentation to introduce it or wrote questions to pose that would help the students discover the idea on their own. She also wrote questions to use when students were working on and discussing the problems to help them think about the important ideas. Elizabeth had randomly assigned her students into small groups of 3 or 4 that she mixed up periodically. She expected that when they were working on problems in class, which was daily, that the students would begin by engaging in the problem by themselves. Following individual work time, they would discuss their ideas in their small groups. Within this discussion students might be working on understanding the solution and/or thinking about how to explain the solution to someone else. Eventually Elizabeth would ask one or two students to explain or write their solutions on the board. She would then lead a whole class discussion of the task in order to wrap it up.

Elizabeth saw herself as having several roles in class. In the beginning of an activity, she was the person who initially motivated the ideas. "I spend some time explaining what is going on. I also try and give some ideas for them to think about why what we are doing is important, so that as they are thinking about it they can reflect on why they are learning what they are learning" (Elizabeth, interview 10/6/05). While students were working and discussing problems in small groups, her role was to pose questions. Elizabeth said she used to walk around and talk to the students during small group but stopped doing it because "it didn't work" because she thought she was intruding on their learning process. She asked questions if students seemed to be stuck or not understanding the task at hand. During the whole group discussion, Elizabeth played the role of moderator. In this role she tried to get the students talking and questioning and would also highlight some of the important ideas in what was discussed.

When Elizabeth answered the question regarding which activity is most like learning mathematics, she chose building a house. She said building a house " …[has] a lot of constraints about how you go about doing it, to make sure a house is structurally sound…and there are a lot of standard practices that go into building a house. But that there is lots that you have to figure out on your own, where you are exercising your own thoughts about what is going on" (Elizabeth, interview 10/6/05). When Elizabeth talked about her own mathematical learning, she said she needed motivation for learning the ideas, time to struggle with the ideas alone, and an opportunity to solidify her knowledge by either discussing the idea with others or by giving a lecture on the material. Perhaps not surprisingly, Elizabeth had a similar view on how her students best learned mathematics.

> I think they need to struggle with ideas on their own, and so they need some place to start. [They need] some interest in what they are learning and also ways to connect it to what they have already learned. And then, having an opportunity to talk about those ideas with other people, to ask questions and to present their own understanding. (Elizabeth, interview 10/6/05)

For Elizabeth, teaching mathematics was like being a social worker.

> I imagine a social worker as someone who highlights someone else's situation, like the problems that they are having and possible avenues, or possible ways to fix it, but then it is up to the person to actually go ahead and resolve their situation. So, similarly I feel that I can provide a good environment for students to learn and give them ideas to think about that will help them advance their learning, but they really have to do the work on their own. (Elizabeth, interview 10/6/05)

I chose Elizabeth for one of the two participants to study. Based on what I had seen in her classroom and the way she described her goals for learning and teaching, I was inclined to place her into the open teaching triangle. She seemed to be focused on having her students make sense of the mathematics for themselves and viewed her role in the classroom, not as one of authority, but one of facilitator. I liked that she respected the conventions of mathematics while still believing that students should have a great deal of input into their own understanding of mathematics. She seemed to fit Kuhs and Ball's (1986) description of a learner-focused instructor. I hypothesized that Elizabeth would be inclined to feel teacher lust when operating in the manner she described.

Samantha

Samantha was a professor in a mathematics department. She had been teaching at the collegiate level for 19 years, 10 of which had been devoted to working with elementary and middle school preservice teachers. She recently spent a year teaching sixth grade mathematics at one of the local middle schools. She was the main architect of the mathematical content courses for teachers taught in the mathematics department and was also the author of mathematics content curricular materials for elementary and middle grades preservice teachers. Samantha was also an award-winning teacher. She had received the highest teaching honor given by her college.

Samantha was teaching a section of the number course and a section of the algebra course both for preservice middle school teachers during the semester I conducted my study. I was interested in potentially observing the algebra course. My choice on this was based on scheduling and because I wanted a course that contained different material from Elizabeth's course on number. Samantha's number course was a comparable class designed for middle school teachers and contains much of the same content. I wanted to have the potential to draw conclusions based on different content as well as different levels of students (middle vs. elementary). This was the first time Samantha was teaching this course, although she had taught all of the other elementary and middle courses several times before.

Samantha's goal for this and for all of the content courses she had designed was for the students to leave being prepared to teach mathematics. "Prepared in the sense that they know the mathematics well enough and they have thought about different ways of solving problems and different methods of presenting the mathematics so they will be comfortable in the classroom" (Samantha, interview 10/7/05). Samantha did not necessarily know how successful these courses were in accomplishing her goal of students being comfortable in the classroom, but through her examination of their homework, class discussions, and test responses she thought she could tell if they had developed an ability to explain the material in several ways. As she prepared a lesson, Samantha thought about which of the activities from her text she would bring into class and said that she often augmented her text with other people's ideas. As far as lecture was concerned, Samantha submitted that there is often "a snippet" of lecture in each class and that it was elaborated on depending on the topic being discussed, but for the most part, her focus was on deciding what problems to engage the students in. Samantha told me that I would see her students doing problems in class, and that she would have them work individually and then talk with a neighbor about the problem. She believed that her students knew the routine in her class and that they spontaneously began discussing problems shortly after working on them. These discussions in the class could best be described as a "buzz," and Samantha said she tried to eavesdrop as best she could during them, but she did not actively go out into the class and listen to what each group was discussing. Her students were responsible for doing the problems and then explaining their solutions. Sometimes the students came to the board to write out their solution; other times they would dictate it to her. Samantha described her role as that of a guide and said that her job was to make sure the students are "coming to terms" with the mathematics they will be required to teach. In order to accomplish this, she posed problems and asked them to discuss their thoughts and understanding of them.

For Samantha, creating a clay sculpture was most like learning mathematics.

> Because I think everybody has a certain amount of mathematical ideas at any given time, and I think what you are trying to do is mold those and build on them and refine them…You are trying to bring forth something out of some raw material that is there. And add to it also; I don't think it is all there and you're just bringing it out, it has to be acquired as well. (Samantha, interview 10/7/05)

Samantha's opinion about how her students learned best was similar to her own ways of learning. In both cases, she mentioned doing problems, struggling with them, and using a resource like a textbook or paper to "put it into a bigger framework." Although she also admitted that she did not know exactly how her students learned best, she was acting on the assumption that they learned as she did. In terms of teaching mathematics, Samantha chose gardener as the best match, "Because I guess I would view that I am trying to plant ideas in their minds and watch those ideas sprout and grow [laughing]" (Samantha, interview 10/7/05).

I selected Samantha as my second participant for the study. I had spent time prior to my study working with her in seminars and workshops and knew that she would make for a very interesting participant. She exuded confidence in her approach to education, and from my past experiences working with her, being in her classroom, and based upon her responses, I felt that I could classify her within the open teaching triangle. She strived to operate in a learner-focused manner (Kuhs & Ball, 1986) . I also felt that she was very interested in using the experience of my study to examine and discuss her practice, and that she was open to the notion of doing so.

Data Collection

Once I had decided on Elizabeth and Samantha, I went into their classrooms to obtain consent from their students to be videotaped. I set up a data-collecting schedule that allowed me to observe and videotape each classroom for an extended period of time on multiple occasions. I collected video data beginning in mid-October and completed my data collection in early December. I used a schedule that would allow me to spend the equivalent of six weeks within each of the two classrooms. This extended time frame gave me more opportunity to see the interactions I was looking for. Further, I found that the more time I spent in class, the more comfortable the instructor and students became with having me there, and I felt more confident that I was observing their natural interactions.

I made the choice to videotape each class session for several reasons. First, I believed that it might take multiple viewings to fully capture the subtleties of the interactions between the instructor and her students. Specifically within the confines of my framework, I needed to be able to examine each interaction closely in order to categorize and analyze it within Mason's modes of interaction. Also, I knew that I wanted to interview my participants about classroom episodes and I wanted to be able to show the video clips to my participants as we discussed them. Finally, as I plan to disseminate my findings through presentations, I wanted to have examples of teacher lust I could share in order to help my audience understand the types of incidents I was looking for.

I used a three-week cycle of data collection that was repeated three times during the course of the semester. For the equivalent of two weeks (roughly six class meetings), I videotaped each class meeting of both participants' classrooms and then conducted an interview with each individual participant during the following week. The protocols for these first interviews were based upon the class episodes (see appendix B). In order to better answer my research questions, it was important that I followed up my observations with interviews with my participants. I entered the study with a conception of teacher lust, which was informed by my own experiences and by Mary Boole's original definition. I wanted however, to also include my participants' conceptions as I answered the question "what is teacher lust?" Second, the interviews gave me the opportunity to talk with each instructor about the decisions she made in the act of teaching. These decisions were most likely mediated by thoughts, feelings, and circumstances, which may have served as the antecedents for teacher lust. Finally, these interviews served as two different means of fact checking. My participants were given the opportunity to discuss and debate my observations and impressions of their practice as it pertained to teacher lust. Further, they were also given opportunities to raise and discuss episodes they selected as moments of teacher lust for themselves.

During each class meeting, I ran the video camera and took some field notes. As I was videotaping the classroom, I focused mainly on recording what the instructor was doing, especially when she was interacting with the students and in discussion. The instructor wore a lavaliere microphone during each class period in order to audio record the verbal interactions between the instructor and the students. It was extremely difficult to take field notes and run the video camera simultaneously. So, the notes I took were mainly notes of times I perceived were important points within the class and some quick notes of what the important incident was. Immediately after the class, I sat down to write more about what I had seen during the session. During this time I tried to expand on the quick notes I had taken during the videotaping.

In between class meetings I re-watched the tapes, examining them for instances I believed were potential incidents where the instructor could have felt teacher lust. Any time the instructor or the students raised mathematical questions during discussions or during the course of students completing mathematical work, I flagged the incident as having the potential for teacher lust to be exhibited. I used a computer program developed at the my university's Learning and Performance Support Laboratory (LPSL) to help me with both my video analysis and data management. As I watched the videotapes, I was able to use the software to mark the clips I felt were important and to attach my comments and reactions to these incidents. (Further description of this process follows in the analysis section.) I used these notes and clips to select representative episodes from the many I had initially chosen and built my interview protocols from them. After choosing these specific events, I compiled each of the video segments into a CD that I used as a stimulus during the semi-structured interview I conducted following the first two weeks of videotaping.

During the first video interview, I used these segments to ask the instructor about her decision process in responding to the questions or concerns of the students. During the course of the first interview with each participant, I also brought up the term teacher lust and used it in discussion of the teaching episodes we viewed together. The first interview was designed to introduce the instructor to the notion of teacher lust and was our first opportunity to begin to define when teacher lust was felt, if the instructor was aware of it, and how the instructor dealt with the feeling. It is important that although I selected the incidents to be discussed, determining whether or not teacher lust was felt and dealt with was a shared understanding between the instructor and myself.

The next three-week cycle progressed in a similar fashion. However, I asked each participant to spend a small amount of time after each class meeting to reflect on the idea of teacher lust and to make notes if she felt it and in what context. As a result of this choice, the second video interview was structured differently than the first. Whereas I selected all of the clips to be viewed and discussed during the first round of interviews, in this session I wanted to have the instructor initiate the discussion of teacher lust and perhaps choose some instances based on her reflections. I did go through the process of choosing clips as I had done in the first cycle in case my participants were unable to identify instances for themselves. Both participants however, were able to select episodes to discuss at the opening of the interview. In both cases my participants chose to talk about interactions that I had also selected. In addition to my participants' clips, we also discussed the other clips I had selected in order to to help me develop an understanding of what did and did not constitute teacher lust for each participant.

During the third three-week cycle, we built upon our work from the previous two. Once again, I asked the participants to make note of their own teacher lust. The third video interview was again a combination of episodes chosen by the participants and some chosen by me. And again, my participants had chosen to talk about clips that I had selected for discussion as well.

Along with these prompts for discussion, I also questioned the participants about what they might do with this construct in terms of teacher education.

Data Analysis

I used the theoretical framework described within chapter two to analyze my data. Data analysis took place in three main stages using the constant comparative method of analysis (Silverman, 2000). The first stage involved my analysis of the classroom videotapes, which was performed in order to design my interview protocols. The second stage was an analysis of the interviews I conducted using the protocols and video clips as sources for inquiry. Finally, the information from the interviews was used to reexamine the original video clips for incidents of confirming and disconfirming evidence. What follows is a more in depth description of each of these phases.

Within each three-week period of data collection, two weeks were spent videotaping classroom meetings of both participants. The final week was used to complete preliminary analysis of the video data and to construct and carry out a semi-structured interview. In between class meetings, a video reflection tool was used to analyze each video for potential incidents of teacher lust. These incidents were selected and then analyzed using Mason's modes of interactions. Episodes in which the instructor was expounding or explaining, as well as moments in which the students were exploring, could potentially contain examples of teacher lust. Special attention was paid to exchanges within these modes of interaction. These clips were then examined to determine whether or not the instructor had engaged in them in a manner related to the open teaching triangle. I then selected episodes in which the instructor seemed to be acting in a closed manner as potential examples of teacher lust. At the end of the cycle of observations, all episodes were examined as a whole in order to detect possible commonalities and emerging themes. I then discussed the data and these emerging themes with a senior researcher in order to establish a sense of validity. Once we agreed on themes, I selected one or two indicative examples of the theme to use within the interview. Once the interview protocol was constructed, I discussed it with the same senior researcher before conducting the interview. This was done to ensure I had captured my conceptions and also had prepared adequate questions to allow my participants to bring their own conceptions to the study.

This process of data collection, analysis, and interview continued for three cycles. After the final cycle of data collection was completed, all interviews were transcribed. Then, the next stage of analysis took place as the interview data were examined and coded. This stage of coding focused on examining the participants' conceptions of teacher lust, the underlying reasons for such actions, and looking for evidence of change during the course of the study. These codes were then examined through all interviews to develop larger themes present through the entire study. Then, the video incidents indicative of the findings were transcribed where necessary in order to support the interview data. Final conclusions were drawn based on multiple sources of data and disconfirming evidence was noted where applicable.

CHAPTER 4 - RESULTS

It is germane to begin this chapter with reexamining the construct of teacher lust in regards to the views of my participants. The first section will define teacher lust in the context of this study and my participants' personal conceptions of the construct. Next I will describe the ways in which teacher lust was manifested within these classrooms, within the moment of teaching, during the planning process, and my own feelings of vicarious lust. After giving examples and descriptions of some exemplar situations, I will then turn my attention to describing the underlying causes of these incidents. This chapter will conclude with examples of how the participants have been affected as a result of the study.

What is Teacher Lust?

Classifications of Teacher Lust

Earlier, I described teacher lust as a teacher's natural desire to impose her own understandings upon their students, even though this approach can be in opposition to their educational goals. As I entered this study I felt it was important to have a sense of what I thought teacher lust was for myself. As a result however, of observing and discussing the practices of Elizabeth and Samantha, I am now better able to describe and define what this construct is. One of the most important additions to my original concept is the notion that there are actually two components that influence the overall construct, an internal impulse and an observable resulting action. So, a moment of teacher lust begins when a teacher feels an internal impulse to insinuate themselves into a student's solution path or conversation. However, this impulse does not necessarily lead to the resulting action of the teacher actually acting upon it. A teacher may, in the moment of teaching, be conscious of this impulse and yet choose not to act upon it. This leads me to describe two different classifications for incidents of teacher lust: *experienced teacher lust* and *enacted teacher lust*. The former consists only of having the desire to act; the latter subsumes the first and further includes an observable action that results from the impulse.

This increases the difficulty for an outsider trying to observe this construct in the moment of teaching. To begin with, there is the issue of trying to determine the presence of experienced teacher lust. An observer must hypothesize based upon the pedagogical situation whether or not teacher lust could have been felt. Confirmation in this case can only come from an open discussion with the teacher to determine whether or not teacher lust was indeed involved. There is also an underlying facet within a teacher's observable actions to contend with. For example, an observer may detect the presence of teacher lust if it is of the enacted type. Though the actions that an observer might classify as resulting from teacher lust may, upon further discussion with the teacher, turn out not to be based upon teacher lust at all. What results from these concerns is that determining the presence of teacher lust as an observer involves a heavy dependency on the teacher's own conceptions of how they felt within the moment of teaching, what they had and had not considered, and their final decision on how to act. With this in mind, I present my participants' views of teacher lust. Their conceptions of teacher lust are reflected not only in what they say directly about the topic, but by the classroom episodes they selected to discuss during the interviews as well. Samantha and Elizabeth have had different classroom experiences, but I believe in spite of this, there is a commonality within their personal descriptions for what constitutes teacher lust.

Participant Conceptions of Teacher Lust

Samantha's conceptions of teacher lust

In the beginning of each interview, I asked the participants if they could select any moments from their teaching in which teacher lust was involved. In each interview, Samantha selected episodes from her teaching to discuss in these segments, although on several occasions during the course of the study, including the final interview, she also verbalized that she was unsure what teacher lust really was. She hypothesized in our third interview that for her, teacher lust might mean moments, "where I'm jumping in too quickly or telling them too much or going too far," (Samantha, interview 11/14/05). And, as we discussed the episodes she chose to talk about, it seemed that she had selected moments where she had acted in a way that was contrary to how she would have wanted to.

A prime example her acting in an unplanned manner came as the students were working on a problem in the context of greatest common factor and least common multiple. The problem was wrought out of using a spirograph toy (see Figure 7[1]).

Figure 7. The Spirograph toy.

The students were given a blue 'wheel' with a given number of teeth on it as well as an orange 'hole' with a given number of teeth and were asked to predict how many petals would be produced. Specifically, their wheel had 22 teeth, and the hole had 48 teeth. The students were given time to work on the problem both alone and in small groups. After, Samantha asked for some possible solutions. The students (S) began offering answers:

> Samantha: Was that enough time to predict?
>
> S1: I said three?
>
> S2: 44?
>
> Samantha: No – I don't think it is 44
>
> S2: 144 is the LCM.
>
> Samantha: Oh, 144 is the LCM of those two numbers?
>
> S1: It's not three?
>
> Samantha: No, it's not three.
>
> S3: I got three, too.
>
> S4: 528?
>
> Samantha: umm –hmm
>
> S4: 6.25 petals!
>
> Samantha: Nope. It's not going to be a decimal. How many petals? It needs to be a whole number.
>
> S5: 24.
>
> Samantha: 24 petals? You are just throwing numbers out at me. Tell me how you were getting some of those numbers. (Samantha, Class video 11/09/05)

The correct solution to the problem was indeed 24. I hypothesized that perhaps Samantha was listening for the correct answer and was shutting down the other incorrect answers, although Samantha seldom validated student responses in this manner in her class. In the 14 times I observed her class, this was the only time I had seen her react to students' answers in this way.

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[1] http://images.amazon.com/images/P/B00000DMD6.01.LZZZZZZZ.jpg

Her usual mode of operation was to collect suggested answers on the board and have the students discuss and evaluate the responses. However, in this case she found herself telling the students whether or not their answers were correct. When we discussed this in the interview, Samantha agreed. She said she was caught up in the moment and yet realized she was operating in a way that was contrary to her preferred actions. Further, she did not have a good reason for why she had acted in this way.

> The main thing I remember from that is that I was surprised that I had let that just kind of happen. And I don't have an explanation for how it evolved that way, but somehow there was something in the way they were talking or something in the beginning that prompted me to start saying "No, no, I don't think so. No, not that. No, no." And I know, I can't – I really can't explain it because I feel like my normal reaction is typically is to put some of these down. Even 6.25. Now which of these? And I don't know. It may be that I was sort of looking for that 24. (Samantha, Interview 11/14/05)

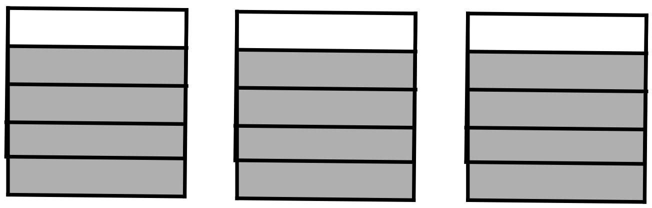
The fact that Samantha did not have any reason for jumping in too quickly telling too much gives further credence to the idea that these actions were an example of enacted teacher lust.

Samantha also associated teacher lust with "wanting to show people really cool things" (Samantha, interview 12/7/05). This idea came up as we were discussing a moment in her class where the students were sharing their solutions to problems involving changing repeating decimals to fractions. Some of the students had done the problem in what I would call the traditional manner, and one of them had shared her solution on the board. However, one student, John, used a method that was similar to a technique the class had used in finding the sum of a geometric series. Samantha overheard him discussing his solution with another student and strongly encouraged him to share his method on the board, even though it was not completely correct. Samantha admitted that she specifically wanted to connect the process to that method and when she heard the student thinking about it in exactly the same way she had, she really wanted the rest of the class to see it. When I asked her if she would have brought it up herself if John had not, she said she would have. We talked about wanting the students to see something that we as teachers think is so cool. This spurned a further discussion of Samantha describing her tendency on occasion to choose tasks for her class purely based on her students seeing something "really cool," rather than because they address an important topic or idea in the curriculum. Samantha equated this desire to show how cool mathematics can be with a form of teacher lust. "You just want people to see something that's really neat and so you kind of offer it to them, sometimes more aggressively than you really should" (Samantha, interview 12/8/05). Within the framework of the study, this example aligns with Mason's (1998) conception of *expressing*. Samantha's exuberance for the subject led her to shift into an expository mode where she was attempting to transmit her own knowledge to the students.

Elizabeth's conceptions of teacher lust

From our opening discussion about the construct, Elizabeth felt as though she was very susceptible to the feelings of teacher lust. For her, teacher lust was about the impact her actions had on her students' opportunities to learn. "I think of it as taking away the thinking opportunities away from students. So, by something I do, I don't give them the opportunity to think through something on their own" (Elizabeth, interview 12/8/05). She selected a couple of episodes in which she thought this had happened in her classroom.

For Elizabeth, direct telling was one way in which she felt she would take away the thinking opportunities from her students. One example of this that Elizabeth chose to bring up took place near the end of a class period. The students had been working on fraction multiplication and connecting it to the grouping model of multiplication. They examined the following problem, "Maisy draws a picture like the one below to show 3 • 4/5 = 12/15 because 12 out of 15 are shaded. Is Maisy right? If not, where is her reasoning flawed?"



(Beckmann, 2005, p. 139)

The students did a nice job of explaining the solution to this problem and discussing why the solution should be 12/5 and not 12/15. They offered algebraic as well as conceptual justification. In Elizabeth's earlier class, her other students suggested a word problem that better demonstrated the ambiguity of the unit. Elizabeth wanted to use that problem with this class as well. However, since the question came up naturally in the first class, she had not thought about how to get her current students to raise the same concerns. Compounding this issue was the fact that she was running out of time in the class period.

> Elizabeth: There was a word problem that we came up with earlier in my other class that I think does a good job of showing the ambiguity in this question, so let me modify it for this situation. So there are three pies; If 4/5 of each pie is eaten, how much was eaten?' (Writes problem on board) So what do you guys think? In this question can we think of the answer as either 12/15 of something or 12/5 of something?
>
> Amber: Both. Both fractions represent how much was eaten, but the correct answer would be 12/5.
>
> Lana: It depends on the whole, like Christine said. If you think about the whole as all three pies together then it would be 12/15, but if you think of each pie as its own whole, then it would be 12/5 of each pie.

> Elizabeth: Ok, so what do you guys think about that? If we are changing the wholes then we could get either answer? So if we said12/5 of a pie got eaten, and if we reduced that we would get 2 and 2/5, so we could say 2 and 2/5 pies got eaten which makes sense, right? Or we could say 12/15 of all the pies got eaten or 4/5 of the pies got eaten if we reduced that. Okay, so that's all for today, I'll see you guys on Friday. (Elizabeth's classroom video 11/9/05)

Elizabeth selected this exchange an example of teacher lust where she felt she was just telling the students things. "…and so I think I ended up just telling them like, 'Look this is the same,' instead of letting them, you know, think about it at home on their own, or wait until next class, or something like that" (Elizabeth, interview 11/18/05). Elizabeth was attempting to act in an explaining mode. However, instead of trying to inquire about her students' conceptions through questioning, she instead shifted into an expository mode and explained her own understanding of the problem. Elizabeth expressed regret at doing this. This episode made her realize that she needed to be aware of and to try to control her desire to wrap things up at then end of a class period. I discuss this desire in more detail later on within the chapter.

Elizabeth also conceptualized teacher lust as a desire to "sort things out" for her students. It was not surprising to know that her students were confused as they discussed the concept of division by zero. However, it was interesting to observe that this topic caused Elizabeth to feel the pull of teacher lust in the moment of teaching. To begin their discussion of division by zero, Elizabeth asked the students to write word problems for two divided by zero and for zero divided by two. It was her hope that in writing the problems for two divided by zero, they would see that the problems did not make sense, and that in turn; division by zero did not make sense. However, what she found was that some students wrote word problems in which it was difficult to tell whether they represented dividing by zero or not. The problem that was shared on the board dealt with a mother dividing two cookies among zero children. The wording was confusing to the students and they wanted to change it. However, their suggested change made the problem imply zero divided by two, which everyone liked better because it made sense to them. At this point, Elizabeth felt the tug of teacher lust in terms of wanting to sort out the confusion for them.

> And I didn't want to just say, "No, this is zero divided by two," so I was trying to lead them to that and people were getting antsy and they didn't want to talk about it anymore. And so, I was having a really difficult time getting everyone to focus on it and relate things back to the meaning of division. So, I guess there I was. I sort of just wanted to tell them, "Look here's the meaning of division and how does it relate to this problem? It's not the problem you're looking for." And I kind of just wanted to leave it. I wanted people to think about it, but it wasn't like the most important topic they were discussing. (Elizabeth, interview 12/8/05)

This is an example of Elizabeth's experienced teacher lust, where she felt the desire to step in but did not act upon it. So, rather than letting the feelings of teacher lust shif her into an expository mode, Elizabeth was able to remain within an explaining mode and continued to allow the students to think through things by offering questions. However, in retrospect, Elizabeth thought that some students were still confused about the concept because she did not step in and explain the problem with which they were struggling.

Further along in their discussion of division by zero, Elizabeth also experienced a moment of enacted teacher lust. One of the students tried to explain why division by zero did not makes sense by making a fraction argument.

> Amber: Another way to show how 2 divided by zero is undefined is, like…Division is kind of like fractions, so if you had two parts of zero wholes, like no whole, and you can't do that. But you can have two parts that equal a whole with zero shaded in. Zero parts.
>
> Elizabeth: So can you say again why it wouldn't make sense for two divided by zero?
>
> Amber: 'Cause you have zero total equal parts that make up the whole, but you have two parts and you can't do that because it is zero.
>
> Elizabeth: So you are saying the whole is made up of zero things.
>
> Amber: Yeah. And you can't have two things if there are zero things.
>
> Elizabeth: Okay. And that is a little tricky because you are using, we have two parts and zero parts. Okay.
>
> Lana: I think that makes more sense than the word problems because if you have a fraction and there is nothing there, you can't divide it up into parts and shade some of them if it doesn't exist. (Elizabeth, Class video 11/21/05)

Elizabeth was caught off guard by this explanation. "…there [were] some things about her wording that made me uncomfortable…and so, I decided at that point just to point them out. I think is what I did. But then everyone liked her explanation" (Elizabeth, interview 12/8/05). Elizabeth was concerned with how Amber was freely going back and forth between fraction and division language. She used language that confused wholes with groups and parts with objects, and Elizabeth felt as though the students needed more time to really think about the relationship between fractions and division. This was compounded by the fact that this was an unexpected offering so Elizabeth needed time to think about Amber's explanation for herself. This was something that she could not really do in the moment of teaching, and so she thought she needed to sort it out aloud for both herself and the students. For Elizabeth, this was a moment of experienced teacher lust that she consciously decided to act upon based on her students' reactions to the discussion. She decided to shift into an expository mode and present her thoughts directly to the students in order to alleviate her own concerns about their understandings.

In each of the above episodes, Elizabeth selected moments in which she felt her actions had taken away an opportunity for her students to learn. Samantha's conceptions of going too far, too quickly, can also be thought of in this manner. For both participants, these episodes are examples of teacher lust that can hinder students' ability to reason out ideas for themselves. Another question however, is whether the exuberance for mathematics that Samantha exhibited in wanting her students to see the mathematical connection John had found be characterized in the same way?

The marshmallow problem

Samantha, like most mathematics teachers, enjoys the subject. Her enthusiasm was evident in her classroom, and it came across in our interviews as we talked about her practice and mathematics in general. Arguably, there are a lot of really cool ideas, patterns, and connections to be found within mathematics, and Samantha wanted her students to appreciate and experience some of those as she had. There is not anything inherently wrong with this idea. The manner however, in which this goal was accomplished is a potential source of teacher lust. Samantha spoke of offering ideas "too aggressively," and that is certainly one way in which this action can be characterized as teacher lust, as it can take away a thinking opportunity. But, Samantha's desire for her students to see "really cool things" about and within mathematics was also evident within the selection of tasks. Occasionally Samantha selected tasks that did not address significantly important mathematical ideas within the scope of the class and instead were simply interesting ideas that she wanted her students to see. Again, in and of it self, that is not necessarily a bad decision. But, when the task is enacted in a way that students do not understand the mathematics, or cannot see how it is connected to their learning, the task becomes an act of teacher lust. In this case, it is an example of the instructor imposing her ideas onto the student, instead of allowing the student to directly engage in the thinking. In terms of Mason's ideas, this is Samantha's expressing mode giving way to expository actions instead of leading to expounding or explaining modes–either of which would still respect the mathematics of the students.

One example of this type of activity was known in our discussions as 'the marshmallow problem.' During a lesson in their unit on sequences and series, Samantha presented a stack of marshmallows made up of a single marshmallow, on top of a 2 x 2 array, on top of a 3 x 3 array, on top of a 4 x 4 array, on top of a 5 x 5 array of marshmallows (see figure 3). The goal was for the students to write an expression for how many marshmallows were in this structure and then generalize it to find the sum of square numbers. I asked Samantha why she decided to use this task in the class. She said that first of all, it was connected to the idea of finding sums of series that they had been working on, and also, "… it is just really cool. I mean this stuff is really neat" (Samantha, interview 10/24/05).

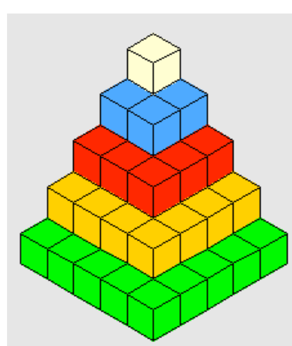


Figure 8. A representation of the marshmallow structure.

When asked to write an expression for the number of cubes, a student first suggested that the structure was composed of $1^2 + 2^2 + 3^2 + 4^2 + 5^2$ marshmallows. Then John offered the representation that there were $\frac{5^3}{2}$ marshmallows in the structure. To explore this possibility, Samantha produced two similar structures made of 1 + 4 + 9 blocks each for a student to try and put together to make a cube. After a couple of attempts and some initial discussion, the class decided that a cube could not be made from two of these structures. Then, in order to "move things along" Samantha asked them to think about the formula for the volume of a pyramid. The students had some difficulty recalling the formula, and so Samantha reminded them of the activity they had done in class the previous semester, which demonstrated how a the volume of a pyramid with a given base area was 1/3 the volume of a rectangular prism with the same base area. Samantha then produced three oblique paper pyramids, which could be placed together to form a cube, and John volunteered to try and put them together to make a cube. John began manipulating the pyramids, trying to find a way to form a cube from them. He first tried to line up each "hypotenuse" of the pyramids. As he described to Samantha what he was trying to do, she suggested he stop his method and try "putting the tips together". Over the next minute or two, John tried to follow Samantha's suggestion. As he did so, Samantha kept repeating, "put the tips together". After a minute or two of watching John's struggle, Samantha took the models from John to do it for him. As she did so, Samantha explained, "it would be nice if we could do some exploring here but I don't want to spent too much time on this" (Samantha, class video 10/14/05). She then demonstrated how the pyramids could be put together to form a cube. Next, Samantha produced a third structure made of blocks. She then demonstrated how to put the three structures together to form a rectangular prism, albeit with some cubes missing.

The prism formed was a 4 x 4 x 3 prism with one gap on the second level, two gaps on the third level, and three gaps on the fourth level. Samantha asked the students to write an expression for the total number of cubes in the structure, which she described for them as “a 4 x 4 x 3 prism with a gap of one, a gap of two, and a gap of three”. The students offered the expression 4 x 4 x 3 – (1 + 2 + 3). Samantha then asked them to write an equation for just one of the pieces. John offered 1 + 4 + 9, which Samantha wrote as $1^2 + 2^2 + 3^2$, “just to be more general”. From this the students were able to write the equation

$$1^2 + 2^2 + 3^2 = \frac{1}{3}[4 \bullet 4 \bullet 3 - (1 + 2 + 3)].$$

The next task posed was for the students to generalize this equation for the original marshmallow structure. The students were confused as to whether the fraction on the right hand side of the equation should be 1/3 or 1/5. In order to emphasize that it would always take three oblique pyramids to make the prism Samantha produced three cube structures made of 1 + 4 blocks, which she put together to make a 3 x 3 x 2 prism with a gap of one and a gap of two. Julie offered the equation $1^2 + 2^2 + 3^2 + 4^2 + 5^2 = \frac{1}{3}[5 \bullet 5 \bullet 5 - (1 + 2 + 3 + 3 + 4 + 5)]$, saying she was not sure if it was right. Upon discussing it and comparing it to the previously agreed upon formula, the students decided that the equation should be

$$1^2 + 2^2 + 3^2 + 4^2 + 5^2 = \frac{1}{3}[6 \bullet 6 \bullet 5 - (1 + 2 + 3 + 3 + 4 + 5)].$$

The students were still somewhat confused, so Samantha suggested that they try to write the formula for the smallest pyramids (made from 1 + 4 blocks) as well. But the very next thing Samantha did was write the equation $1^2 + 2^2 = \frac{1}{3}[3 \bullet 3 \bullet 2 - (1 + 2)]$ on the board. She then asked the students if they thought the formula would generalize and then told them that it would. This is an example of the actions Kilpatrick (1987) referred to as teacher lust–when a teacher asks a question and then immediately answers it for the students.

Samantha then asked the students what the equation would look like for the sum of the first 100 square numbers. In attempting this, they found they needed to recall the formula for the sum of the first n integers: $1 + 2 + ... + n = \frac{n(n+1)}{2}$, as this would be subtracted from 101 • 101 • 100 on the right side of the equation. The final equation was never written completely on the board, nor was the final generalized equation ever presented either by Samantha or by the students.

Samantha began her wrap up of this activity by saying, "This isn't really a particularly important formula or anything, it's just kind of – I think it is a really neat connection because it is, you know, the volume of pyramids and cones related to this situation" (Samantha, Class video 10/14/05). When the students asked where they might teach this topic to their middle school students, Samantha explained that it was not a topic that they were necessarily going to teach, but it could be used as an enrichment activity for students to look for patterns and relationships without taking it to the same extent as they had in class.

Samantha then pointed out a relationship between the ½ in the sum of the first n integers and the 1/3 in the sum of the squares of the first n integers, going further to say that if they examined the sum of the first n cube numbers this pattern would continue, and that the formula for that sum would involve ¼. The students seemed very confused at this point. They had been struggling to follow this lesson to begin with and now did not see where this new idea came from or where it was going. Samantha tried to alleviate their concerns by repeating that, "I want to make it clear, this isn't something of great importance; it's just kind of an interesting connection, to connect it to the volume formulas" (Samantha, class video 10/14/05). Samantha also told the students at the end of the activity that this material would not be on any future test.

As we talked about this task, it was clear that this was not something Samantha expected the students to be able to do for themselves and that she was planning to lead them through the process. The lesson began with a moment of expressing when Samantha said, "This is a really neat problem, they should see this." It could have been implemented in a way that allowed the students to enter a state of exploring and engage in the mathematics for themselves. Instead, Samantha chose to present the problem to the students from her own point of view. She pre-made all of the manipulatives she was going to use for her demonstration, bringing only one set of each structure. She had planned on introducing the connection with the formula for the volume of a pyramid herself, saying that if she had not brought it up then it never would have been discussed. The students never had a sense of involvement within the lesson; it was more like it was being done to them instead of with them. This is probably why they expressed confusion and frustration both with generalizing the formula and in wondering where these ideas fit into what they had been learning and where it would fit into their teaching. Samantha's lesson had a very elegant mathematical trajectory. I was able to see how the ideas were developing and how everything would connect, though her students could not. Weighing all of these different factors, I would categorize this task an example of teacher lust.

A definition of teacher lust

I entered this study with a conception of teacher lust that was influenced by Mary Boole's (1931) definition and by my own experiences. Through the observations, interactions, and conversations I had during the course of this study, my original conception has changed. The definitions I now present will continue to evolve as I continue my exploration of teacher lust. What follows however, are my definitions as of today.

Experienced teacher lust is an impulse to act in a manner that may remove thinking or learning opportunities from students. Instructors may be aware of moments of experienced teacher lust, or it may be felt unconsciously. Experiencing teacher lust does not automatically imply instructors will act on that impulse.

Enacted teacher lust is a result of experienced teacher lust and is an act that removes the thinking or learning opportunity from a student. Instructors may enact teacher lust unconsciously, or they may also make a conscious decision to do so. The instructor may justify enacted teacher lust; although justification does not change the notion that student learning was removed.

These definitions raise the question as to whether or not it is wrong to engage in acts of teacher lust. The nature of the term carries a negative connotation, but categorizing all teacher lust as being "good" or "bad" is a not a straight forward decision. Fundamentally, it is wrong to impede the learning of students. There are certainly moments however, when pedagogical choices are made that may result in acts I have classified as teacher lust. In these cases, there are trade offs within these different decisions and the instructor most likely has weighed each option and made a choice. The important idea is that these judgments have been made consciously. Because of this, these moments can be discussed from a pedagogical standpoint and now the argument is whether or not the instructor's choice was the best one.

Instructors who are unaware of this construct and of their tendencies to engage in acts of teacher lust are a different story. These instructors are not making conscious choices in the act of teaching, which can be detrimental to their students. When instructors fail to consider other options and the consequences of their actions, they can react to situations instinctively. For instructors who are still learning to operate within the open teaching triangle acting without reflection can trigger a shift into a direct telling mode, which can remove an opportunity for student sense making. It is important to educate instructors who unconsciously engage in acts of teacher lust in order to make them aware of these tendencies and to encourage them to make reflective choices on when to engage in these acts.

How is teacher lust enacted in the classroom?

Enacted teacher lust is an action that takes away a student's thinking opportunity. As described above, the tasks an instructor chooses to pose to a class can be made as a result of teacher lust, but it is certainly not the only example of teacher lust. In most instances within my sample, teacher lust is not found within task selection, but rather occurs within the implementation of the given task and can be classified as a form of telling. The instructor's intent in telling, along with what is told and when it is told, all factor into whether or not a given telling action is the result of teacher lust. There are various telling actions associated with teacher lust that can hinder student learning in different ways. Some telling can be classified as an instructor's attempt to impose her mathematical knowledge directly onto her students. This action forces the students to understand the mathematics as the instructor does, rather than affording them an opportunity them to make sense of it for themselves. Another form of telling involves offering ideas, hints, or suggestions at inopportune moments, which can inadvertently reduce the level of the task at hand (Stein, Schwan Smith, Henningsen, & Silver, 2000). Verbally steering students down a particular solution path is another form of telling that can be an example of enacted teacher lust. Within the following section, I offer examples of each of these types of enacted teacher lust.

Imposing knowledge

A teacher's attempt to directly impose her knowledge is an example of Mason's (1998) description of teachers operating in an expository mode. My participants imposed their knowledge onto their students in different ways. Samantha was very adept at working within the open teaching triangle and making her students' knowledge the focus of the classroom. Thus, when she imposed her knowledge, her forms of imposition were subtle. Elizabeth was in the early stages of developing her teaching style and was not as comfortable working within the open teaching triangle. And, as a result of her emerging practice, she experienced more blatant moments of this form of teacher lust. However in both cases, regardless of their levels of subtlety, they both exhibited enacted teacher lust. That is, either because of something they did or did not do, their actions removed learning opportunities from their students.

One thing that both participants engaged in was imposing mathematical structure onto a discussion. One example of Samantha doing this took place as the students were working through the marshmallow problem. John had suggested the expression $1 + 4 + 9$ as one way to represent the number of cubes in the structure they were discussing. When Samantha wrote John's expression on the board, she changed it to read $1^2 + 2^2 + 3^2$, saying she did so "just to be more general." Chazen and Ball (1999) might be inclined to classify this action as an example of judicious telling. But, what makes this an example of enacted teacher lust is the intent behind the action. Samantha did not take the opportunity to talk explicitly about why she decided to make the adjustments she made. If, for example, Samantha had led a quick discussion in the class about what writing the given expression in a more general format would afford them mathematically, I would not be inclined to characterize this as an episode of enacted teacher lust.

Here Samantha was attempting to operate in an explaining mode but neglected to connect with the students' understandings.

When Samantha and I discussed this clip, I raised this issue for her in terms of the students finding mathematical generalizations within the course, which they had done quite a bit previously. She described her actions as "putting the structure on it" and did not feel as though the students would see it as big leap to do that. I agreed with her assessment but raised the possibility of using that action as a teachable moment to help the students understand why the form we write something in is important when we are trying to find a generalization. She responded to this with, "Oh yeah, that's nice. Actually, yeah. Now that I'm looking at this and we are talking about this, it would have been nicer if I had not done that step. And I don't remember why [I did]" (Samantha, interview 10/24/05). She recognized that she had in some sense removed thinking and learning opportunities from the students.

For Elizabeth, impositions of mathematical structure were much more serious than Samantha's. Elizabeth did not add structural modifications to her students' ideas without reason or justification; her impositions concerned larger mathematical structures such as mathematical conventions. In some ways she was imposing her conception of what constituted mathematics within the classroom. During a test review, a student asked Elizabeth to talk about what exact steps should be shown in trying to explain the FOIL method (the fist-inner-outer-last method of implementing the distributive property to multiply two binomials). As we talked about this exchange in our interview, Elizabeth said she felt that the question was really asking what constituted a good explanation, and for her that it was about mathematical conventions. "But then also some of those things are just conventions, like within the community. And since I decide what the conventions are, sometimes I feel like it's appropriate for me to just tell them that this is what you'd include" (Elizabeth, interview 11/18/05). She continued to talk about how she responded to this question in one of her classes by saying what needs to be in the explanation depends on what the question is asking. I asked if it seemed that this was the response the student was expecting. Elizabeth agreed that she did not answer the question in the manner the student wanted, but she felt that for herself she was not just answering that specific question, but also helping them to understand more about how to decide what to put in an explanation in general.

During a different test review day, the students wanted to talk about the proof that a negative number times a negative number is a positive number. Elizabeth saw that question as an issue of what constitutes a proof. She admitted that the proof that is most convincing for her is not the one that is most convincing for her students but went on to say that deciding what constitutes a proof is "…a really hard thing for them to analyze…because it's what the community decides constitutes a proof, and that's me. What I decide constitutes a proof, and that it's something that you just kind of learn by doing it enough" (Elizabeth, interview 12/8/05).

There are two different facets to these impositions. The first is the notion that Elizabeth views herself as the sole authority of the community in the classroom and that what she decides is convention is what it is. It seems that this should be a shared understanding, especially if she wants to use the word community to describe it. Instead, it comes across as her imposing her conceptions of mathematics onto the students. This may be impacted by Elizabeth's beliefs about where the mathematical authority resides within her classroom. This is a topic that will be addressed later in the chapter.

Compounding the issue was Elizabeth's lack of justification for her telling actions. Elizabeth expressed that to her, the responses answered the students' questions in both a specific and general manner. However, she did not make this explicit to the students. Because of this, her students could have came away from those exchanges with the understanding that Elizabeth simply did not want to answer those questions for them. By not being explicit with the students about her actions, she was unintentionally removing the object of the lesson she was trying to communicate. Elizabeth was attempting to operate in an explaining mode, but because she did not connect her telling actions to the understandings of her students, she instead was acting in an expository mode, providing an example of enacted teacher lust.

Know mathematics as I do

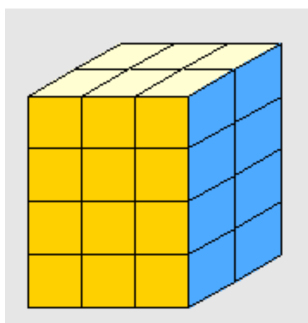
Elizabeth's desire to be the authority in her classroom was also evident in other telling actions. Through her actions and in her words, Elizabeth had moments where she exhibited a desire for her students to know mathematics as she did, or at the very least, unconsciously encouraged them to do so through the way she presented material. This was reflected in the way she facilitated the tasks in her class. Elizabeth's normal way of operating involved her doing a set up for the given task, allowing the students to work on the task, having them share their solutions, and then she would complete the task by doing a wrap up of the task for them. Within each of these different stages, Elizabeth was prone to encouraging her students to assimilate her conceptions of mathematics. At times, she shared her understanding of the problem before the students had an opportunity to engage in it. When the students shared solutions, Elizabeth often rephrased their explanations for them, even when she thought the students had done a good job of explaining things. During the wrap-ups, she would tell the students how the ideas in the task connected to others they had previously discussed. All of these actions took away the opportunity for her students to think for themselves. In the following paragraphs I give specific examples of how Elizabeth's actions removed the thinking opportunities from her students.

Volume, multiplication, and the cube problem

The students were presented with the following problem from their text:

Multiplication and Volumes of Boxes

5H: 3. The next two pages show different ways of subdividing a box into groups. If you have built a box from blocks, subdivide your box in the ways shown in the figures. In each case, describe the number of groups and the number of blocks in each group. Then write an expression for the total number of blocks. Your expression should include the numbers 2, 3, and 4.


(Beckmann, 2005, p. 99)

Elizabeth set up this problem by telling students that they were going to talk about volume and how it could help them to think about associativity of multiplication. She then went on to remind the students what associativity meant for addition. She then defined the associative property of multiplication for the students, using the equation (A • B) • C = A • (B • C). Then, Elizabeth gave them even more information about what they might see in the problem.

We are going to think about this in terms of volume because, remember we use all three dimensions when we are finding volume. The standard formula is that the volume is the length times the width times the height. So we are going to see in this activity we can use our meaning of multiplication to express that volume formula in different ways; to think of grouping in different ways. And we'll also think about why the volume formula makes sense. (Elizabeth, class video 10/14/05)

In this example, Elizabeth's set up highlighted the important mathematical ideas the students should see in doing the task. Notice that the problem itself never mentioned associativity, yet Elizabeth began by defining the property for them and then telling the students that the problem would involve it. The associative property is certainly the key idea within this problem. But, I believe the task was designed for it to arise naturally in the discussion after completing the task. The notion that this activity immediately proceeds the section on the associative property of multiplication in the textbook. This activity could be a powerful experience that allows students to think about and perhaps 'discover' that the associative property makes sense. However, Elizabeth's set up altered the cognitive demands of the task (Stein, Schwan Smith, Henningsen, & Silver, 2000) . At best it made the task less effective and at worst, perhaps removed that possibility completely.

The first two questions of the activity asked the students to use one-inch blocks to build a box 3 inches wide, 2 inches deep, and 4 inches tall and to think about the different ways they might subdivide the box into natural groups. Elizabeth did not provide blocks for the students to try this; instead she told them to think about what they might do for that part before moving on to complete part 3 described above. I am not sure why Elizabeth chose not to do the first two parts. It could be that she did not have blocks. Or, it could be that she did not need to do those parts in order to complete the third question, and so perhaps it was not important for the students to either. Either way, her choice removed, or at least lessened, the opportunity for the students to engage more in this problem.

As the students worked alone and in small groups, Elizabeth stayed at the front of the room and did not interact with any of the groups. After the students had time to complete the task, Elizabeth asked six different students to come to the board and write their answers to the six parts of question three. She asked three of those students to talk explicitly about what they had done. Before she gave the students an opportunity to talk about what they had done and how they thought about the problem, Elizabeth reminded them that the problem wanted them to use the standard meaning of multiplication, that A • B meant A groups of B things. Alice discussed her solution to Figure 9, writing 2 • (3 • 4) on the board as her answer.

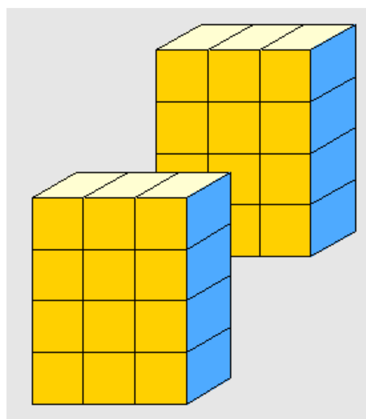


Figure 9. The representation in Alice's problem.

> You divided your piece in half lengthwise so you have two parts and each one of them is made up of 12 small blocks. So I did three times four in parenthesis, because if you look at each individual set of blocks, it is three rows by four columns. So you can think of that as three sets of four blocks. And then I multiplied that by two because there are two of them; two groups, each with 12 blocks. (Alice, class video 10/14/05)

Elizabeth rephrased Alice's solution for the class, replacing Alice's choice of the word *column* with the word *group*, "Okay great – so you were using columns there to be your groups for this 3 x 4, so there are three columns each making up four blocks.   And then we had another set of groups" (Elizabeth, class video 10/14/05). She went on to point out that in this problem they were dealing with "nested sets of groups." The other two students explained their solutions, and Elizabeth again asked question and probed for them to explain their ideas using the word *groups*. Elizabeth's use of the word group was important to her, because it emphasized 'the traditional' meaning of multiplication.

There are four different models of multiplication that are commonly used in school mathematics: the set model, the array model, the number line model, and the combination model (Van de Walle, 2004). Elizabeth often referred to the set model, which involves a given number of groups with a certain number of objects in each group, as 'the' meaning of multiplication. As she did in the example, she often would present a task to the students and then ask them to think about the task in terms of 'the' meaning of multiplication – unconsciously reinforcing the notion that there is only one meaning. I do not believe that this was Elizabeth's intent and that for her, when she said 'the' meaning, she meant 'the traditional' meaning.

It was clear from Elizabeth's actions that the set model was the way she liked to think of multiplication. Unfortunatleey, her actions were indicating to her students that their goal should be to explain mathematics in exactly the same way their teacher would. Elizabeth's habit of referring to 'the' meaning of multiplication, along with the fact she seldom referred to other models, rubbed off on her students. At different times during the course, when they asked Elizabeth questions about to how to explain fraction or decimal multiplication, they always referred to using 'the' meaning of multiplication. These requests reflected their understanding that they be able to explain certain algorithmic procedures in the same manner Elizabeth would.

When I asked Elizabeth to talk about why she felt the need to restate student solutions, she answered this question in a most curious way. As her explanation for why she does this for her students, Elizabeth talked about how she learns mathematics best herself. For her, it is important to hear someone else's perspective on material because it helps her to pick out what ideas are important.

> I'll get to a stage in something where I have lots of ideas about it, and I feel like I'm sort of getting to understand it, but I had trouble getting a broader perspective on it or picking out the key ideas, and that's when I feel like it's really helpful to have someone else come in and give their version of it or pick out from what I'm doing what's important 'cause then I can look back on it and think, yeah, that really is the important idea and it helps me organize and focus my thoughts. (Elizabeth, interview 10/24/05)

In her mind, the ideas were still the students' and she was simply shaping them and helping the students to see where they should focus their attention. The reality of the situation however, is when Elizabeth is the only person who decides what material is important, she is in a sense emphasizing her conceptions of mathematics instead of allowing the students to create their own.

Elizabeth then wrapped up the cube problem for the class. In her wrap up, she discussed all of the ideas she felt were important within the task, even those that had not been discussed by the students. She made the point that all of the different expressions the students had written for the 24 blocks were equivalent, and this equivalence illustrates both the commutative and associative properties of multiplication.

> So these six different ways I think are all natural ways to split up those set of 24 blocks that we have, to think about the volume. And you probably noticed that no matter how you do it you always get the same volume. Right? The prism takes up the same amount

> of space no matter what. So this is illustrating this property of associativity and commutativity at work right? We have all of these different expressions for the same amount of stuff. The order of the numbers is different, the order that we are multiplying them in is different, but we still get the same answer no matter how we do it. Okay, any other questions or comments on that? (Elizabeth, class video 10/14/05)

This is another example where Elizabeth's telling actions imposed her own understanding and did not allow the students to decide for themselves what ideas were important or what mathematics was inherent to this problem. Elizabeth seemed to be working within an explaining mode, but again, she did not attempt to ascertain her students' conceptions of the problem. Instead, Elizabeth did all of the analysis and made all of the connections for them. In doing so, she took away their opportunity to make sense of these ideas for themselves. We talked about her decision to tie everything up in a nice bow for the students, and I asked her if she felt her students could have made the same observations and come to the same conclusions as she had. Elizabeth talked about the possibility of doing this differently in the future, saying instead of doing it for them, she could ask them what properties of mathematics might be exhibited in this task. However, she followed this up by saying that she did not think that the students' summary would be like hers and that she "probably would have given [her summary] at the end anyway" (Elizabeth, interview 10/24/05).

Concerning proofs

Division by zero.

Elizabeth also expressed a desire for her students to make mathematical arguments similar to the ones she would make for herself. However, as the semester went on, she was better able to control these desires. Within her class, the issue of proof was treated with less formality than you might find within an upper level mathematics course. Almost all discussions involved the students engaging in informal reasoning and justification. However, within the discussions of division by zero and why the arithmetic properties do not hold for division, the idea of a proof was needed or at least discussed with a little more formality.

Some of the discussion that took place about division by zero was described earlier. Another part of that discussion involved Elizabeth making her own case for why division by zero was undefined. Amber had written the following word problem for the case of two divided by zero: *Maisy walks 2 miles at a constant speed, and it takes her zero hours to do it. How fast did Maisy walk?* The students struggled to make sense of this situation within their meaning of division. They grappled with which meaning of division the problem addressed; were they looking for the number of groups, or the number of objects in each group? Elizabeth helped them arrive at the conclusion that the problem was asking how many in each group and that a group was the distance Maisy traveled in an hour. Once this was established, Elizabeth asked the students if the problem made sense. When the students replied that it did not, Elizabeth pressed for them to tell why the problem made no sense. One student, Charlotte, argued that using zero hours made the problem unsolvable. However, her logic was based on the term zero hours, explaining that zero hours did not necessarily mean it took no time at all. She said that it could have taken her 20 minutes or 30 minutes, which would still be zero hours. Eventually, the students convinced her that if that were the case, they could express the time as 1/2 an hour or 1/4 of an hour, which would not be zero. Charlotte seemed frustrated by the fact her idea was not the reason the problem was unsolvable.

Charlotte: The whole point is that this doesn't work, right?

Elizabeth: Yeah, but why doesn't it work?

Lana: If it did take her any amount of time you could do the problem. For the problem to really not be defined she has to take 0.00 seconds.

Alice: Because if she took half an hour you could say 0.5 hours.

Elizabeth: And could we solve the problem in that case, if we knew it took her half an hour? Or if it took her one-minute, can we solve the problem? Or, five seconds, could we solve the problem? So it's really something special about the fact that it took her no time at all. Right? So, what if she can walk 2 miles in zero hours, could she also walk 10 miles in zero hours? Would that still make sense? Could she walk 500 miles in zero hours? Okay, if it takes her no time to walk any distance, she could walk any distance she wanted in zero time. Right? So her speed somehow could be anything. (Elizabeth, class video 11/21/05)

Elizabeth explained the point she was trying to show the students in our interview. "So, what I was saying for the no hours, is if you can go two miles in no hours, you can go any amount [of distance] in no hours, because you have an infinite velocity" (Elizabeth, interview 12/8/05). For Elizabeth, this type of argument was similar to one a mathematician would give. She thought that division by zero situations were vacuously true for any given statement, and for people who do not engage in these mathematical logic arguments, it did not make sense to make these types of statements in the first place.

Even though this was the argument that was convincing for her in this situation, her students were not convinced by it, and Elizabeth knew it. Later on in that class period, Amber gave her explanation of division by zero using fractions, which the students liked much better than Elizabeth's reasoning. She later reflected on her choice not to emphasize her idea more.

> At the time I think I thought, you know, I tried it once. And nobody picked up on my argument at all. So I didn't want to like, just say this is the argument you have to make and try to keep making that same argument, until finally at least one person in the class figured it out and then said it and we could move on. (Elizabeth, interview 12/8/05)

This was a moment of experienced but not enacted teacher lust for Elizabeth. She wanted them to accept her reasoning as justification, but when she realized that they were not going to, she resisted the urge to press the issue further. This episode took place late in the semester and can serve as evidence of Elizabeth's growing awareness of her tendencies to impose and her ability to make the choice not to do so.

Properties of arithmetic.

Another example of Elizabeth wanting her students to make arguments as she would took place as the students were doing an activity that explored whether or not the properties of arithmetic held for division. The first two questions asked the students if the commutative and associative properties held true for division. The students were to decide yes or no and provide explanations for their decisions. Elizabeth called on students to share their answers, and in both cases, the students gave arithmetic counter examples to show that the properties did not hold. It should be noted that neither student used the term counter example nor referred to the fact that if they could show one case where it was false, then the statement was false overall. For the commutative property, Erica offered the equation $8 \div 2 \neq 2 \div 8$. Elizabeth asked Erica to explain why this equation demonstrated that division was not commutative. She specifically wanted Erica to use the meaning of commutativity in her explanation. After Erica's explanation, Elizabeth asked if anyone else had another way to think about the problem. She thought she had heard someone talking about it in terms of fractions. When no one responded, she went on to ask about the associative property. For the associative property, Ann offered that "(2 ÷ 1) ÷ 3, [is] not the same as 2 ÷ (1 ÷ 3)," (Elizabeth, class video 11/2105). Again, Elizabeth asked for an explanation involving the meaning of associativity and, upon hearing it, asked another student for her thoughts in regards to fractions. Charlotte's idea involved an expression like $\frac{2+3}{7}$, and she explained that order of operations would always force her to perform the addition first, and so the associative property would not hold. Elizabeth then offered her own conception of how fractions might play into this question. She explained they could think about division in terms of fractions; for example, dividing by two is the same as multiplying by one-half. Using this idea, each division could be written as a multiplication problem, and then all of the properties for multiplication would hold. Here Elizabeth introduced the relationships she saw between fractions, the meaning of division, and the properties of multiplication. She did nothing other than to state this idea for the students. This moment could be classified as a moment of expressing, where Elizabeth felt compelled to share her understanding but did not intend for the students to engage in the idea–only to act as witnesses to her thoughts.

Elizabeth then identified Charlotte's idea as addressing the relationship between addition and division, which would be examined in the next two problems of the activity. The next two problems were as follows:

> 7D: 3. Is the following statement true? $200 \div 45 = 200 \div 40 + 200 \div 5$
>
> Why or why not? Explain your answer carefully, including diagrams if possible,
>
> 7D: 4. Is the following statement true? $365 \div 7 = 300 \div 7 + 60 \div 7 + 5 \div 7$
>
> Does it depend on how you express the answer (as a whole number with remainder, a mixed number, or a decimal)? (Beckmann, 2005, p. 164)

Again, as students made valid arguments for these statements, they relied solely on arithmetic reasoning. Carmen tired to explain that number three was not true, but number four was because, "…you can't split the number you are dividing by into different parts. But, you can split the number that is being divided," (Carmen, class video 11/28/05). Elizabeth pushed for someone to make an argument based on the meaning of division. Lana offered that in number three there was an extra 200 on the right hand side of the equation. This still did not satisfy Elizabeth. She asked for other thoughts, but none were offered. She continued by asking about number four, and Megan explained that it was correct because when you perform the standard division algorithm you look at one place value at a time, just as the equation stated. Heather added that if they thought about division as fractions, the equation in number four would be $\frac{300}{7}+\frac{60}{7}+\frac{5}{7}$, which was equal to $\frac{365}{7}$. Charlotte then tried to use this reasoning to show why number three was not true, saying it would be easy to see the extra 200, "Because, if you put $\frac{200}{40}+\frac{200}{5}$, then that would be $\frac{400}{45}$ which is not the same as $\frac{200}{45}$," (Elizabeth, class video 11/28/05). Elizabeth questioned her equation and, with the help of the students, was able to help Charlotte understand that $\frac{200}{45}+\frac{200}{5}$ was not $\frac{400}{45}$ and, more importantly, it was not equal to $\frac{200}{45}$. Again, Elizabeth asked for someone to make an argument using the meaning of division, "And what if we just went back to the meaning of division? So why is 365 split up into 7 groups the same as what we have on the right?" (Elizabeth, class video 11/28/05)

Elizabeth suggested this episode as an example of her teacher lust. She selected it because she felt the students had not given the explanation she would have given.

> And I don't remember what explanations they gave, or what I was expecting. But I know at the time I was thinking my way was the right way to explain it. And then like sort of mathematically, I would accept my way as a proof of it. And I wouldn't necessarily accept their ways as a proof of it. (Elizabeth, interview 12/8/05)

However, Elizabeth never actually stated for the students her conceptions of the problem. She resisted the urge to do so. She explained why she felt it was not necessary.

> But then as they were giving it, I was like, "You know, it's okay if they don't have a proof of it." Like, what I really want is [for] them to be able to make lots of connections to other things. And so the explanations they gave, I felt were doing that. Even though it wouldn't be a proof where you say "This is my hypothesis and I can follow through and prove it." They can give me a reason that made sense for why it shouldn't work or why it should. (Elizabeth, interview 12/8/05)

Even though Elizabeth never acted on her desire for the students to use explanations like she would, she did exhibit experienced teacher lust. We talked about her decision not to give her explanation, and although she was fine with her decision, she still felt as though "it would have been better if they knew it my way. But I didn't feel like I was going to get them to that point in the class" (Elizabeth, interview 12/8/05). Elizabeth also was aware that if she continued to try and impose her thoughts, she would be taking a big risk. "I felt like if I continued to press my way even further, they'd turn off all their reasoning and just say, 'We have to memorize this way of doing it, because that's what Elizabeth wants us to do'" (Elizabeth, interview 12/8/05). Elizabeth felt the pull of teacher lust, but successfully stayed in explaining and expounding modes. Although she wanted to shift into an expository mode and offer her own views, she did not do so.

This example took place late in data collection and serves as evidence that raising Elizabeth's awareness of the construct helped her to be more reflective in the moment of teaching. She was aware that her actions could potentially take away thinking and learning opportunities from her students. And, even though she wanted to share her knowledge directly, she understood that her students were capable of forming their own mathematical conceptions even if they were not the same as hers. Elizabeth wanted her students to have a strong understanding of mathematics but also realized that because they were going to be doing different things with their knowledge, that it was not crucial that they understand mathematics in the same exact way she did. In the course of teaching the class through the semester she found some success while acting in an explaining mode, and these mastery experiences helped her to better deal with the pull of teacher lust.

Reducing the task

Telling actions associated with teacher lust are not confined to instances of dispensing information with the intent of student assimilation. Beyond what is told and the intent of the telling, there is also the crucial issue of *when* something is told. In the following example, I examine how information offered at inopportune moments can take away thinking and learning opportunities from students, categorizing these acts as incidents of teacher lust.

In Samantha's class, the students had been working on a unit on functions. She wanted to connect the information in this unit to other branches of mathematics. She selected a sighting activity as a means to connect linear functions to geometry. The first task posed was to measure the height of the classroom wall without direct measurement. Samantha introduced this activity saying it might seem a bit odd at first but for the students to trust her that they would eventually see where it was going. Someone was to hold a piece of rectangular construction paper at eye level and sight upward along the diagonal of the paper toward the top of the wall. Then, they were to change their distance from the wall until they could sight the top of the wall along the diagonal of the construction paper. After they measured the distance the person was standing from the wall, the students were asked to find the height of the wall. Carol volunteered to perform the sighting for the class. Samantha did not bring a tape measure, so the class estimated Carol's distance from the wall. After two student estimations of eight feet and fifteen feet, Samantha paced off the distance herself and asked for a measurement that was around nine or ten feet. They finally decided on an estimate of ten feet, five inches. Samantha then supplied the students with some other information they would need.

> Okay. So we'll just use that as our number, 10'5" that was the distance to the wall. And then this rectangle was 10" wide and 5" tall like this. And there's one other piece of information that we are going to need to know but I'm going to let you think about what that might be. [2-second pause] It's something about Carol actually. So the rectangle was 5 inches and then the question is how tall is the wall? Okay, so go ahead and start figuring that out and when you think about what other piece of information you might need, just go ahead and ask. (Samantha, class video 10/31/05)

After a couple of minutes of working, Annette raised her hand and stated that she thought they were missing information. She wanted to know the length of the diagonal from where Carol had been standing to the top of the wall, presumably to use the Pythagorean Theorem to find the height of the wall. Samantha responded that that would involve some "heavy measuring" and asked again if there was information about Carol that would help. A student thought to ask Carol how tall she was (5'7" without heels, 5'9" with the heels she was wearing that day). Samantha told them they now had enough information to solve the problem. However, the students were still unsure how to use the information they had. Carol began by drawing a diagram showing that the shorter a person is, the closer they would have to be to the wall. Annette suggested that the size of the paper had something to do with the problem, so Carol drew that onto her diagram as well. At this point, the students were more interested in following Carol's idea of comparing a person's height to the distance from the wall. However, Samantha redirected them to the problem at hand–finding the height of the wall with the information they had about Carol.

Josie suggested using a proportion between the length of the paper (10") with the distance from the wall (10'5") as compared to the height of the paper (5") with the '*x*' of the wall. Samantha then asked if anyone could add something to the diagram that would be helpful. Carol suggested drawing in the line from the person's head parallel to the floor (see Figure 10). Samantha then told the students to think about how Carol had performed the sighting. Julie suggested drawing in the diagonal through the rectangle to the top of the wall. With the construction lines in place, the students were able to see that this problem involved similar triangles. Margaret came to the board to show the two similar triangles, and John explained how to set up the proportion. He explained how the

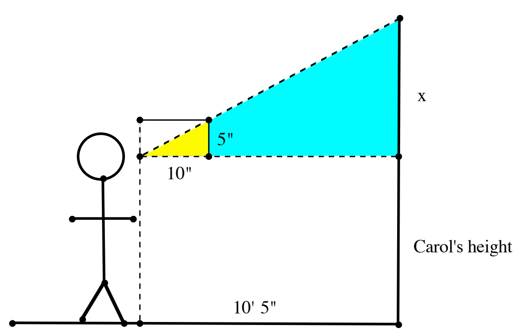


Figure 10. Carol's diagram.

proportion $\frac{5"}{10"} = \frac{x}{10'5"}$ would allow him to find x, the height of the wall from Carol's eyes to the top of the wall. Then he said they could add the value of x to Carol's height of 5'9" to find the total height of the wall.

Within the description, there were a few moments where Samantha used a form of telling to reduce the level of the task. The most blatant example occurred after Carol had done the sighting and the students began to think about how to solve the problem of finding the height of the wall. Samantha had summarized all of the information for the students and told them that they would need another piece of information to solve the problem. She was not going to tell them what is was but would let them think about it. She gave them two seconds to do so before telling them the information had something to do with Carol herself. This was done before the students had an opportunity to engage in the problem, let alone think about what information they may have needed for the problem. This information reduced the level of the task by removing one of the hidden aspects of the problem. Further, introducing this question into the problem at that early stage changed the focus of the students' attentions. They were concerned with finding the missing information before they even knew what they would need it for. Combining this with Samantha's cryptic opening statement that the purpose of the task might not be clear at first, it was not surprising that the students struggled with what to do.

Then later, as the students struggled to put their ideas together to form a useful diagram, Samantha again stepped in and reminded them about how the process of the sighting was accomplished, all but telling them directly to draw in the diagonal along the line of sight to form the similar triangles. With this done for them, the task changed from one that required the students to organize information and to analyze a geometric situation to simply solving a problem involving similar triangles from a diagram that could have been found in a high school textbook. There was certainly an opportunity for Samantha to use their confusion to talk explicitly about the value of adding construction lines to a diagram in order to help make better sense of a situation. However, she did not tell with the intent of instructing the students in this manner. Instead, she made direct comments meant to lead the students to the solution to this specific problem, without mention of why this idea was important in the larger sense of doing mathematics. Engaging in this telling act, which reduced the level of the task and also removed opportunity for her students to learn and think for themselves, is a form of enacted teacher lust.

Telling as Steering

Another telling action evident within the classrooms of my participants involved encouraging students to take a particular solution path in solving a problem instead of allowing them to choose their own. There were two different forms of this telling action that I observed in Samantha's class. One type involved her shutting down solution paths she knew would be fruitless; a second type was forcing students to use their prior knowledge to solve a certain problem. Specific examples of both of these forms of enacted teacher lust follow.

Sum of a series

During their unit on sequences and series, the students worked through a set of activities that examined the sums of powers of two from two different perspectives. The first approach asked the students to develop a closed formula by looking for patterns. They were to examine the following equations and then predict the sum of 1 + 2 + 4 + 8 +16 + 32 +64 + 128 + 256 + 512 without adding the terms.

$$1 + 2 = 4 - 1$$

$$1 + 2 + 4 = 8 - 1$$

$$1 + 2 + 4 + 8 = 16 - 1$$

$$1 + 2 + 4 + 8 + 16 = 32 – 1$$

Then, they were to use what they had learned to write a closed formula for the geometric series $1 + 2 + 2^2 + 2^3 + 2^4 + \ldots + 2^n$. The students were able to arrive at the closed form of $2^{n+1} – 1$, although there was some confusion as to what they were actually doing in finding this expression, as well as what the *n* stood for within it. Samantha explained that the expression was a way of finding the sum of those numbers quickly without actually adding them. Once one of the students cleared up the mystery that *n* represented the last power of two in the series, the class seemed to understand. Then, they began finding the formula using an algebraic approach. The textbook set the approach for them:

> 13R: 4. Here is a way to find a formula for the sum of the geometric series in part 3: Let S be this sum so that $S = 1 + 2 + 2^2 + 2^3 + 2^4 + \ldots + 2^n$
>
> Use the distributive property to write 2S as a series (fill in the blank with a series):
>
> $2S = 2 \bullet (1 + 2 + 2^2 + 2^3 + 2^4 + \ldots + 2^n)$
>
> $= \underline{\hspace{6cm}}$

Now calculate 2S – S in the following two ways, in terms of S and as a series:

2S – S in terms of S:	2S – S as a series:
2S	
<u>- S</u>	$\underline{– 1 – 2 – 2^2 – 2^3 – 2^4 – \ldots – 2^n}$

The two results you get must be equal, so you get an equation. Solve this equation for S. (Beckmann, 2005, p. 462)

John came to the board to write the series for 2S. After some initial confusion in writing the correct terms for 2S, he finally arrived at the stage of being ready to solve 2S – S as a series. He had the following two equations written on the board above one another like this:

$$\begin{aligned} 2S &= 2 + 4 + 8 + 16 + 32 + ... + 2^{n+1} \\ -S &= -1 - 2 - 2^2 - 2^3 - 2^4 - ... - 2^n \end{aligned}.$$

At this point, Margaret interrupted John and suggested that they could cancel some numbers if they lined up the common terms. John wanted to subtract vertically.

John: But can't we just subtract down like 2 – 1?

Samantha: We can but, um…

John: Can't I do that?

Samantha: Well we can do it, and there might be able to do it in different ways. So, what did you do John?

John: I subtracted straight down.

Annette: Why don't you subtract down and do it?

John: That's what I did.

Samantha: Well we can do that, but let's…Margaret, show us what you had in mind.

Margaret: Well this was in the book. Like you had it lined up with the 2 above the negative 2, the four was above the negative four…

Samantha: So if we want to make it easy on ourselves, and not do a lot of calculation, what can we do here?

Josie: Does that mean you can cancel out?

Samantha: Do you want to show us? Show. So we will just have S on the left, which is what we started with, but maybe we can write it in a better way. Can we do some canceling here?

Annette: Can't you just subtract vertically?

Samantha: Yes you can subtract vertically but can you also subtract another way? (Samantha, class video 10/12/05)

Samantha stopped John from pursuing the solution path he had chosen; she chose to value Margaret's idea instead. Margaret's approach was what Samantha wanted the class to see. Margaret's approach would cause all the terms of the series to cancel out with the exception of 2^{n+1} and – 1, which would result in the formula they had found in the first part of the lesson. John's solution path was not going to get the same result. Samantha knew that if John had subtracted vertically, he would have gotten the original series S back. However, John never had an opportunity realized this. By shutting down this path before it came to a resolution, she stopped John's thinking process, and in doing so exhibited a form of enacted teacher lust. Samantha talked about this and said her choice not to let John see that his idea would not work was based on time and student confusion. She was concerned with the possibility the students would be more confused by the fact John would have shared an unproductive solution, and she did not want them to get all tied up in that.

I didn't consider letting it go on because I saw where it was going to go and I felt like okay, we're just going to get bogged down in this. And I think this would be an example… I would kind of put it in the category of if I'd let it go on, it would have taken us like kind of down that path that we went on with the arc link where we're just floundering and we're not getting anywhere and everybody's frustrated. So it's more

> just… this isn't going to be productive. And it's true you could let him… it's not a bad thing, but I would say it would not have been a wise use of classroom time. That's the key thing. (Samantha, interview 10/24/05)

John was in an exploring mode, interacting with the content. Samantha could have chosen to support his exploration, scaffold his work on the problem, and allow him to come to see why his approach was not going to work. However, Samantha chose to move the class along a more fruitful solution path. This episode took place on the first day of video data collection, but Samantha made other similar choices throughout the observation period.

Developing divisibility rules

A different example of Samantha using telling actions as a means to steer solution paths occurred during the class' discussion of divisibility rules in their number theory unit. In previous classes, the students had discussed the divisibility rules for 2, 3, 4, 5, 9, and 10. In addition to describing the rules, the students had also engaged in thinking conceptually about why each test worked. The students had been instructed to think about bundles of toothpicks to help them reason through the different rules. When the rule for eight was first raised, it was posed to the students as a question: "Is there a rule for eight?" Near the end of one class, Annette had proposed that a number would be divisible by 8 if it were divisible by both 2 and 4. As the class ended, the students were able to disprove this idea by presenting a counter example. The following class, Samantha began by asking the students to come up with a rule for divisibility by eight. The students were given about four minutes to work alone and in small groups to discuss their ideas. After further discussion regarding Annette's proposed rule from the day before, John offered his approach to the class. His approach was to list a bunch of numbers he knew were divisible by eight and to try and find some commonality among them using what he knew about the other divisibility rules. Samantha listed his numbers on the board and allowed the class to think about and discuss John's method for a bit. When the class had come to a lull in their thinking, she asked if anyone had thought of using the toothpick ideas to help them. Annette offered some faulty reasoning that was mistakenly based upon divisibility by ten. Then Samantha started to lead them more directly. She asked the students to think more about the other divisibility rules they had discussed. The students raised ideas regarding divisibility by three and two. As they had not mentioned the rule she wanted them to use, Samantha continued to push further, asking if there were other divisibility rules. When a student finally suggested four, Samantha jumped all over it.

> Samantha: Four! What was the scoop there? Look at the last two digits? So there we are looking at every bundle of 100 you can already put into groups of four with none left. So, it comes down to what is in the tens and ones place. If that number formed by the last two digits is divisible by four, then the original number is divisible by four. Does that make sense? Does that spur your thinking at all? [pause – 6 sec] Everybody take a minute and think about that four test but now think in terms of eight, the divisibility test for eight and see of you can just talk to a neighbor for a minute and use the test for four as an inspiration. (Samantha, class video 11/28/05)

Once Samantha led the students to the prior knowledge that would be most helpful, they were able to decide on a rule for eight.

In talking about this exchange, Samantha again suggested the she made this choice based on appropriate use of classroom time. She knew that John's approach was not going to lead the students to discover the rule for eight and that they needed to focus on place value ideas in order to get to it. "I think I had to kind of get them to think in those terms. Well, I mean I wanted them to think in those terms, so I was just kind of giving them a little push in that area" (Samantha, interview 12/7/05). I suggested that her telling actions were leading and hinted rather strongly at the idea on which the students needed to focus. Interestingly, Samantha felt that getting them to think about the rule for four was what was going to make the problem work, and in a way, that was the same as telling them what the answer was.

On both occasions, the steering Samantha engaged in during these examples can be classified as enacted teacher lust. Samantha began both examples by operating in an explaining mode but along the line switched into a direct telling mode in order to maintain the flow of the class. Although she had justification for the conscious choices she made, it did not change the fact that she was taking away thinking opportunities. In the last example, she did this by doing the thinking for the students herself. In her efforts to move the class along, she was forced to tell the students how to think in order to solve the task she had posed for them. She was aware of the consequences but explained that she made a decision to give them a certain amount of time to get to the idea themselves, and when they had not, she tried to nudge them in the right direction. Finally, when that did not work, she made the choice to tell because things were too unproductive. Time concerns seem to be connected to incidents of teacher lust. I will explore this idea in more detail later on in the chapter.

Vicarious Teacher Lust

In describing the manner in which teacher lust can present itself within the classroom, I would be remiss if I did not comment on what I have termed vicarious teacher lust. Vicarious teacher lust describes the feelings I had as a result of my participation in this study. There were moments as I was observing and video taping classes, as well as in my interactions with my participants during interviews, where I exhibited both experienced as well as enacted teacher lust.

Lust as an observer

From behind the video camera, there were two different times that I felt the pull of teacher lust. Both instances took place within Samantha's classroom. The first took place during the students' attempts at finding a function involving arc length. As the students floundered with the notion of function in general and specifically within the context of circles and arc length, I felt a desire to jump in and help. I saw where their confusion lay, and I felt if I could just get in there and explain a few basic ideas to them, they would be able to complete the task Samantha had set out for them. This moment of experienced teacher lust was not a new feeling for me. I knew that I was very susceptible to these feelings in general. In fact, my personal battle with teacher lust was one reason I decided to pursue this study. However, I was surprised to find that I felt the pull of teacher lust when I was not acting in the role of teacher. I had observed others have this experience, most notably some of the participants of the CPTM Summer Institute in Michigan. But, to see this in myself was a bit unsettling, especially because even though I was not supposed to interact with the classroom I was observing, I felt a strong desire to do so anyway.

On another occasion, I actually acted upon my feelings. The class was discussing whether or not a set of lines was parallel, and no one, including Samantha, was able to remember the term corresponding angles. They knew what the angles were and that knowing they were congruent would allow them to prove the lines parallel, but they could not recall the term. I blurted it out. From a research standpoint, I know it was wrong to interact when I was supposed to be in an observing role, but I honestly felt much better for having said it. And, because supplying the term helped resolve the issue so the class could focus on the mathematics at hand, I could classify this as an example of judicious telling. However, it was a moment I felt the desire to jump in and acted upon it. To me, it is an example of vicarious teacher lust due to the context, not necessarily to the action itself.

For me, these moments were about my need to demonstrate my own mathematical knowledge. These examples were not monumental in a pedagogical sense, although from a research standpoint they may be. What was worse in my mind was what I found in transcribing and analyzing the interviews I held with my participants.

Lust as an interviewer

The interview process is supposed to be conversational, at least that is how I had always thought of it. My interviews certainly were comfortable, and there was a free exchange of ideas between the participant and myself. What I was not aware of until examining these interviews was the number of times I had inserted my own thoughts on pedagogy and mathematics into the conversation. During the three interviews I held with Samantha, I engaged in this form of teacher lust six different times. With Elizabeth, I did so eight times. These examples consisted of me sharing my opinions on how to teach the same material, my experiences working with preservice teachers in general, and my own conceptions of the mathematical ideas we were discussing. I cite these examples because although it was my intent to raise awareness of the construct of teacher lust, it was not my intent to directly change the practice of the participants as if this were a professional development activity. Due to my own teacher lust however, I found myself engaging in these types of acts. From a pedagogical standpoint, I was more likely to offer suggestions and ideas to Elizabeth, as in my mind she was still developing her practice. In Samantha's case, my interactions could best be classified as a need to demonstrate my own competence as a mathematics educator. This is most likely due to the fact that she is very experienced teacher, and I wanted her to see me as an equal. Regardless of the factors that influenced my teacher lust, it is important to note that I was susceptible to its siren call without being in a leadership position.

What Factors Influence Teacher Educators To Feel or Give in to Teacher Lust?

My participants were susceptible to feelings of experienced as well as enacted teacher lust. My examination of the data revealed several factors that served as an impetus for these feelings. Some can be attributed to the individual participants. Factors such as pedagogical content knowledge and beliefs regarding teaching and learning mathematics can have an impact on how susceptible a person is to experienced or enacted teacher lust. Beyond internal influences, contextual issues such as student actions and interactions can also be attributed to influencing these feelings. Within this next section, I present evidence supporting these claims.

Pedagogical content knowledge and teacher lust

An interesting side result of my participant selection process was the contrast in experience between the two participants. As the main architect involved in designing the six courses taken by elementary and middle school preservice mathematics teachers, Samantha had a great deal of experience in thinking about these courses. She also had extensive experience teaching these courses within this institution as well as some experience with children in the middle school classroom. Conversely, Elizabeth was in her first semester at this institution, and this was her first experience working with this particular population of students as well as her first time teaching this, or any of these classes. With these factors in mind, I make the case that the levels of pedagogical content knowledge demonstrated and held by the two instructors were significantly different. And, their individual levels of pedagogical content knowledge played an important role in how they experienced and responded to feelings of teacher lust.

Elizabeth's pedagogical content knowledge

During our preliminary interview, Elizabeth had expressed a desire to create a classroom environment where students were given the opportunity to make sense of mathematics. However, within my first round of classroom observations, it appeared Elizabeth was consistently doing most of the thinking for her students. As described earlier, within Elizabeth's set ups she often told the students what mathematics would be needed to do the problem, as well as what mathematical ideas they should see within it. As they worked in small groups, she stayed at the front of the room and did not attempt to engage with the students as they worked on and discussed the problems. As the students shared their solutions, Elizabeth would often reshape and restate their ideas in her own words. She wrapped up each task by reiterating the main ideas she wanted the students to get out of the problem. These were often the same ideas as those with which she introduced the problem. During the interview following this cycle of observations, we discussed what I had observed. On several occasions I asked questions pertaining to the choices she had made to tell or to explain. My intent was to find out what other approaches she may have considered before deciding on her course of action. Based upon her responses, it seemed that many of her actions resulted from her developing pedagogical content knowledge. Specifically, two main issues limited her: she lacked knowledge about this particular population of students, and she was developing her questioning techniques and, as a result, had difficulty generating discourse. Due to these influences, Elizabeth, at times, engaged in actions that unintentionally limited the thinking opportunities of her students.

Elizabeth's knowledge of her students.

In the process of teaching over time, teachers develop an understanding not only of their specific course but also the ways in which students respond to it. As teachers gain experience, they learn to anticipate what prior knowledge students need to have to understand a new idea or topic. They also learn to anticipate which topics will be particularly difficult for students. Elizabeth was going through this process as she taught this course, but during this first cycle of observations she often missed opportunities to develop this knowledge because she either made assumptions about her students' knowledge or did not think to examine them in the first place. When the various models of multiplication were being discussed, Elizabeth was very explicit in telling the students what a tree diagram was and explained how it could be used as a model of multiplication. Elizabeth claimed that tree diagrams were not "natural ways of organizing the information" and that if she had not explained to the students how they could be used to think about multiplication, they would not spontaneously invent them. This is an example of Elizabeth's pedagogical content knowledge influencing her actions. On one hand, the students had possibly learned about tree diagrams at some point in their schooling career, although it was also possible that they had not seen them used in the particular manner Elizabeth wanted them to use. Whether she considered this or not is unknown. However, it was evident that she did not know how to pose questions or tasks that could help students generate the idea of a tree diagram and to then connect it to multiplication. (In elementary mathematics this is often done through the use of word problems involving combinations.) Instead, Elizabeth made an assumption about her students' prior knowledge, and missed an opportunity to examine what the students really did and did not know. As a result, this task was pitched at too low of a level for her students, became very teacher directed, and was not as effective as it could have been.

Elizabeth explained that she thought the tasks in the textbook influenced her actions. She saw them as very structured and often assumed some prior knowledge from the students. As a result of this, she was compelled to "introduce some of the machinery." She gave an example of a task that examined a student's use of the distributive property. Elizabeth claimed if she had not explicitly defined the distributive property for the students before assigning the task, it was possible the students would have been confused, and not in a productive way. I countered by pointing out if that had happened she would at least have learned something about her students' knowledge of mathematics. Again, this was a missed opportunity for Elizabeth to develop knowledge of her students, which could inform her future choices.

Elizabeth missed another opportunity to help her students make a mathematical connection she had recently discovered. As she was preparing for class and working through an activity involving the distributive property, Elizabeth came to a mathematical realization. In the course of doing the problem, she realized that the distributive property allowed her to switch the order of operations for a given expression. For example, in simplifying $6 \cdot (5 + 1)$, one would add the numbers inside the parenthesis first. However, the distributive property allows you to perform the multiplication first should you choose to do so. Elizabeth made it clear that this was a big discovery for her. However when it came time to use this task in class, Elizabeth did not think to give her students the same opportunity she had. Elizabeth introduced this task by defining the distributive property for the students. She continued by stating that the distributive property allows us to switch the order of operations for a given expression and then asked the students if they knew why she made that statement. However, instead of waiting for a response, Elizabeth immediately answered her own question for the students with scarcely a pause. This is consistent with Kilpatrick's (1987) notion of teacher lust.

Elizabeth's statement impressed me when I heard it in class. That idea had never occurred to me and I thought it was an incredible question to ask. When she did not give the students an opportunity to think about it, let alone answer it, I wondered why. In our interview, Elizabeth made a point to tell me she did not like answering her own questions, and if she was going to pose a question she truly wanted it to be open for discussion. It was at this point that I asked her about this episode. She explained that it had not occurred to her to actually pose that to the class as a question, and she just used it as a means to talk about the distributive property. This is evidence of Elizabeth's developing pedagogical content knowledge as defined by Shulman (1986); a lack of an arsenal of different ways to approach a topic. Elizabeth made this connection for herself in the act of exploring the content. However, as she presented the set up for this task, she removed that opportunity from her students by engaging in an expository mode on the topic. This choice lessened the effectiveness of the task.

In Elizabeth's classroom, there were very few examples of genuine class discussion. Within small groups the students seemed to have worthwhile mathematical conversations, but in the whole group setting this did not seem to be the case. In general, Elizabeth claimed to struggle with knowing how to respond to student questions. "I'm very tempted to just give them an answer and I'm often not sure how to balance both helping them figure things out on their own and wanting them to just know the right answer" (Elizabeth, interview 10/25/05). This can be a struggle for most teachers, especially those who are relatively new to the practice. Elizabeth admitted that there were times when she did not know what to do in order to achieve her learning goals. In those cases, she did the only thing she could think of–she told. For example, the students had been working on a task that asked them to find the area of a stamp that was $\frac{3}{4}$ of an inch long and $\frac{5}{8}$ of an inch wide. The students came to the board to draw diagrams and explain their solutions. Elizabeth wrapped up the problem for them by talking about how the "shifting wholes" can cause confusion within fraction multiplication problems. She explained how solving $\frac{3}{4} \bullet \frac{5}{8}$ forces you to first find $\frac{5}{8}$ of a unit square (the original whole) and then to think of $\frac{5}{8}$ as your new "whole" and then find $\frac{3}{4}$ of that. Apparently, within Elizabeth's other section of the course, her students had raised this point themselves, whereas in this class no one had mentioned it. Elizabeth had not previously considered how she would raise this issue for the class through questioning, and therefore she "…couldn't think of what questions to ask or how to continue the activity to make that come out as an important point" (Elizabeth, interview 12/8/05). Elizabeth wanted to act in Mason's explaining mode, to question and help her students make sense of this idea for themselves. But, she did not know what questions to use to allow them to do this. This lack of pedagogical content knowledge forced her into a telling action, as it was her only option.

Generating discourse.

The above example was indicative of some of the other problems Elizabeth had with her questioning technique and in generating discourse in general. Elizabeth's students, with the exception of three or four, seldom participated voluntarily. Elizabeth was aware this small group was monopolizing the class discussion; however, she still expressed a reluctance to randomly call on students. Elizabeth sympathized, saying she would hate being called on randomly but also saw a need for more students to be involved in the class discussions. She thought her students were more than capable of contributing to class, but she struggled with resolving this dilemma, "It's okay to make them uncomfortable by challenging their thinking, but I don't want them to cower and not want to come to class because they're so uncomfortable about being in the room" (Elizabeth interview 10/25/05). Based on her experiences, she decided it would have been best if she had begun the semester calling on people randomly. Not having this option, she did the next best thing. At the beginning of one class she announced that she was going to choose students to begin the discussion of a problem by selecting a random name from a bag. She hoped that this would get more students involved and improve the discourse in the classroom. When we discussed this change in our second interview, Elizabeth shared that although she was worried about how her students were going to react, she found they did not have a problem. When she called on students, they were perfectly happy to share their answers and felt comfortable enough with her to tell where they struggled with a given problem. Elizabeth used this to confirm her thought that she should have begun the semester in this manner.

Unfortunately, calling on students randomly did not solve all of Elizabeth's discourse problems within the classroom. She was also in the process of developing questioning techniques she could use to facilitate classroom discussion. This facet of her pedagogical content knowledge limited her possible teaching actions at times. One problem involved the types of questions Elizabeth was asking. "Sometimes I think I have something too specific in mind with my questions. I've asked it and then no one answers" (Elizabeth, interview, 10/25/05). When this occurred, Elizabeth felt she had no other choice but to answer the question, stating the information she thought was important for the class to know. Again, she desired to act within the construct of the open teaching triangle but struggled in knowing how to do so.

We discussed her students' lack of willing participation in these cases, and I asked her what types of things she had tried in order to get the students to answer the questions instead of her. She had tried waiting, although she admitted that had not helped. She had also tried asking for verbal group responses or asked students to raise their hands if they agreed with a statement or not. Neither of these approaches resulted in more responses, though it should be noted that Elizabeth tried these approaches sporadically and without much reinforcement. Elizabeth was unsure why the students were not participating; she did not know if it was because they did not know the answers, because they did not want to think about it, because they did not feel like it, or if they had not had enough time to think about it. Without understanding why the students would not participate, Elizabeth admitted she did not really know what to do about the problem. I asked her if this lack of response influenced her need to tell.

> Well, I feel like I have no choice but to tell them something cause no one's volunteering. And I don't want to just keep calling on the same three people over and over again because they're the only people who will respond. I don't want everyone else to think, "oh well we'll just wait for Amber to tell us," although I feel they do that anyways. And I don't know how to get out of that. (Elizabeth 12/8/05)

When she posed a question and received no response, Elizabeth did not have any other recourse but to tell. One alternative would have been to pose a different question to attempt to engage the students in the discussion or use a strategy such as think-pair-share (Thornton, 1991), but she did not know any other way of restating the question or trying another path to help the students think about the idea she was getting at. This lack of knowledge forced her into telling actions of enacted teacher lust.

Elizabeth's developing pedagogical content knowledge.

Elizabeth's developing pedagogical content knowledge did limit her actions at times during the study. Through our interviews however, Elizabeth was able to reflect on her practice. This allowed her to make some significant shifts within her teaching as the semester progressed.

Being able to reexamine and discuss her practice opened Elizabeth's eyes to how she was actually acting in her class as opposed to how she thought she was acting. During our first interview, Elizabeth often was able to talk about what she would do differently if she had the opportunity. She remarked on more than one occasion that certain alternative options had not occurred to her as she was planning her lessons. We discussed her choice to wrap up the cube problem by making all of the connections for the students and summarizing the mathematics for them. Although she had not considered it before, Elizabeth suggested an alternative approach that asked the students to point out the properties involved. She could have asked them to examine the six different expressions, find relationships between them, and use the properties of arithmetic to describe the relationships. Taking this approach would have allowed her to know if the students really understood how the associative and commutative properties worked.

Beyond considering choices she could have made in the classroom, Elizabeth also made a concerted effort within her planning and implementation to make adjustments to her practice. She admitted that in many instances she simply had not considered certain actions in the classroom, and after we had discussed some cases where she may have made different choices, she was quick to take these ideas into consideration. In general, Elizabeth began to realize that she did not need to tell as much as she had been doing. So, instead of planning what she would tell the students to introduce a problem, she would decide on a question to ask them about it first and see what they knew. In Elizabeth's opinion, the students learn more by doing things for themselves rather than her doing it, and if they could not respond to a question she posed, she could then feel justified in telling them things they did not know.

These changes were also evident in her actions in selecting, setting up, discussing, and wrapping up tasks. Whereas in the first cycle of observations Elizabeth often gave lengthy introductions to activities, after our first interview her introduction of a task was more likely to be along the lines of "Do activity 7H, numbers 1 and 2." She realized in many cases she did not need an elaborate introduction to motivate a given task, and doing so could take away from its effectiveness. During discussion of the problems, Elizabeth was more careful to use the students' language and word choices, putting their incorrect ideas on the board for the class to discuss and debate instead of changing it herself. During wrap ups, Elizabeth still tied ideas together, but in these cases she was more likely to point out where the student explanations could be improved instead of summarizing by introducing her own ideas. Each of these actions was a subtle shift in Elizabeth's mode of operation and demonstrated her ability to reflect on her experiences and develop her practice. She attributed much of these changes to her planning process.

> I think I've also changed the kinds of activities I've chosen a little bit, so it might be sort of all wrapped up in there. I think when I started, I felt like I had to do the foundational activities first. So I had to really explore fraction multiplication completely before it would be a good idea to introduce something about a student misconception. It's a traditional, very mathematical approach to the idea. We start with the idea and make sure we completely understand it, and then we can go on to something more sophisticated. And so I think I'm maybe starting to feel like it's better to start out with some activities that require you to have a more sophisticated understanding to totally understand, but they bring out good ideas right from the beginning, and so they maybe motivate things a little more for them when we go back and look at what does fraction and multiplication mean. (Elizabeth, interview 11/18/05)

Elizabeth's decision to make this change is evidence of her developing pedagogical content knowledge. Once Elizabeth realized that there was a disconnect between her intent and her actions, she made a conscious effort to change her practice and operate in a manner more in line with the foundations of the open teaching triangle.

Shifting from her self-described "traditional" approach and electing instead to elicit the mathematics through her students' activity is a relatively large leap to make.

Elizabeth's progress in this area was evident within her description of the choices she made in introducing the four operations throughout the semester. Elizabeth took a different approach to each of the operations, and each new attempt helped her to eventually arrive at a method that pleased her. In introducing the addition and subtraction operations, Elizabeth said she had "some sort of long winded introduction to get through" and then asked the students to write word problems and pick out which meaning of addition or subtraction was being used in their problem. When this approach did not work, she surmised it was because her students did not have a concept of what it meant to define an operation and that they did not know how to compare it to the problem and the situation. I was not present for these classes, so I cannot speak directly to whether this was indeed the problem. However, I can say that I think this approach could be effective and am very interested in how Elizabeth facilitated these lessons and how the students responded to it.

Due to the "failure" of this approach, in introducing multiplication Elizabeth decided to state the meaning she wanted the class to use. Then, her goal was to make sure it made sense to the students and that they understood how to apply that meaning. She was not pleased with this approach either. When it came time for the class to begin thinking about division, Elizabeth decided to try her first approach again. She asked the students to write a division word problem for 12 divided by 3. She then asked for some examples and wrote them on the board. Her students were able to successfully identify the two different meanings of division within the word problems and define them as well. Further, her students were able to connect the two meanings of division (how many groups and how many in each group) back to the meaning of multiplication. Elizabeth was really pleased with this lesson, saying “I felt like I’d finally found a good way to do that activity that balanced letting them come up with the ideas on their own but not having the activity just be sort of directionless” (Elizabeth, interview 12/8/05).

Not having witnessed the addition / subtraction lesson, nor the division lesson, I cannot speak for certain what made the difference the second time around. However, I can hypothesize that her success was influenced by two factors. First, her students were more comfortable with the notion of defining an operation, and their knowledge of the other three operations played a role in their ability to successfully interact with the tasks and discussions Elizabeth set for them. Second, I would surmise that Elizabeth was better equipped both to pose questions and facilitate the discussion within the class. As a result of the experience she had gained in introducing the other operations, as well as thinking about what did and did not work for her in the past, Elizabeth was able to maintain smooth shifts between acting in an exploring mode and an explaining mode of interaction. Through which her students were able to engage within the mathematics in a meaningful way. Thus, Elizabeth was successful in maintaining her presence within the open teaching triangle during the division lesson, unlike the others in which she either shifted towards the closed triangle (addition and subtraction), or chose to act within it from the start (multiplication).

Samantha's pedagogical content knowledge

Samantha's strengths

Samantha's actions within her classroom were markedly different than Elizabeth's. It was evident that Samantha had developed considerable skill in facilitating discussion and was able to alter her questioning in order to engage the students within the mathematics without having to present the information herself. In certain specific instances where Elizabeth might have been inclined to shift from an explaining mode into an expository one, Samantha was able to continue to pose questions, offer counter examples, or present new tasks to keep the mathematics in the hands of the students. As the students worked towards one main idea within the number theory unit, Samantha had several opportunities to demonstrate her abilities.

The students worked a set of activities that examined various ideas involving factors, multiples and primes numbers. Samantha's overarching goal for this set of activities was to use them to have the students pose and answer the question 'How far do you have to check in order to decide if a number is prime?' The set began with an activity asking the students to find the greatest common factor and least common multiple for two whole numbers. The students decided that listing was an appropriate method to accomplish this and offered several methods for finding all of the factors of a number, including a method they referred to as the "swoosh" method. In the swoosh method, the factors were listed as pairs shown below. The 'swoosh' is invoked as you wrap around the factors from the left side to the right side.

1	40
2	20
4	10
5	8

During the discussion of listing all of the factors of a number, Samantha had a natural opportunity to raise her main question, but she consciously avoided doing so, choosing instead to let that task be wrapped up and to then present another. The next task continued the exploration of LCM and GCF through the use of the spirograph problem discussed earlier. In working through the problem involving 48 teeth and 22 holes the students stumbled upon an interesting conjecture. One student had found the solution by using the LCM of both numbers and dividing it by 22; another had found the GCF of the to numbers and divided it by 48. The result in both cases was the answer 24. The students wondered if this was a coincidence. Samantha had two options at this point: the class could spend time examining the validity of the claim, or they could spend time exploring why it was true. Samantha chose the latter, confirming that their idea was not just a coincidence and posed a task for the students to explore that relationship. Samantha made this choice purposefully, explaining she thought it was more important for the students to spend the time exploring and thinking about why the relationship was true.

After completing this new task, the students spent some time working through the Sieve of Eratosthenes in order to sift for prime numbers. In discussing this activity, there was another opportunity for Samantha to raise the question of how far a person needed to check to see if a number was prime. Carol, who talked about using the sieve in her middle school field experience class earlier in the semester, raised the issue. On their 100 boards, Carol had told her students they only needed to sift through 7 in order to find all of the primes. Samantha asked her what reason she had given the students, but Carol could not remember what she had said to them. Samantha elected not to give anything away and instead mentioned that they would explore that question during the next class. At the beginning of the next class, Samantha asked the students to think about the following: “How do you determine if a counting number is prime?” They began exploring whether or not 239 is a prime number. Annette suggested that only prime numbers, like 2 and 3, needed to be checked to see if they are divisors. This statement confused some students, and as the discussion continued, Julie finally asked the question Samantha had been waiting to hear, "When do you know when you can stop checking?"

In our interview Samantha discussed this series of tasks and explained her purpose in selecting them, as well as how she was able to put off posing the question herself. "The big idea that I want them to get to is that you can stop… to say less formally you could stop checking primes where the divisor and the quotient become roughly the same size" (Samantha, interview 11/18/05). When the listing methods were discussed, she considered whether or not she should raise the issue then and knew that she could get back around to that idea, so there was no need to push toward it at that time. She was correct of course; Carol touched upon the idea again as she discussed the Sieve of Eratosthenes. This exchange was even more connected to the question, but Samantha again did not press the question. She knew where the lesson was going to go and that the students were eventually going to be faced with that specific question. But perhaps more importantly, Samantha was adamant about the students posing that question for themselves before focusing the class discussion on it.

> And it's actually important I think for them to get to that question, because otherwise the answer doesn't make any sense if you don't… it happens so much in math that you're hearing a lecture on the answer to the question and you don't get the question. That's a problem. (Samantha, interview 11/18/05)

For Samantha, it was about motivation for her students' learning. Having an answer to a question you do not understand or care about is not as useful in her eyes. This sequence is evidence of Samantha's ability to operate within the open teaching triangle and supports the theory that her pedagogical content knowledge allowed her to do so.

Consequently, once the question was posed Samantha still needed to help the students grapple with the answer. The first suggestion, from John, was to stop once all of the prime numbers that lie halfway to the given number had been checked. The class made an intuitive argument that there had to be a smaller stopping point than that. During the next part of the class discussion there was great confusion, along with a lot of random guesses. The students seemed to be fixed upon the number 17 as the key to answering this question. Samantha was able to ask questions such as "Do we always stop on 17?" in order to help the students open their thinking from specific cases to more general instances. Another idea they continued to cling to is the notion that if 11 did not divide the number, then you did not have to check any of the multiples of 11 either. This is a true statement; but, the students were confusing this issue with whether or not you had to check 11 in the first place. The students became borderline obsessed with this idea, and no matter how many different ways Samantha asked, the students did not catch on to her meaning. I asked Samantha if this was frustrating to her (because it certainly was for me as an observer). Samantha seemed to shrug it off, saying that that type of confusion is a part of learning because sometimes "you get yourself balled up in something and you have to try to get yourself out of that, and they were kind of stuck on that" (Samantha, interview 11/18/05). Samantha eventually suggested they revisit the swoosh method in order to help them think about where it made sense to stop checking. Here Samantha was acting in an explaining mode; scaffolding their ideas by asking them to revisit a previous idea. This is also an example of what Chazen and Ball (1999) would classify as judicious telling. With this focus, the students were able to arrive at the notion of the square root of a number being the stopping point to check to see if it is prime. Samantha was able to maintain a balance between the students' exploring of the problem and her explaining of their ideas. She was not tempted in this case to shift into an expository mode, and her quote regarding the process of student learning serves as possible explanation for this.

Throughout these lessons it was evident that Samantha had a good sense of where the overall trajectory was headed. Also obvious was that she had used these tasks before and was comfortable knowing which would allow her students to explore the ideas brought up during the course of the discussion. Having this flexibility not only in task choices but also in questions to ask and approaches to take within the tasks also allowed her to facilitate these classes with little direct telling. Samantha had worked in such an environment for many years and had designed her courses to be implemented in this way. As a result, she was very comfortable with the pitfalls that inevitably arise when working in a non-lecture format. However, she also understood that acting in this manner was not a natural thing for most teachers to do, and she has had to work at developing techniques and strategies to avoid getting in the way of her students' thinking during class.

> I remember when I was first trying to teach from an activity point of view where they think through things, and then we discuss what they've come up with. That is very difficult. It was really hard to try to learn to teach that way – my colleagues seemed to always struggle with that also. And part of it is you don't know how to handle what the students say. You know? They say things and then you're like well, what do I do now? Do I say yes? No? Do I say, "Well why is that?" Do I ask somebody else for what they thought? And for some reason, you just have to learn how to have a repertoire of things that you can say at the moment or ways of dealing with that. And then the hardest part is

> how do you deal with something that's not correct? I mean that is just a killer. What you say when you see something that's not correct. So yeah, I think when I was first starting to teach this way, there would be a lot more times when I was saying – you know, I was intervening more often, saying different types of things to the students than I am now. It was partly just kind of learning to say things like, "oh, what do you guys think? Is that right? Do we agree?" (Samantha, interview 12/5/05)

One technique Samantha employed quite frequently in order to spark conversation without telling the students what to talk about specifically was posing a question along the lines of "What is the scoop on that?" Samantha made a conscious choice to use this question and others similar to it in order to stimulate discussion. In her view, this question was used when she had put the students in a situation where hopefully they were seeing something interesting going on and she was asking them what they saw. But she did this in a manner that did not point out anything for them. "I don't want to point out. I want *them* to see, all right, what is going on? So that's why I say what's the scoop?" (Samantha, interview 12/5/05) Interacting with students in this manner has become second nature for Samantha, although she realized that she was still prone to lapses. This questioning technique allowed her to keep the focus of the discussion on the students' conceptions of mathematics without having to impose her own views.

Samantha's developing pedagogical content knowledge

As evidenced above, Samantha's strength in pedagogical content knowledge had allowed her to avoid some of the trappings of teacher lust. When she operated within unfamiliar territory however, she seemed to have just as many struggles as Elizabeth had. This was the first time Samantha had taught this particular course for preservice middle school teachers, although she had taught a similar course for elementary school teachers. One of the main differences between the two courses is the depth in which functions are addressed; the middle grades course places more of a focus on functions. And because her textbook mainly focused on elementary mathematics, she had not developed activities for some of the ideas she wanted to cover. As a result, Samantha was teaching some topics in this unit for the first time, and it was evident that she was developing pedagogical content knowledge as she did so. This lack of experience impacted Samantha's feelings of teacher lust and caused her to engage in acts that were in contrast to her actions while teaching other topics.

Samantha began her first lesson on functions simply by asking the students to give some examples of functions. The students offered two examples; $f(x) = 2x + 3$ and $\frac{1}{2}x + 5$. Samantha did not press for any others; instead she asked the students to describe the different ways a function could be represented. With some leading from Samantha, the class was able to suggest ordered pairs, tables, graphs, and equations as possible answers. Samantha then presented an eighth grade state standard for functions that requires students to translate among verbal, tabular, and algebraic representation of functions. The class was confused by the term verbal functions. Samantha tried to pose questions to help the students understand what she meant by verbal functions, but in the end, she ended up giving an example herself. She wrote $y = 2x$ on the board and described it for them as "the doubling function." She then explained that she wanted the students to be flexible within these different types of representations and then asked them to describe some of the advantages and disadvantages of each different representation. The students did not respond to this question and seemed unsure what Samantha wanted. At this point, Samantha asked them a specific question about each representation. The students responded, but did not provide responses for which Samantha was looking. She shifted gears again and asked if the table would show everything you need to know about a function. After little response, Samantha told the students that tables are limited in what information they can convey. She then posed a similar question about graphical representation; again she was met with silence. Samantha moved on to algebraic representations; she asked if every function has an algebraic formulation. This question was also met with confusion. At this point Samantha decided to backtrack and tried to refocus the lesson. She wanted to talk in general about what functions are. She defined a function for the class, telling them it is a set of ordered pairs where no first coordinate is repeated with a different second coordinate. She attempted to tie this information back to some of the ideas they had discussed. After doing so, she asked the class for another definition of function. The students did not respond, so Samantha described a function as an input/output machine and gave an example. Her next question asked them to describe a function that did not have numerical inputs or outputs. The students had no clue how to answer this question. Samantha hinted around the idea that it was something they had seen before and then reminded them of the sequence function they had explored involving shapes, where a number like 5 was input and the 5^{th} shape in the sequence was the output. The lesson went on in this manner for the rest of the class period. In general, the students were very confused about what Samantha was asking them to do and struggled to give responses that met her expectations. As a result, Samantha answered a lot of the questions herself.

Samantha attempted to orchestrate this lesson in much the same way she had done others in this course. She posed open-ended questions and hoped to elicit the mathematics from the students' responses. However, this was the first time teaching this lesson, and she had difficulty accessing her students' background knowledge of functions. As a result, her lesson did not have enough support within it for the students to engage in the mathematics in a meaningful way. The students seemed completely lost from the first moment in class and failed to follow the trajectory

Samantha had set up for their learning. For Samantha, her questions had logic behind them and were intended to help the students think about functions beyond a basic level of understanding. However, the students did not appear to remember the basics of functions when the lesson began, let alone engage in the higher order thinking Samantha was asking from them. With the students bringing nothing to the conversation, Samantha was forced to provide almost all of the information herself by direct telling.

Samantha labeled this lesson as one that was "unsatisfactory" for her, mainly because it was ambiguous and the students were "just fiddling around with a lot of stuff." However, she also understood that these types of things could occur when working in a non-lecture format.

> As much as I like the idea of okay, you guys come up with a lot of stuff and let's pursue what you're doing; at the same time there's this danger of it going off into outer space. And it did kind of go off into outer space … how much did they really learn out of that lesson? I don't know. (Samantha, interview 10/24/05)

I asked her what she would do to restructure this lesson if she had an opportunity to teach it again. Samantha reflected on her students' lack of understanding and decided she needed to do more scaffolding for them than she had done. She would have begun by presenting examples of functions for the students to consider. She would have also given them examples of functions within a given context and made sure to address the notion of inputs and outputs as it pertained to functions. Samantha was aware that the students were lost from the beginning and wanted to make sure they had some experiences to draw on before opening up her questions. It is interesting to note that Samantha was surprised by her students' confusion, especially that they did not seem to grasp the concept of input and output of a function.

> I didn't expect that to be so mystifying and so it was more mystifying than I thought. So if they'd had a little more experience, I think then it would have been less of a mystifying thing. And then it might have been more productive to think about okay, now I'm giving you a context, it's very open, and I want you to come up with some [functions].
> (Samantha, interview 10/24/05)

Samantha lacked knowledge of how the students might respond to this material, and as a result was forced into actions within the moment of teaching in which she would rather not engage. This is very similar to the struggles Elizabeth went through almost on a daily basis. Within this unfamiliar context, Samantha did not have the same resources to draw upon as she normally did. This resulted in Samantha engaging in more direct telling actions than she did ordinarily. However, the experience in teaching this lesson helped her to understand more about what knowledge her students might bring to class in terms of functions, as well as what types of approaches would be more fruitful to use.

Samantha was going to use what she had learned as she continued to write and develop activities for middle grades preservice teachers.

The impact of beliefs on teacher lust

Elizabeth's beliefs

Teachers' beliefs impact the pedagogical decisions they make in planning as well as within the moments of teaching. These beliefs can also impact how they experience teacher lust. Different aspects of their beliefs influenced the participants' episodes of experienced and enacted teacher lust. Elizabeth was influenced by her beliefs about what it means to teach mathematics, specifically by the issue of authority. She did not want to act as the authority in the classroom, but some of her actions and responses suggest otherwise. When she took an authoritative stance within the classroom, it placed a limit on her students' opportunities to think for themselves. Earlier, I described Elizabeth's responses to a student question regarding explanations. She gave the students a prescription of what she felt constituted a good explanation. In doing so, she was implicitly telling the students to produce a mathematical explanation that would satisfy all of her questions, rather than one which satisfied the other students in the class. Elizabeth said the community decided what constituted as a good explanation but went on to say that she was the voice of the community. This statement demonstrates the tension between her expressed desire for the students to create meaning and understanding and her underlying need to act as the authority within the classroom. When all was said and done, she was the one that was going to decide if an explanation was adequate. This is not necessarily wrong, but she did not seem to ever give the students a say in the process. Within the classroom, the students presented the explanations, but Elizabeth was the one who critiqued and evaluated them.

She had also responded to a question regarding proof. The student wanted to review the explanation of the statement 'the product of two negative numbers is a positive number'. Elizabeth reviewed the three explanations that had been discussed in a prior class–using patterns, using story problems, and using the distributive law. The students seemed to be more convinced by intuitive explanations, which suggest the product should be positive. The explanation involving patterns within the multiplication tables, like the ones below, was acceptable for them.

$$-3 \bullet 3 = -9$$

$$-3 \bullet 2 = -6$$

$$-3 \bullet 1 = -3$$

$$-3 \bullet 0 = 0$$

$$-3 \bullet -1 = 3$$

They were also convinced by the explanation based on "The Postman Game," where giving away bills to be paid resulted in a positive gain. However for Elizabeth, neither of these explanations fully proved the conjecture. A proof for this needed to involve the distributive law, and Elizabeth seemed to want the students to be able to argue in a manner that was convincing to her. She presented her proof and explained her logic using the following equations:

$$
\begin{aligned}
&(-2 \bullet -3) + (2 \bullet -3) = (-2 + 2) \bullet -3 \\
&(-2 \bullet -3) + -6 = 0 \bullet -3 \\
&(-2 \bullet -3) + -6 = 0 \\
&6 + -6 = 0 \\
&\therefore (-2 \bullet -3) = 6
\end{aligned}
$$

She seemed to understand that this proof, although convincing for her, was not as convincing for the students, nor was it necessarily useful by itself. However, she thought that within the context of the other two explanations, the students could make sense of her argument. It was as though she presented this proof with the sole purpose of feeling right about the proof for herself, and if she could convince some of the students to accept it as well, so much the better.

Elizabeth also interpreted this question as one of "what constitutes a proof?" Again, Elizabeth explained that the community decides what constitutes a proof, and again she named herself as the community. She justified this choice by saying the students had not done enough proofs to be able to decide for themselves what would be convincing to the community. But, this was another case where the opportunity was never given to the students. In this class, Elizabeth approached the issue of proof from a very informal standpoint and, in her defense, stated that although she wanted her students to have a good understanding of mathematics, it did not need to be exactly like hers. But, she also wanted them to have a sense of what it meant to prove something. Elizabeth was unsure how well she achieved that goal; perhaps she realized she had not given the students enough opportunity to develop that sense. This may have caused her to take more of an authoritarian stance than she wanted to.

In contrast to these examples are Elizabeth's comments on the issue of her perceived authority. She was aware that the students were inclined to view her as the authority figure in the classroom and tried to take steps to counter that. In recounting the class discussion of division by zero, Elizabeth made a conscious choice not to press the students to accept her explanation, because she understood in doing so, she would be sending the message for the students to "just memorize what she had said." In another example, Elizabeth explained her telling actions, which resulted from her students' lack of participation. She viewed them as introducing a viewpoint from another member of the classroom, rather acting as an authority, although she was unsure how her students interpreted this action. In both these cases we can see the tension between Elizabeth's desire not to act as the authority and her students' willingness to place her in that role. This is a common tension in classrooms where instructors encourage students to make sense of ideas for themselves. The instructor wants to place the responsibility on the students, but the students, who may be unaccustomed to this type of approach, expect the instructor to tell them what to do and when to do it. Elizabeth's struggle with this tension caused her to engage in actions that can be classified as teacher lust. Elizabeth continued to search for a way to reconcile this tension within her classroom.

Elizabeth's beliefs on learning mathematics also influenced her actions in the classroom. She described the manner in which she learned mathematics best, and these beliefs were reflected within the pedagogical approaches she took in the classroom. Elizabeth felt as though she first needed motivation in order to learn effectively; she only learned mathematics that mattered to her. Then, she wanted to have time to struggle with an idea for herself by working on problems and reading about it. Then, Elizabeth solidified her understanding by listening to other people's perspectives on the topic. Elizabeth followed a similar pattern in her approach with this class. She tried to motivate a need for the material and always gave the students time to work on it before they discussed and presented their ideas to the class. However, as she attempted to complete each of these stages she was sometimes prone to engage in acts of teacher lust. To motivate the learning for her students, Elizabeth attempted to act in an expounding mode, where she could share her connection to the mathematics in a way that engaged the students in her discussion. However, she tried to do this by listing her conceptions of the important mathematical ideas that a problem addressed. In taking this course of action, she was risking a failure to connect to the students' experiences and remove an opportunity for the students to make these discoveries for themselves.

Elizabeth also wanted her students to share their ideas aloud and to learn from other people's opinions. Her struggles with generating discourse in the classroom impacted this goal. Further, Elizabeth thought the students needed her to help them understand what parts of the discussion were important. As a result, Elizabeth's voice was heard most often as she attempted to make sense of things for the students. She thought she was contributing to the students' learning by reshaping and focusing the ideas they had presented. We discussed whether or not her students were capable of summarizing the big ideas from a discussion. "I think sometimes when I leave things up to class discussion, it ends up being sort of really muddy for them… I think they need help focusing on ideas" (Elizabeth, interview 10/25/05). Elizabeth often presented her own conceptions of a problem at the end of a discussion, at times entering an expository mode and introducing new ideas that had not been raised by the students. She defended this action by explaining how that would help her to better understand what was said.

"I guess it's not just hearing another person's solution, but sometimes hearing someone who I think has a better understanding, sort of crystallize what it is that I'm seeing" (Elizabeth, interview 10/25/05). In these examples, Elizabeth imposed her own method of learning on to her students. Although she did so with good intentions, she later realized that there were other ways to achieve the same goals.

Samantha's beliefs

In chapter two I classified Samantha as taking a "content focused" approach to teaching mathematics (Kuhs & Ball, 1986). Samantha's actions were controlled at times by her beliefs about what it means to do mathematics. Samantha had strong feelings about protecting the integrity of mathematics, and the tension between her beliefs and the informal approach used in this course sometimes caused her to engage in direct telling actions. In most cases these incidents took place as the students were engaged in problems that involved the concept of proof.

The first example took place during the sighting activity. The students had used a proportion to find the measurement of the wall. However, they had not proven explicitly that the triangles involved were similar. Samantha pointed this out to the class, saying that there were some things about this problem that were "hidden." She asked them to justify why the two triangles were similar. The students struggled with remembering how to prove two triangles similar; one even offered "side-angle-side" as a reason why it was true. The class could not remember how to prove this, so Samantha tried to act in an explaining mode to help the students think through the problem. Instead, she ended up leading them step-by-step through an explanation of the reasoning in an expository mode.

Samantha then told the students they were going to tie the sighting activity back to their discussion of linear functions and that they would use the same technique to derive the equation of a line. She began by reminding the students that in order to prove triangles similar, it was enough to show two angles were congruent. Then, she handed out a sheet containing a diagram similar to the one they had used in the sighting problem (Figure 11) and a list of some 8th grade standards.

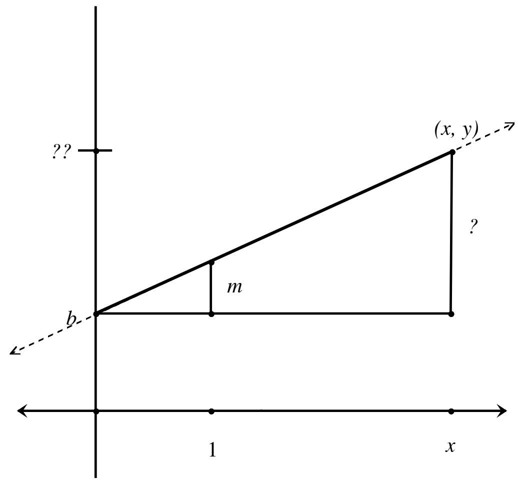


Figure 11. The slope-intercept formula diagram.

The class used this to unpack more of the mathematics involved in the problem. They first discussed an eighth grade standard involving angle relationships formed by parallel lines and transversals. Annette identified the parallel lines and transversal on the diagram and then stated the corresponding angles were congruent. The students also pointed out the right angles as being congruent. Samantha then directed their attention to another standard that required students to understand the ratios of segments formed by parallel lines cut by a transversal. Julie pointed out the segments they used in the proportion from the similar triangles. With this information they were able to conclude that the triangles were then similar by angle-angle-angle. The next task was to use what they knew to determine the two unknowns in the diagram; these were delineated by the question marks. Josie came to the board to discuss her solution to the problem. After restating the triangles were similar, she set up the proportion: $\frac{m}{1} = \frac{?}{x}$ and stated that the question mark was equal to *mx*. She said the double question mark (??) would be equal to whatever the question mark was, plus *b*. So, the double question mark was equal to $mx + b$. She completed the problem by pointing out that the double question mark was the same as the y coordinate, so $y = mx + b$, which is the equation of a line. Samantha then summarized how the parallel lines formed congruent angles that in turn led to the similar triangles. She also pointed out that there was something "sneaky" going on in the problem as well. She told the class that they were able to use the markings on the axis to determine the lengths on the diagram because of the rectangles that are implicit to the diagram (Figure 12). She told them that the opposite sides of a rectangle are congruent and that is why they were able to use the axis to determine the measurements. She concluded the lesson by asking the students to write out solutions to this problem for homework.

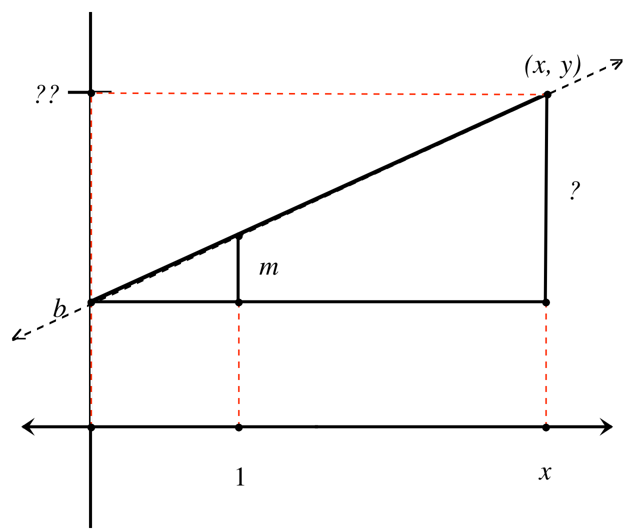


Figure 12. Samantha identifies the rectangles within the diagram.

Samantha and I discussed her decision to point out the rectangles. She said she had not planned on talking about the rectangles, but in the moment she thought that in order for this to be an "honest proof" she should do so. She mentioned it as a case of adhering to "intellectual honesty." I asked her to whom she thought the intellectual honesty was important.

> I mean maybe this almost seems silly, but I think it's important to mathematics. You know what I mean? The integrity of the subject that even if there are times when you know hardly anybody in the class is really going to sink their teeth into this or really going to pick up from this. But by gum, you know what, on the homework, some people did bring out that rectangle stuff… I want to at least say this because I believe in the integrity of mathematics. I have a duty to the subject to present it in an honest fashion. And if you shove something on there under the rug you ought to at least say a little something about the thing that you shoved under the rug. (Samantha, interview 11/18/05)

So, even though she was not expecting the students to completely understand her reasoning, she felt it was important to say it anyway. This action was a function of her belief in the integrity of mathematics. It can be classified as an example of enacted teacher lust because it was not her intent to engage the students within the discussion. It can also be an example of expressing, where the content acts directly on the instructor and causes her to say, "look at this."

A second example took place during a discussion of a homework problem. The students had written explanations for why the product of two odd numbers is an odd number. It seemed that many of the students tried to prove the statement by showing one specific example was true and then simply stated it would be true for all cases. This approach was unsatisfactory for Samantha, and she decided to spend some time in class clearing up this issue. She explained her reasoning,

> I know you can see it, but that's not a proof. So explain to me why. Give me some reason for why. And we had done something like that in class I think the day before even, or a few days before. Whenever it was. And you know we had given an argument. They had come up with an argument that I thought was good. I mean it really did hold

water. This one was a little harder. You had to say a little bit more. And I think they got suckered into – because the last one was sort of easy and it just kind of rolled off the tongue, that they kind of felt like "well, I'll just kind of mimic that". And you have to say a little bit more. And so they were sloppy. (Samantha, interview12/5/05)

In class, Samantha began by explaining what she had wanted them to do and then drew a picture on the board (Figure 13) to help them rethink the problem.

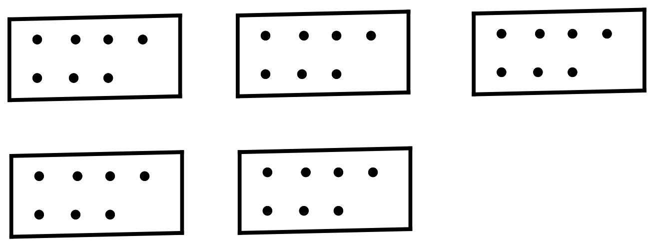


Figure 13. Samantha's representation for proving the product of two odd numbers.

She asked them to look at the picture and explain how they would know for sure that the answer would be an odd number. Susan explained that when the groups were paired up, the dots hanging off of the end would pair up, and the one dot left over in the unpaired group would make the answer odd. Samantha agreed and explained that she drew the diagram specifically in this manner for the students to see the dots as naturally pairing up. She then asked for a general explanation for why an odd times an odd would have an odd answer.

Margaret: There is always one group left over with one dot unpaired in it.

Samantha: And what about the other stuff?

Margaret: Everything else pairs.

Samantha: Everything else pairs up so if it is an odd number of groups, you can arrange the groups in pairs with one left. And if there is an odd number in each group, we can pair up these extras for each of these pairs of groups, but there is still that one left over group, and that one left over group has one left over thing in it. So every thing else if now paired and there is one left over.

Susan: It is kind of the odd man out thing.

Samantha: Yes. This is the odd man out thing. But do you see that you can't just say "well there is an odd number of groups and an odd number in each group so we automatically know its odd"? You have to give some indication of why everything pairs up except for one just odd man out.

Elizabeth: So you could say that the groups pair with one group left over, or you could say that the objects pair with one left over?

Samantha: You kind of have to say both of those things don't we; because it is the paired up groups that allows us to line up the odd man out from each group. Do you see how this is a more generalized explanation when we say it this way? Does that make sense to you? Comments? Questions? (Class video 11/30/05)

This was another case where Samantha thought it was important to step in and set the students' reasoning straight. She could tell that they had mimicked an earlier proof and done a bit of "hand waving" in their explanations, and she wanted them to realize that the two cases were not completely the same. She was not concerned about how directive she was because she had already given the students an opportunity to think about the problem, and she had given feedback to them on their work. She spent time in class to make sure all of the students understood what would count as a proof in this situation. This was another example of Samantha's adherence to intellectual honesty, and her belief in the integrity of mathematics influenced her to engage in the telling actions associated with teacher lust.

Contextual influences on teacher lust

As discussed, internal factors such as a teacher's knowledge and beliefs can influence feelings of teacher lust. However, there also external factors that can impact these feelings as well. My participants were affected by contextual influences such as time constraints, unproductive activity, a desire for closure, a desire for connections, and by the students themselves. These factors seldom operated independently of each other. More often one or more of these or of the internal influences acted on the instructor simultaneously.

Time concerns can certainly influence an instructor in her feelings of teacher lust. It is conceivable that an instructor could run out of time within a class and, as a result, be forced to take a more directive approach in order to complete the lesson. Samantha cited time constraints as justification for her actions on several occasions. Some of these time factors were found within an individual class session; other times the concern was based upon the time frame of the course. In the instances where Samantha was concerned with individual class time, she also mentioned the students' productivity as well. She often used the phrase "off in outer space" as a means to describe unproductive activity in the classroom. In instances where the students seemed to be heading in a direction that was unproductive, Samantha often made the choice to curtail their activity and redirect them in a more fruitful direction. She understood that students were sometimes prone to 'spinning their wheels,' and in the interest of time she was quick to put a stop to it.

> You're trying to stay on a productive line of discussion. You don't want to get derailed off of that. You want to keep people focused. And you know you want to keep moving forward. And I have a particular thing in mind that I want us to talk about at this point. (Samantha, interview 11/18/05)

The students' approach to finding the divisibility rule for eight and their exploration of where to stop to find all factors of a number are examples where Samantha stepped in to keep the class moving in a productive direction.

Elizabeth also was influenced by time constraints within individual class sessions. However the issue of time was compounded by her need to wrap up all discussion on a particular lesson before the end of class. This need for closure influenced Elizabeth to shift from discussing a problem with the students, to lecturing the class about it. She described her feelings about a class where she shifted to an expository mode in order to finish the problem before the class ended.

> I think it's just my natural tendency is to want to wrap things up at the end of class. And so as soon as I did it I regretted that decision. As soon as I did it I thought this would have been a perfect thing for me to say, Here's a problem, think about it at home, is it related at all to what we just talked about, and how is it related. And I guess I think there have been a number of situations in class where that would have been a good idea. I think maybe on one or two occasions, I said think about this on your own and I think that would be a better approach in general, like it's good for them to think about something outside the class, and also there's no reason for me to just tell them. (Elizabeth, interview 11/18/05)

This episode encouraged Elizabeth to be more reflective about these situations in the moment of teaching. She realized she had a natural tendency to bring closure to class, and she became more decisive in regards to these opportunities when they presented themselves.

Students are perhaps the single most important external influence on feelings of teacher lust. Students can impact a teacher's actions through their participation levels, the questions they ask, their responses to questions, and their levels of frustration in the process of doing mathematics. As was described earlier, Elizabeth was especially influenced by her students' lack of participation. She cited a need to tell when the students did not answer the questions she had posed in class. Samantha was influenced not by whether or not her students talked in class, but what they said. For her, the hardest part of working in a task-centered classroom was having a strategy for responding to incorrect answers. When students offer answers that demonstrate a lack of understanding either of the question or the material, instructors may feel the pressure to help them understand by giving a hints or suggestions. Unfortunately, these can lead to the students shutting down their thinking processes and becoming more dependent on the instructor's knowledge. Samantha was prone to these types of influences. One example of this can be found in her interactions with the students as they attempted to prove the triangles within the sighting activity similar to each other.

Both instructors were also concerned with monitoring their students' frustration levels in the process of doing mathematics. They gauged how much and when to give more information based upon their perceptions of the students' collective frustration level. I conceptualized this give and take as 'answering questions with answers versus answering questions with questions.' Samantha commented that, overall, she would prefer to answer questions with questions, but her students would rather she answered with answers. And this tension can be a source of frustration for the students.

> So there's a bit of that tension there, because you know you're trying to bring it along with you. I mean you don't want to get them too frustrated. So maybe sometimes the choice is a little bit a sense of you don't want to get them too frustrated, so that could contribute to answering with an answer. Then there's always the time issue. You know

> it seems like it's going to be productive to have this question on the floor and think about it and keep going with it. (Samantha, interview 11/18/05)

Samantha also thought experiencing some frustration is a part of the learning process, and finding that balance was important. "The whole point of stuff is for them to be thinking about things…I think it's a matter of what is going to most productively focus on those things and sometimes that means a little more information and sometimes a little less" (Samantha, interview 11/18/05). On one occasion, Samantha felt she had offered information prematurely but had made the decision to do so in anticipation of student frustration. Samantha had planned to connect the derivation of the equation of a line to the process of the sighting activity. But she was concerned that if the students did not see the point of performing the sighting activity before engaging in it, it would serve as a source of frustration for them. As a result, she told the students that they were going to derive the equation of the line before they began the activity. Upon reflection she thought the activity could have been more effective if she had not done so. "In retrospect it might've been better to let them see that connection…because I think that did make the whole thing drier than it might've been. It would've been neat for them to say oh, it's really the same thing" (Samantha, interview 11/18/05). This is an example of what Stein et al. (2000) refer to as reducing the level of the task.

Elizabeth's decisions about when to answer questions with questions versus questions with answers were similar to Samantha's. "I tell them things when I think not telling them is going to be a source of frustration without any gain in understanding for the topic. And I don't tell them things when I think their struggle will be helpful in getting at the fundamental ideas" (Elizabeth, interview 10/25/05). When she was planning her lesson on the scaffolding procedure for long division, Elizabeth considered asking the students to try and invent their own algorithms. Upon reflection, she thought it might be frustrating for the students if they produced other approaches and were ignored because Elizabeth wanted to discuss the scaffolding approach. Elizabeth also tried to maintain a balance within the types of questions she posed based upon her students' present understanding of the subject. She thought she could ask specific questions to help students get back on track with the discussion, or she could ask more open-ended and general questions that would serve to help them make connections between this topic and others with which they may be more comfortable. When she was confident in her students' understanding, she was more likely to answer their questions with an answer. In these cases she thought the students were looking for confirmation of their ideas, and it was important for her to give them some positive feedback to reinforce their thinking. There were times when she thought an answer would not address the underlying problem at hand, so she would try and pose a question to better get at the situation. Her sense of the students' frustration levels was underlying all of these decisions.

Another influence attributed to students is the instructors' desire for them to make connections within the material being discussed. For each topic she covered, Elizabeth purposefully selected activities that shared a connection. At times, she wanted her students to see these connections, so Elizabeth would point them out to the students. In other instances, she was not as concerned if the students saw connections, so she did nothing. "I haven't asked them to make connections. I either tell them the connections or just leave it be" (Elizabeth, interview 10/25/05). After discussing this approach, she reflected on other options. She discussed the possibility of asking the students to look for connections themselves and what that might afford her.

> Well, certainly I would think the connection would probably be more meaningful for them if they saw it themselves and sort of worked through in what ways it was similar and in what ways it was different. I think more easily… nothing could come out of my question. And either at that point I could either decide to make the connection myself or I could just leave it. (Elizabeth, interview 10/25/05)

As the semester progressed, Elizabeth seldom pointed out connections. However, she also did not seem to actively encourage the students to make connections for themselves either. Incidental connections that were made were discussed within the class. It appeared that Elizabeth was still developing this part of her pedagogical approach.

Samantha experienced similar feelings during her implementation of certain activities. Samantha's desire for her students to see mathematical connections was evident during the marshmallow problem, the sighting problem, the exploration of the divisibility rule for eight, and in the lesson on repeating decimals. The connections that existed within and between these problems were intentional, and Samantha was active in bringing them to the students' attention. Within the marshmallow problem, Samantha wanted her students to see the connection to the volume formula for pyramids. Samantha made this connection explicit for the students; she did not expect them to be able to make this for themselves. This problem also contained a connection to the students' work on series as well as to repeating decimals. In fact, not only was Samantha adamant that John share this connection with the class when he stumbled upon it, but she had specifically posed the marshmallow problem earlier in this semester in order for this to happen. Samantha's exhaustive efforts to help the students connect the divisibility rule for eight to the rule for four were discussed earlier. Samantha was also explicit about the connection between linear functions and the sighting activity. In each of these instances, she made connections for the students and did not intend for the students to make them on their own. Removing these opportunities is classified as an act of teacher lust.

Each of the preceding examples serves as influencing the participants' feelings of teacher lust. The next section of this chapter examines how their participation in the study impacted their ability to deal with the phenomenon.

How does making teacher educators more aware of teacher lust help them to deal with the phenomenon?

One goal of this study was to examine if raising an instructor's awareness of teacher lust would allow her to better deal with the feelings of teacher lust. Based upon my experiences with my elementary preservice teachers, I surmised that an increase in awareness would lead to a realization of moments where teacher lust was present. This could lead to a more reflective stance regarding actions within the classroom. However, I am not sure if the results from this study support this hypothesis. My participants were very different in terms of their teaching experience and as a result interacted with the phenomenon in very different ways. It appears that the best way to answer this is to examine the impact of the study on each participant on an individual basis.

Elizabeth's changes

Through the course of participating in the study, Elizabeth made a lot of progress in developing her practice. As was described earlier, I saw Elizabeth doing much of the thinking for her students in my first round of observations. During the interview that followed, I asked her to talk about the choices she made in the classroom and why she had decided on those particular actions. She reacted to these questions with a sense of realization. She had not considered examining what the students could tell her about a topic before they began discussing it, nor had she thought about how some of her actions were impacting her students' ability to learn. I believe the conversation served as an impetus for her to do so in the future. She made a conscious decision to make changes in the manner she operated within the classroom during the remainder of the course, and was able to implement them.

I had thought as Elizabeth opened up her practice toward a more student-centered approach, she would be more likely to feel the pull of teacher lust. However, she claimed never to feel any such pull in the moment of teaching. When I asked her if she knew why, she credited her planning process.

> I guess I try and think about before I'm actually in the classroom. Cause it's hard to think through things ahead of time. So I try and think about what might happen. And how my different responses would affect the students. Like, would it be appropriate to let a discussion on this go on? Would this be beneficial for them? Would they understand the material better at the end or not? (Elizabeth, interview 12/8/05)

This serves as evidence that Elizabeth had been thinking about the construct of teacher lust, and made attempts proactively battle it. She had not only reflected on what she had been doing in the class but was able to consider future actions within the lens of teacher lust. When we discussed what she thought she had gained from participating in the study, she said the process helped her to be more conscious of her practice in general.

> I've certainly got a more like focused look at what I've been doing which has been very helpful to see what it is I'm actually doing. And by doing that, I've thought more about why I decided to do things. In many cases I wasn't really deciding cause I wasn't thinking about it. And so I've thought about different ways of working through material with students, and helping them understand it. (Elizabeth, interview 12/8/05)

Elizabeth's experiences in this study certainly appear to have influenced her practice. She developed a sense of what teacher lust meant to her, and she was able to take steps to try and combat those actions.

Samantha's changes

Unlike Elizabeth, Samantha never really developed a sense for what teacher lust meant to her. During our second interview, she said as much and wanted me to define the construct for her. I declined to say directly what my conceptions were, as I wanted to learn how she conceived it. But, I also felt that the episodes I had chosen to discuss indicated some of the actions that I considered to be acts of teacher lust. At the end of that discussion she proposed that perhaps teacher lust was a sense of her going too far too quickly with students. Before our final interview, Samantha was still unsure what teacher lust was. However, in the course of the interview, she latched on to the notion of wanting students to see "really cool stuff."

> I'm not sure I've really figured this out except for just now wanting to show people really cool things. So maybe that is the conclusion. I think even before we started talking today I'm still sort of scratching my head about what is this exactly? I'm not completely sure. (Samantha, interview 12/5/05)

One explanation for Samantha's reaction to the study could be that her experience made her somewhat immune to the pull of teacher lust. She struggled with finding episodes she thought she could classify as teacher lust. "I never really felt it. And then when I would try to think if I had felt it, I wasn't really sure" (Samantha, interview 12/5/05). The one genuine episode, in her mind, was her reaction to the students' responses during the spirograph problem. But, aside from that, she never felt she was caught up in a moment of teacher lust.

Although she did not feel as though she made any strides in terms of dealing with teacher lust, Samantha did feel that the study was beneficial to her. Samantha was genuinely interested in thinking about and discussing the act of teaching, and she appreciated the opportunity to have another person observe her classes and to help her reflect on her pedagogical choices.

> It's always fun to think about. You know, what are you doing? Why are you doing it? And where's it going? And did you have a reason for it, or did you sort of just do it? So that is interesting. (Samantha, interview 12/5/05)

Samantha thought engaging in this type of reflection was harder to do alone, and having another person to pose questions and help her think about her practice made it easier. She lamented the fact that I was not able to see every one of her classes during the semester. If it had been possible, she would have liked to have me observe all class meetings and then hold weekly reflection sessions to discuss what went on in class. She did offer a class for graduate students that involved weekly observations, but she did not think she could raise enough interest in the students to justify adding the discussion component. Based on these statements, Samantha valued this opportunity and it helped her to gain a better understanding of her practice in general.

This study has revealed information concerning the construct of teacher lust that goes beyond Mary Boole's original definition. First is the notion of teacher lust being both a feeling and an action. The distinction between experienced and enacted teacher lust is important as instructors begin to examine their practice in light of this construct. I have also presented some of the manifestations of teacher lust within a classroom, such as imposing knowledge, steering, or reducing the level of the task. And, I have given evidence that teacher's beliefs, the classroom context, and teacher's pedagogical content knowledge are factors that influence teacher lust.

Finally, I have tried to make a case that it is important for teachers who unconsciously give in to teacher lust can become aware of it and take steps to combat its effects.

CHAPTER 5: CONCLUSIONS

Summary

This study was an examination of the construct known as teacher lust. Mary Boole first coined this term in 1931, and she described it as a teacher's natural desire to "…regulate the actions, conduct, and thoughts of other people in a way that does no obvious harm, but is quite in excess both of normal rights and of practical necessity…to proselytize, convince, control, to arrest the spontaneous action of other minds" (Boole, 1931, p. 1412). Boole maintained that when teachers are acting in this manner they may be unintentionally hindering their students' learning; as such this is a construct germane to all fields of education.

Teacher lust is especially relevant within mathematics education as continuing reform efforts urge teachers to act less as providers of knowledge and more as directors of students' active engagement with mathematics. Teacher lust however, is not a popular term within the education vernacular, nor has it been studied with any kind of formality. Therefore, one goal of this study was to better define what teacher lust means within today's classroom. Defining and reintroducing this term into the mainstream can help teachers give a name to feelings or actions they experience in the moment of teaching. In turn, having a name can allow teachers to better reflect upon their experiences and discuss them with others. Simultaneously, the study examined the antecedents of teacher lust. Having a deeper understanding of the factors that may influence its presence can help teachers of all levels to better cope with their interactions with the construct. Another goal was to raise the participants' awareness of this construct and to study what impact this had upon their practice. This is applicable within the realm of teacher change and also connects to issues of reform. The research questions that were addressed in this study were:

1. What is my conception of teacher lust, and how is it evident during mathematics instruction?
2. What factors influence teacher educators to give in to teacher lust?
3. How does making teacher educators more aware of teacher lust help them to deal with the phenomenon?

Teacher lust has not been prominently featured within mathematics education literature; although several educators have mentioned the construct in passing. Hatfield (2001) and Mason (2003) both alluded to their desire for their students to have experiences that mirror his own. Each realized that the pull of teacher lust was a phenomenon that they needed to be aware of and deal with as educators. Kilpatrick (1987) employed the term in describing actions of mathematics classroom teachers in which they ask a question and immediately jump in and answer it themselves.

In order to provide the macro-structure for the examination of this construct, Jo Boaler's conceptions of open and closed mathematics (Boaler, 1998) were embedded within two teaching triangles of operation, the open teaching triangle and the closed teaching triangle. Each triangle connects three important components of education: learning theory, curriculum, and teaching. The open teaching triangle connects constructivist-learning theory to standards-based teaching and results in the reform classroom. The closed teaching triangle associates behaviorist-learning theory with conventional curriculum and produces the traditional classroom. These two triangles serve as two extremes of a continuum of teaching approaches on which a teacher may fluidly slide during the course of a lesson. It is important to define this continuum, as teacher lust is a more applicable construct when a teacher is working within the open end of the scale. Teachers who consistently operate on the closed end of the scale impose their own mathematics as the norm of their instruction and as such are not exhibiting teacher lust. Rather, they are embracing a pedagogical approach founded in behaviorism, which supports the direct transfer of information as the source of learning.

In order to differentiate between specific teaching acts that are or are not teacher lust, I employed Mason's six modes of interactions. He conceptualized the interactions between expert and novice within the realm of mathematics as a triangle that relates tutor (teacher), student, and content such that one of these three "impulses" acts upon another while being mediated by the third (Mason, 1998). There are six distinct ways in which this can happen, which leads to Mason's six modes of interaction: Expounding, Explaining, Examining, Exploring, Exercising, and Expressing. He referred to these as the six Ex's. In each of these modes of interaction, Mason assumed a stance in which the teacher acts as a facilitator and not as a provider of knowledge; this intent is ascribed to the open teaching triangle. But, these intended interactions can result in acts of teacher lust when they are carried out in a way that places the teacher's mathematics at the forefront.

Expounding, explaining, and exploring are most germane to the study of teacher lust, as they describe interactions in which the teacher is in a potential position to impose her own knowledge on the student. Expounding is a connection between the teacher and the content that is mediated by the student. However, in Mason's sense of the word, expounding does not include an authoritative slant. Expounding is not simply talking at or to students; it is a moment where the teacher shares his connection to the mathematics with the students and does so in a way that connects to student's experiences and engages them in the discussion. Explaining occurs when the content brings the student and teacher together. The teacher initiates this interaction but does not do so by imposing his mathematics upon the student. Instead, his goal is to make contact with the current understandings and conceptions of the student. When a student is acting directly on the content, he is in a state of exploring. The teacher then acts as the mediator between the student and the content, supporting the student in their exploration but not directing it herself. Within each of these interactions, the teacher's focus is on making sense of and serving the mathematics of the student. When operating in these modes, a teacher is not exhibiting teacher lust, but teachers who engage in these types of interactions with an authoritative, controlling stance are.

With this framework in mind, I selected two participants (from a potential four) based upon an initial interview that examined background, experience, and their beliefs about teaching, learning mathematics. Each participant held a PhD in mathematics, taught content courses for K-8 preservice teachers, and professed beliefs and actions connected to the open teaching triangle. Other potential candidates were eliminated due to their professed use of lecture as their primary mode of instruction. A schedule of classroom observations was constructed and carried out following participant selection. Three observation and interview cycles, each consisting of three weeks, were the primary form of data collection.

Within each three-week period, two weeks were spent videotaping classroom meetings of both participants. The final week was used to complete preliminary analysis of the video data, and to construct and carry out a semi-structured interview. In between class meetings, a video reflection tool was used to analyze each video for potential incidents of teacher lust. These incidents were selected using Mason's modes of interactions. Episodes in which the instructor was expounding or explaining, as well as moments in which the students were exploring, could potentially contain examples of teacher lust. Special attention was paid to exchanges within these modes of interaction. At the end of the cycle of observations, the selected episodes were examined as a whole in order to detect possible commonalities and emerging themes. The interview protocols were then created from the preliminary analysis. The construct of teacher lust was not discussed with the participants until the beginning of the first observation interview. This choice was made in order to establish a baseline for possible instances of change after the construct had been discussed. Each interview began by giving the participant an opportunity to select episodes in which she may have experienced teacher lust. After this portion, I asked questions from the protocol and accompanied these with the associated video clips from the classroom in order to stimulate recall. During the interview the participants were asked to describe their thought processes and decisions and to comment on the results of their actions as well as to predict what may have happened if different choices were made. The goal of the interviews was to develop a shared understanding between the participants and myself of the thoughts and actions of the instructor as they pertained to teacher lust. Following the second cycle of observations and interview, the participants were asked to write down potential incidents of teacher lust they may experience during the final cycle of observations. The final interview was mainly driven by the participants' choices and not by the clips I selected.

After the final cycle of data collection was completed, all interviews were transcribed. Then, the next stage of analysis took place as the interview data were examined and coded. This stage of coding focused on examining the participants' conceptions of teacher lust, the underlying reasons for such actions, and looking for evidence of change during the course of the study. These codes were then examined through all interviews to develop larger themes present through the entire study. Then, the video incidents indicative of the findings were transcribed where necessary in order to support the interview data. Final conclusions were drawn based on multiple sources of data and disconfirming evidence was noted where applicable.

Conclusions

A main goal of this study was to better define teacher lust. As a result of the analysis of my observations and interviews, I present the following as a working definition of the construct. There are three forms of teacher lust: enacted, experienced, and vicarious. Enacted teacher lust is an observable teacher action that takes away an opportunity for students to think about or engage in mathematics for themselves. Examples of enacted teacher lust can include imposing mathematical knowledge or structure; directing and/or limiting student solution paths and strategies; or telling information in a manner that reduces the level of the task.

Experienced teacher lust is the impulse to act in the manner described above. The instructor may unconsciously enter a state of experienced teacher lust. Instructors who are unaware of these feelings can continue into a state of enacted teacher lust without reflection or consideration of the outcome of this action. Instructors who exemplify these characteristics have pedagogical practices that can be classified as residing within or near the closed teaching triangle. However, instructors can learn to become more aware of these feelings, and this awareness can fuel a reflective stance. Instructors who are conscious of experienced teacher lust are afforded a choice; they may reflect upon their pedagogical options and choose whether to act upon the impulse or not. If the instructor chooses not to act on the impulse, the episode ends and that incident of experienced teacher lust cannot be identified by anyone but the instructor. In some instances, instructors choose to engage in acts of teacher lust and justify their choices in doing so. However, engaging deliberatively does not discount the action as enacted teacher lust.

The debate within these examples is on the possible outcomes from each pedagogical choice and what is most important to the instructor in that moment.

Vicarious teacher lust is a phenomenon one may only experience as an observer. It is an impulse similar to experienced teacher lust, as the observer feels a desire to "jump in" and interact with the students in the role of an instructor. This form of teacher lust can also lead to enacted teacher lust, if the observer crosses the boundaries and engages with the people he is observing.

The antecedents of teacher lust can be found within several sources, both internal and external. These factors often work in conjunction with each other in determining the impact of teacher lust. From an internal standpoint, an instructor's beliefs and knowledge impact her interaction with teacher lust. Specifically, an instructor's pedagogical content knowledge seems to have a direct bearing on feelings of experienced teacher lust. Instructors who have developed considerable experience working within the open teaching triangle are more likely to engage in enacted teacher lust as a conscious choice rather than as a reflexive action. Instructors who are in the process of developing the pedagogical skills needed to operate within the open teaching triangle are more likely to engage in acts of teacher lust due to a lack of consideration or awareness of other options. Beyond pedagogical content knowledge, an instructor's beliefs also impact her experiences with feelings of teacher lust. Beliefs on authority within the classroom significantly influence the pull of teacher lust, as does the belief the instructor holds regarding the nature of mathematics. Instructors who have a need to uphold "intellectual honesty" within their classroom can engage in telling acts that go beyond the information they expect their students to master. It is not necessary for these acts to result in student learning, as instructors engage in them mainly to satisfy their own mathematical beliefs.

There are also external forces that work in combination with the instructor's internal influences; students are the most significant of these factors. Students' responses, questions, and actions form the external context for the classroom and as such are a dynamic part of the stimuli instructors must respond to in the moment of teaching. Instructors engage in acts of teacher lust in order to "help" students make mathematical connections and to curtail their seemingly unproductive activity. Compounding these issues are concerns with time on both macro and micro levels. Concerns for closure in a given class period and for covering a syllabus worth of material within a semester also impact how and when teachers engage in acts of teacher lust.

I have conflicting results from my examination of how raising awareness of teacher lust can influence an instructor's practice. It seems awareness of this construct is most likely to impact the practice of instructors who are in the early stages of their career. Teacher lust is about the impact classroom choices have on students' learning, and in the early stages of a career instructors focus more on what they are doing rather than what their students are doing (Fuller & Bown, 1975). As instructors become more conscious of their actions in the classroom and better understand the outcomes, they are more resistant to the influence of teacher lust and have more pedagogical options at their disposal to use to combat its pull.

Implications

This study has several implications for mathematics education. Perhaps most importantly, this study serves to define the construct of teacher lust in a more formal manner and in turn to reintroduce this construct into the mainstream of education. Teacher lust is a feeling that many educators have dealt with, perhaps without having a name for the experience. This study attaches a name to these feelings and naming this construct can give it power (Mason, 2002). Now, if an instructor experiences a form of teacher lust, she will be better able to articulate, understand, and reflect on her experiences. Thus, raising the awareness of the field of mathematics education in regard to this phenomenon can lead to further discussion of shared experiences and an improvement in practice.

Beyond its implications as a construct, research on teacher lust is also applicable to the continuing cause of mathematics reform. The vision of mathematics instruction outlined in *Principles and Standards for School Mathematics* (NCTM, 2000) calls for teachers to act in the role of facilitator for students' active exploration of mathematics. This vision can be conceptualized within the open teaching triangle, and teachers who are learning to operate in this manner will most likely experience feelings of teacher lust. Teacher educators who work with preservice teachers can benefit from this research. Preservice teachers are beginning to develop their pedagogical knowledge and will be susceptible to these impulses as they attempt to develop their classroom style. Likewise, professional developers can also apply this research to their practice. When working with these groups of teachers, professional developers are often trying to instigate teacher change by encouraging teachers to shift their practice toward the open teaching triangle. As this shift takes place it should theoretically result in increased feelings of teacher lust. These feelings can be signs of genuine change in practice. If a teacher begins to experience more impulses to tell or direct, it can mean she is asking her students to explore without her direct instruction and to make sense of the mathematical concepts for themselves.

This change in practice can also lead to new issues within the classroom. One could hypothesize that when students become more responsible for sense making, it is possible that they could also be affected by feelings of teacher lust. I can imagine a classroom where a student might engage in acts associated with teacher lust in the course of communicating with other students. If so, instructors need to be aware of this form of student-student teacher lust, and have a means to deal with it as well.

Limitations

Although informative and worthwhile in and of itself, this study was limited in some ways, and these limitations have detracted from the potential richness of the results. One main shortcoming of this examination is that I neglected to consider the student perspective. Due to shortsightedness, I did not think to include provisions for interviewing the students of these classrooms to garner their opinion of the episodes deemed as examples of teacher lust. One participant's comment brought this limitation to my attention. As we discussed her choice of when to answer questions with an answer or with another question, she remarked that although she would rather answer questions with questions, her students would rather she answered with answers. There is certainly a tension between these two approaches and without this information, it is possible that actions classified as having taken away opportunities to think from students were not seen as such by the students themselves. Future research that examines teacher actions must include a student component as well. By leaving the students out of this study, in some sense I only have half of the story, for what is teaching without students?

Another limitation of this study was found within the participant selection process. Due to issues of time, class scheduling, and monetary concerns, I was limited in my choice of participants. As such my pool of potential applicants was rather shallow, and although I was able to find two excellent participants, it could have been a more effective study if I had been able to observe more than two instructors. My participants were extremely varied within their experiences, and this gap between them made it difficult to draw conclusions when considering them as a whole. Also, having more instructors to study would also increase the potential to discover new and different examples of enacted teacher lust. As this study is the beginning of the refinement of this construct, more research will allow the theory to continue to develop.

The time frame also served as a limitation to the study. One goal of this research was to examine how raising awareness would impact an instructor's practice. Having less than one semester's worth of data is certainly not enough to be able to detect any significant amount of change. In order to be more beneficial, I would need to continue to observe the participants during subsequent teaching experiences. However, as it was not possible to do this, I leave that as a facet of future research on this construct.

Future Research

It is clear that this study does not serve as the end of the research agenda for the construct of teacher lust; rather it only scratches the surface of future work. More research needs to be carried out to continue to refine and develop the definition of the construct. Studies similar to this one need to be replicated at the university level, as well as with preservice and inservice teachers. Data from teachers at different levels of education and with different levels of experience will allow researchers to help the construct to become more universally understood.

Along with efforts to further examine the construct, it is germane to simultaneously include a focus on its potential antecedents. Research more closely aligned with measurements of content knowledge, pedagogical content knowledge, or beliefs will help us to better understand this phenomenon. This study presents several possible influences of teacher lust, but there are most certainly other factors which have either not been discussed here, or that need to be studied further. Content knowledge is one such factor. I conjecture that a teacher's lack of content knowledge could lead to an increase in feelings of teacher lust. Without the confidence in his own mathematical ability, a teacher may find it difficult to allow students to freely explore mathematical ideas for themselves. Similarly, having an abundance of mathematical understanding could lead to an instructor's desire to impose that knowledge upon his students. With these possibilities in mind, it makes sense for content knowledge, or perhaps more specifically, mathematical knowledge for teaching to serve as another facet of exploration.

One hypothesis I had that did not seem to be validated by this research is the issue of changing practice influencing feelings of teacher lust. It makes sense that as teachers attempt to open up their practice and move away from the premises of the closed teaching triangle that they would experience an increase of feelings of teacher lust. This was not evident within my data, but I am inclined to believe this hypothesis to be true. Efforts aligned with this question in mind should be undertaken. But, it is also important to note that studies that attempt to do should be longitudinal in nature. A study that examines teachers from their preservice training into their early induction years would be a suitable time frame. This extended time period would also allow for closer examination of their developing pedagogical content knowledge and its impact upon their interactions with feelings of teacher lust. Teacher lust's connection to pedagogical content knowledge is another area that needs to be explored further. The framework for examining this connection has been laid out within this study. I plan to continue moving in this direction with my future research.

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Appendix A - Background Interview Protocol

The purpose of this interview is to gather some background information on your teaching experience, your expectations of the course I am going to observe, and give you an opportunity to talk a little about your views on mathematics and teaching.

Personal / Background / Course

1. What is the highest degree you hold, and what is your current position?
2. How long have you been teaching at the collegiate level?
3. How many years of teaching experience do you have in K- 12 education?
4. How many years have you spent working with teachers (preservice and / or inservice)?
5. What is the full name of the course I am going to be observing?
6. How many times have you taught this course?
7. What are your the goals for this course
    a. For your students?
    b. For yourself?
8. How will you know if you have been successful in reaching these goals?
9. Please describe for me the process you go through in preparing to teach class.
    a. How much planning is based on the material/content vs. the students – what they know, where they are, what happened last class?
    b. Do you feel compelled to cover the plan for the day?
    c. How do you feel about students who bring up questions or topics that seem “off topic” during class?

10. What can I expect to see your students doing during the classes I attend?
    a. Grouping used?
    b. Role of discourse in the classroom?
11. What do you see your role being during class?
12. How do you think of office hours?
    a. Is it different from what you do in class?

Beliefs about mathematics

13. Which of the following activities is most like learning mathematics? Explain your choice
    a. Working on an assembly line, watching a movie, cooking with a recipe, picking fruit from a tree, working a jigsaw puzzle, conducting an experiment, building a house, creating a clay sculpture
14. How do you best learn mathematics?
15. How do you think your students best learn mathematics?
16. Which of the following activities is most like teaching mathematics? Explain
    a. News broadcaster, entertainer, doctor, orchestra conductor, gardener, coach, missionary, social worker
17. What does it mean to be “good” at mathematics?

Learning Mathematics

Working on an assembly line	Working a jigsaw puzzle
Watching a movie	Conducting an experiment,
Cooking with a recipe	Building a house
Picking fruit from a tree	Creating a clay sculpture

Teaching Mathematics

News broadcaster	Gardener
Entertainer	Coach
Doctor	Missionary
Orchestra conductor	Social worker

Appendix B – Video based interview protocols

Samantha -Video Viewing Interview Protocol #1

You were chosen for this study because I believe that your teaching goals reflect a constructivist stance towards student learning. That is, you make the students' understanding and sense making of mathematics the focus of your class. And you view your role in the classroom as that of a facilitator or guide. I have been in your classroom for the past two weeks and have shot video during that time. I have a particular lens that I have been using as I watch and re-watch the classes, and this lens concerns your pedagogical choices in dealing with student questions and responses. Specifically, I am interested in a particular construct that is known as teacher lust. Mary Boole first coined the term teacher lust back in the 1930's. For me, teacher lust is the pull a teacher may feel to tell, to lead, or to give direct answers to their students even though their pedagogical goals suggest that they would rather have the students come to the conclusions for themselves. And, this study is about examining the antecedents of teacher lust and what teachers may do to deal with this phenomenon.

1. I'd like to begin by getting your initial reaction to the phenomenon. So, before watching any video clips that I have chosen – I want you to take a minute or so and think back to any moments in the past couple of weeks where you might have felt this desire to tell more than you may have planned.

Now that you have had a chance to talk about some places where you think you may have experienced teacher lust, I am going to offer some clips of moments where I think you may have felt teacher lust. For each of these instances, I have further conjectured as to whether or not you may have given in to these urges to tell or direct. It is not my intent to judge your choices, only to better understand what went into making them and how you may have felt in the moment of teaching. I see the product of this research as a shared understanding of your experiences in the classroom, and only a shared understanding will help me to better describe this construct and its possible causes.

The first sets of clips I want to talk about are instances where I think that you may have felt and potentially given in to teacher lust.

Video #1 –finding the sum of the geometric series 1+2+…+2^n using 2s – s [This is an example of Samantha stopping the solution path of the student and redirecting it to a method she knows will be more fruitful.]

2. This clip is from the class where the students were finding the sum of the geometric series: 1+2+…+2^n using an algebraic representation. Right before the time we are going to look at, you had just finished finding the formula for this series by looking for a pattern. Can you tell me why you chose to pose the next stage of this particular problem, where they were going to find the same sum algebraically?
3. I am going to show you a clip of the students at the board working on solving the problem. (37:00 – 37:25) Stop it when Jay has started to subtract down)
4. Can you talk about what you were thinking when you first saw what Jay was doing?
5. What was going to happen if Jay continued his method?
    a. Did you consider any other possible courses of action? If so what were they?
    b. Can you describe why you chose to stop Jay before he / the class realized that? And instead called on the other student to show what she had done?
    c. What might have happened if you had decided on another option?

Video #2 – Extending the marshmallow problem [This portion shows Samantha leading the students, and eventually taking over the direction of the problem, sometimes subtly, sometimes not. The end result is confusion as to what they had done. I hypothesize that there is confusion because it is Samantha's conceptions that are being imposed instead of the students making sense of the math for themselves.]

6. I want to show three different clips that occurred during the exploring of the marshmallow problem. But before I do, can you talk a little about why you chose that particular problem and what you had hoped the students would gain from it.
    a. Was your final goal for them to produce a generalized formula that could find the sum of the first n square numbers?

b. Was it your intent to have the students connect this problem to the pyramid formula?

c. If so, how did you plan to get them to make that connection?

7. Show the first marshmallow clip where the students are confused and Samantha introduces the idea of the formula for volume of a pyramid. (6:28 – 7:08)

   a. What made you decide to tell the formula when you had other ideas about how you might get them there?

   b. Can you hypothesize some about what might have happened if you made the choice not to tell in this case?

8. In the next segment, you produced both paper models and cube structures for the students to try to put together to form a prism. Why did you give the models to the students?

   a. I want you to watch what happens when you gave them the models. (Show clip of Samantha verbally directing, and finally putting them together herself) (10:10 – 12:25) What were you thinking about when the students were struggling with the models? How did you feel?

   b. Can you talk some about your choice to tell/ step in at this juncture? Can you name a reason why you decided to do what you did?

9. I want to jump ahead in the lesson to the wrap up of the problem. You asked the students to find a formula that could express the number of blocks in one of the marshmallow structures. This is a clip of what happened. (Show clip where Samantha takes their ideas and makes subtle changes to them.) (15:38 – 17:30) I noticed that you made some slight modifications to what the students offered and what you wrote on the board. Can you talk some about why you decided to do that?

   a. The students seemed confused at the end as to what they had been doing this entire time. Do you have any sense of why that might have happened?

   b. Can you think of anything different that you might have done to address those issues? What might those choices have done for the students?

I want to switch gears now and discuss some instances where I think you may have felt teacher lust but didn't act upon it. I'll begin this section by saying that I think for the most part that you do an excellent job of keeping the focus on the students and their understanding. All of the examples we are going to talk about occurred in very open problem solving situations. When we watch and discuss these clips, I am hoping you can confirm or deny the incidence of teacher lust. And, if you did indeed feel its pull, the more you can talk about how you were able to resist it, the better.

Video #4– Functions and circles

10. The students offered a really nice example of looking at angles and arc length, which you returned to after examining some more recognizable functions like area and circumference. Let's watch the clip of what happened when you asked them for more information. Jay offers a rather trivial formula. (Show the clip.) (21:25 – 23:25) Did you know where this was going to end up before Jay did?
    a. But, you let him finish his line of thinking and see that for himself. This is something you didn't do when they were exploring geometric series. Can you tell me why you made this choice this time?

11. I want to continue looking at this part of the lesson. (23:25 -"a radius") In this next clip, the students seemed to offer some pretty random ideas, and then waited for you to run with it. As I observed this portion of the lesson, I felt the pull of teacher lust – I guess in a vicarious way. Did you? And if so, how did you deal with it?
    a. What else had you considered doing?

12. You began last Wednesday's class by asking the students to write some examples of functions in the context of circles. You prompted this task by saying "I'm going to be pretty vague" – Can you talk some about why you chose this particular approach and what you had hoped would come from it?
    a. When no one offered any immediate answers, you offered the reminder of input/output. What other options did you consider and why did you decide on this one?

13. "The ah-ha moment". The final clip I want to talk about occurs as you were asking the students to generalize the formula for angle and arc length. As they examined inputs and

outputs in the table, there was an "ah-ha" moment. Let's watch that as it occurs. (Show clip.) (31:00 – 33:25) What is interesting to me is your choice to ask the students to rephrase the "ah-ha" moment for the class. Can you explain why you made that choice?

a. How do you think the student did in capturing the idea you might have been looking for?
b. Did you consider doing it yourself? Did you want to? If so, why did you decide not to?
c. I have seen other examples of this in your class, where a student makes a statement or summarizes an idea and you choose not to act in any way that demonstrates you validating their ideas. Do you think the students need to know that you agree in order to believe it for themselves?

Video #3 – Functions

14. Brainstorming types of functions. When you began the topic of functions in class, you asked the students to brainstorm and write different functions. There were two functions offered, and both of them were linear functions. How did you feel when you found that your students were limited in what they could offer at that point?
    a. What pedagogical options did you consider using to combat the situation?
    b. Why did you decide on your course of action, namely to pose questions that tried to extend their thinking from where they were at that moment?
    c. What might have happened if you had chosen differently?
    d. You then posed the question," Does every function have an algebraic equation?" Again, there was little response. What were you thinking about in that case?

15. Are there any other moments you want to talk about before we end the interview?

Fine. This concludes the first video reflection interview. Thank you for your time.

Samantha -Video Viewing Interview Protocol #2

Thank you for setting aside time for this, our second of three interviews based on by classroom observations. As we talked about last time, I am particularly interested in examining the phenomenon of teacher lust. I have selected clips that I would like to ask you about, but I would like to begin this interview as we did the previous one, and ask you to think back over the classes from the past two weeks and back to any moments where you think you may have experienced teacher lust - this desire to do or tell more than you may have planned.

Now that you have had a chance to talk about some places where you think you may have experienced teacher lust, I am going to offer some other clips of moments where I thought you may have experienced teacher lust. For each of these instances, I would like you to tell me as much as you can about your thought processes and what went into your pedagogical decisions. Again, it is not my intent to judge your choices, only to better understand what went into making them and how you may have felt in the moment of teaching.

[It is quite possible that the participant will raise some of these issues and obviously I will not need to revisit them]

Answering questions w/ questions vs. answering questions with answers
- Is that a coincidence? (11)
- What does that have to do with checking 13? (18)
- So you stop after it changes / Is 17 always when it swaps? (19)

Giving it away -
- Setting up the task (5b)
- “Something about Claire” (2)
- Flower patter problem (8)
- How do you know when to stop? (resisiting)

Talking more deeply about mathematics
- Rectangles (6b)
- FTA (24)

Valuing student reponses
- Waiting for 24 (10)
- Rachel vs. Allison (23)

<u>The cardstock similarity problem</u>

1. Before we talk about some of the examples from this problem, I was hoping you would begin by telling me about this set of problems.
    a. Why did you choose them and what were you hoping the students would get from doing them?
    b. Did she intend to connect this task to deriving the equation of a line?

2. Scaffolding idea [video #5 13:54 – 14:46] – Samantha lists all of the relevant information of the problem and then tells the students about missing some information that they will have to think about. Then you immediately gave a "hint" needing information about Claire. Can you talk about this decision – was it conscious, did you think the students needed you to tell them they didn't have enough information? Did they need the hint? Did you feel the pull of teacher lust here?

3. [Video #5 22:32 – 22:35] Scaffolding idea. The students were having trouble drawing the correct diagram, you asked them to remember what Claire had done to find data. [I don't think this is lust, but I want to ask her thoughts]

4. Show clip [Video #5 26:05 – 28:44] Samantha restates Jay's solution
    a. How do you think Jay did in explaining the solution?
    b. What was your purpose in restating what he had said?
        i. Did you feel an impulse to jump in?
    c. Could Jay – or another student have completed the problem?

Extending the cardstock problem – Feel lust?

5. Show the clip [video #5 31:09 – 32:56]
    a. Unpacking the mathematics of similar triangles
    b. Tells that this procedure can be used to derive equation of a line – then assigns task that does it. Why give away the point of the next task?
        i. Did she consider another path?
        ii. What would that choice have afforded?
6. Show the clip [video #5 45:00 – 48:30] Georgette's solution – Samantha stays out of it
    a. Did you feel any impulse to jump in at any time?
        i. How about when questions were directed towards Georgette?
        ii. How do you think her explanation was?
    b. [48:30 – 50:00] Discussing the rectangle - "There is something sneaky here…"
        i. Did you feel an impulse to tell in this situation?
        ii. Had you planned on telling this information
        iii. Is this something that the students could have discussed?
        iv. What difference might that have made in their understanding?

Flower patterns and Spirograph relationships

7. Before we talk about some of the examples from this problem, I was hoping you would begin by telling me about this set of problems [flower petals, spirograph and activity 12G (relationships between LCM and GCF)].
    a. Why did you choose them and what were you hoping the students would get from doing them?
    b. Was it your intent to do all of these problems originally?
8. Show the clip - [video #8 41:03 – 41:42] – Students truly have no idea, Samantha offers the "hint" of looking at GCF / LCM of the numbers.
    a. The students didn't know where to start in solving the problem – has this happened before when you have done this task?
    b. What were you feeling / thinking when they said they didn't know what to do?
    c. You gave a pretty direct hint – did you consider other options?
    d. What might have those other choices afforded you?
9. [video #8 41:59– 42:30] - "I don't get it – just tell us." – Being open and not telling them exactly what they want to know.
    a. The students are still confused. What options did you consider at this point?
    b. The end of class was near and I got the impression that the students wanted you to wrap up the problem for them, but you didn't. You assigned it for homework. Was that you plan all along? Why?
10. Show clip - [Video #9 14:05 – 15:01] – Students sharing solutions and Samantha makes validity judgments – "waiting for 24" – then asks for computations
    a. In this clip you seemed to be waiting for a specific answer and you were making validity judgments that I don't see you do often. Can you talk a little about making this choice here?
    b. How do you decide when to validate correct answers, or when to ask the students to do so?
11. Show clip - [video #9 16:25 – 17:13] "Is that a coincidence?" –
    a. You answered this question quickly and directly. Did you consider not doing so? What was the intent of giving a direct answer to this?
    b. What would have been afforded by leaving it open?
    c. Did you plan to use 12G as a means to examine this coincidence all along?

d. What did you want them to get out of activity 12G?

12. Show clip - [Video #9 26:40 – 29:00] – Samantha connecting 12G back to the spiro-graph problem
    a. The students had completed 12G and then you led them in connecting it directly back to the spirograph problem. Why did you deicide to do this yourself?
    b. Do you think the students could have done that without your assistance?
    c. What might have happened if you had left it to them?

Finding prime factors

13. This seemed to be a theme that was characterized through the use of a few different problems and activities. Before we talk about some of the examples from this problem, I was hoping you would begin by telling me a little about this set of problems. [sieve of Eratosthenes, activity 12J]
    a. Why did you choose them and what were you hoping the students would get from doing them?

The preamble…motivating the question

14. When Georgette discussed the "swoosh method" for listing factors there was an opportunity to bring up the square root of a number to know how far to check – not taken, did you want to? Show clip if needed [video #7 9:55 –10:45]
    a. This idea was implied again in video #9 and 10 (2 classes later)– did you want the students to see the connection within this idea/question?
15. [Video #9 41:13 – 42:35] – discussing the sieve of Eratosthenes, Claire shared what her class had done – you asked her how she knew to stop after 7 on her 100 board? Did you want to say more then? You told her you would be looking at that idea in a little bit.
    a. Jenny offered an explanation where she conjectured it had something to do with our number system being base 10 – you made a comment of validation, saying

you didn't think that was true. Did you want to give a direct answer there? If so why / how did you decide to hold back?

16. [Video #10 10:24 – 11:04] – Activity 12J (connections between GCF and LCM) – Student Q: "Are 2 and 3 the only numbers we have to divide by?" → Student Q: "When do you know when you have to stop?" – now Samantha addresses this question saying it is what she wants to talk about.
    a. Finally a student poses the question that I think you have wanted to talk about. Did you want to pose it earlier? Why didn't you?
    b. Was it a relief that they finally did so?
    c. What is the value in having them raise this question instead of you?

Addressing the question – how far to check to determine if a number is prime?

17. Show clip - [Video #10 11:04 – 12:01] – Jay's conjecture.
    a. You seem willing to let them whittle down the choices and refine their conjectures. You posed questions as a means to help them do so. Was it hard to not lead, direct, or tell them things to help them along?
    b. In doing this activity before, was it less easy?
18. [Video # 10 12:33 – 14:02] Students keep bringing up not checking the multiples of primes – Samantha keeps asking questions like "what does that have to do with checking 13 or not?"
    a. Here you are very patient in letting them grapple with this idea of multiples of prime numbers. You keep posing the same type of questions to them. Was it frustrating that they never seemed to pick up on the point of your question?
    b. Did you consider any other options at this point?
    c. What made you decide to switch gears and refocus the students on their work from 12J?
    d. You asked them to focus on the quotients and divisors, and asked if something was going on there somewhere. Did you feel you needed to be so direct at this point? Why?

19. Show clip - [video # 10 18:58 – 20:00] –
    a. Student asks if you stop after it changes? - You seemed to be willing to tell the student that her conjecture was correct, but not tell the 'why' of the question. Can you differentiate between these two choices?
    b. The question is raised "Is 17 always when it swaps?" Here, instead of answering directly, you pose a counter example for the students. How do you decide when to be direct and when to let the students come to the conclusion?
20. Students ask for a written explanation of the answer
    a. As you watch the clip I want you to think about whose solution you wrote on the board. Show clip.[video #10 28:09 – 30:47]
    b. When students ask you to write the explanation on the board, what do you see as your role in obliging?

The conclusion – introducing square roots

21. [video #10 33:22 – 34:55] - Samantha poses two problems to help them discover (?) the square root as the cut off point –
    a. Why did you pose these problems?
    b. Did you want to talk more about the square root as the cutoff point yourself? Had you considered it?
    c. Eventually Rachel and Jay discuss this idea what might have you have done if they hadn't?

The Fundamental Theorem of Arithmetic

22. The last idea I want to talk about involves the Fundamental Theorem of Arithmetic. When you posed tasks that focused on examining prime factorizations, was discussing the FTA a primary goal?

   a. What were your main goals in choosing these tasks?

23. [Video #10 41:33 – 42:43] – Motivating the question related to FTA –

   a. It seems that again, you are listening for a particular response. Did you hear Allison's question? Why did you choose to 'ignore' Allison's question for Rachel's?

   b. I'm choosing this as a parallel to Jay's sequence problem – valuing one student's input over another. How do you make those types of decisions?

24. [video #10 43:00 – 46:00] – Samantha's "lecture on the FTA" –

   a. What was your intent in making this nice speech about FTA?

      i. Was it important that the students hear about it in a 'formal' sort of way?

   b. You next posed the question "does 17 divide N?" – where N was the prime factorization of a number that did not include 17.

      i. What was the purpose of asking this problem? [Is it to show the value of the FTA – did she want to tell about it?]

25. Are there any other class examples you would like to discuss?

This concludes our interview, thank you for your time and cooperation.

Samantha -Video Viewing Interview Protocol #3

Thank you for setting aside time for this, our final interview based on my classroom observations. As we talked about last time, I am particularly interested in examining the phenomenon of teacher lust. I have selected clips that I would like to ask you about, but I would like to begin this interview as we did the previous one, and ask you to think back over the classes from the past two weeks and back to any moments where you think you may have experienced teacher lust - this desire to do or tell more than you may have planned.

Now that you have had a chance to talk about some places where you think you may have experienced teacher lust, I am going to offer some other clips of moments where I thought you may have experienced teacher lust. For each of these instances, I would like you to tell me as much as you can about your thought processes and what went into your pedagogical decisions. Again, it is not my intent to judge your choices, only to better understand what went into making them and how you may have felt in the moment of teaching.

[It is quite possible that the participant will raise some of these issues and obviously I will not need to revisit them]

The divisibility rule for 8

1. Is there a rule for 8? → Jay's suggestion [3343] you pose this as a question and Jay offers his idea. You decided not to make a judgment on his statement – why? Was this your intention?
2. Students disprove Jay's theory [3349] – Why is that enough to show that it isn't true –this connects back to the idea of proof and how Samantha deals with it in class.
    a. You also raised the issue of whether a number that is divisible by 4 has to be divisible by 2 – why was this an important idea to bring to the floor?
3. Trying to find a rule - looking of patterns [3358] - Samantha lets them try this and then moves them away from it. It seems that you wanted them to use the rule for 4 to reason through the rule for 8, but they weren't thinking about that. Can you talk about how you decided to get them to do so?
4. What about…others [she wanted to say "4"]?" "What's the scoop there?" [3359] This is another instance where you seem to want them to go in a certain direction, and you used

the question "What's the scoop?" to get them to talk more about what they say / knew. Are you aware of this tendency?

   a. Show clip [3370] – This is a question you pose often to the students. Can you tell me about whether or not this is a conscious choice to use this phrasing?
      i. What is the intent of asking a question like this? To me it seems that you use this as a way to avoid telling – that this question allows you to ask about the pattern or idea without mentioning exactly what you want them to see.

5. Eventually you tell them to use the rule for 4 as "an inspiration" [3360] – why did you make this choice here?

Rational numbers

6. [3364] Introducing the idea – How had you planned to introduce this topic?
   a. Watch clip where Samantha starts to define, then asks, then answers her own question. Did you feel TL here?
      i. Can you talk about the reasons why you took this approach? Was it your original intent?
7. [3365] The students seemed confused, even though the definition was stated for them. Why do you think this happened?
   a. My theory is that they were used to thinking of it from the standpoint of a decimal instead of as a fraction – do you see this as valid? How comfortable do you think the students are in applying a mathematical definition to a situation – do you ask them to do this often? Why/why not?

"Proof"

8. I have noticed that you do not talk specifically about proof in the class, but you engage the students in reasoning to make sense of ideas. Can you talk about your stance on proof in this class and how it is different than it might be for another type of math class? I'd like to talk about two different episodes from this last section of classes that deal with this idea.

9. For homework, the students needed to explain why odd x odd = odd [3366] – Can you talk about what you saw on their homework?
    a. You drew a picture to help "stimulate thinking". Why did you decide to take this approach in class to discuss this problem?
    b. Your picture was very suggestive – was this intentional?
    c. Did you consider talking about an algebraic proof of this idea?
10. You engaged the students in a "proof" that every fraction has a decimal representation that is either terminating or repeating. How well do you think the students followed the arguments laid out within the activities associated with this idea?
    a. There seemed to be confusion within the notion of what happens when you have the same remainder that you have had before. Why do you think they struggled with this idea?
        i. I'm not sure if they realized that you were always bringing down a zero, which would make the next dividend the same. This idea seemed to remain implicit to the process until you verbalized it. Were you trying not to raise this point yourself? [3378]
    b. During the wrap up of this problem in the next class – Samantha hints at the notion that their proof is complete because they hadn't used anything specific to 7/31. Can you talk about your choice not to be explicit about this? [3411]
    c. The next segment has you engaging the students in the converse of the statement they had just proven. This wasn't explicit to them either. Can you talk about your choice not to be as explicit about the mathematical structure within these activities?

Repeating decimal → fraction

11. Are repeating decimals rational numbers? Did you want to connect this to the telescoping sequence problem? How had you intended to make this happen?
    a. [3434] You told the students that there is going to be a connection to something they did earlier in the semester. Then you set up .12 repeating as N and then reminded them of the summing of the geometric series. Can you use this to determine how to find the fraction representation of .12121212…

i. Would they have seen it if you hadn't been so explicit?
ii. Did you consider letting them come to this connection instead of showing it to them?
iii. Was there another way to go about this?

b. After Jenny shared Kristten's solution, you asked for Jay's solution to be shared. Why?
   i. Several times you say that they don't have to pursue this if the students don't want to. Did you want to?
   ii. Did you feel any TL in this case? This seems like there might be teacher lust felt to want to show this, but if so, she is fighting the urges well.

12. Moving around the room in Aderhold [3367] You did a lot of walking around and talking to groups as they were working. I haven't seen you do this before. What were you doing at each group?
    a. What do you see as the benefit of this?
    b. Why don't you do this in Boyd?
    c. Would it be worth the hassle to gain this information?

I want to complete this interview by asking you some questions directly related to your participation in this study and about the construct of teacher lust.

13. What would you say you have gained, if anything, from participating in this study?
14. What is teacher lust for you?
    a. How do you know when you feel it?
    b. How have you dealt with these feelings in the moment of teaching?
15. Has your newfound awareness of teacher lust had any impact on your practice?
    i. Does it influence your planning?
    ii. Does it influence your choices in the moment of teaching?
    iii. Do you see it in other educators?

Is there anything else you would like to talk about? This concludes our final interview thank you for your time.

Elizabeth -Video Viewing Interview Protocol #1

You were chosen for this study because I believe that your teaching goals reflect a constructivist stance towards student learning. That is, you make the students' understanding and sense making of mathematics the focus of your class. And you view your role in the classroom as that of a facilitator or guide. I have been in your classroom for the past two weeks and have shot video during that time. I have a particular lens that I have been using as I watch and re-watch the classes, and this lens concerns your pedagogical choices in dealing with student questions and responses. Specifically, I am interested in a particular construct that is known as teacher lust. Mary Boole first coined the term teacher lust back in the 1930's. For me, teacher lust is the pull a teacher may feel to tell, to lead, or to give direct answers to their students even though their pedagogical goals suggest that they would rather have the students come to the conclusions for themselves. And, this study is about examining the antecedents of teacher lust and what teachers may do to deal with this phenomenon.

16. I'd like to begin by getting your initial reaction to the phenomenon. So, before watching any video clips that I have chosen – I want you to take a minute or so and think back to any moments in the past couple of weeks where you might have felt this desire to tell more than you may have planned.

Now that you have had a chance to talk about some places where you think you may have experienced teacher lust, I am going to offer some clips of moments where I think you may have felt teacher lust. For each of these instances, I have further conjectured as to whether or not you may have given in to these urges to tell or direct. It is not my intent to judge your choices, only to better understand what went into making them and how you may have felt in the moment of teaching. I see the product of this research as a shared understanding of your experiences in the classroom, and only a shared understanding will help me to better describe this construct and its possible causes.

I have decided to organize this interview in the same way that I have seen you operate within your classroom. I want to examine some instances when you are introducing a task, some instances when you are reacting to and discussing student work, and some examples when you are wrapping up a completed task.

Introducing tasks

17. I wonder if you would start by talking a little more about how you decide on the particular tasks you use in the classroom.
    a. When selecting tasks for the students, do you think about how the tasks may or may not be related to each other, or how they may or may not complement each other? If so, does that play into your decisions at all?

18. Why do you want to have your students connect one problem to previous ones?
    a. How do you try to do this?
    b. Did you consider other options that might accomplish this same goal?
    c. What went into the decision?
    d. What was gained or lost from making this choice?

19. We are going to look at a specific example of this situation now. In this clip you are setting up the problem of finding the number of square feet in a square yard. (Show clip. Video #2 - 31:30 – 32:13) Can you talk about what went into your decision to take this approach?
    a. Did you consider any other options?
    b. What might the other choices have afforded you / the class?

20. In the interview you mentioned that you often give the students a set up – that is you begin by explaining what is going on in the task. What is the purpose of giving the students a set up?
    a. What do you think would happen if you did not do this?
    b. How do you decide what goes in the set up and what to leave for the students to investigate?

c. What is gained / lost in making the decision to present this information before the activity is engaged in?

21. I have noticed a general pattern to your class, and how you operate on a daily basis. I'd like to talk specifically about the multiplication and volume task. This is in the book, and it involves the students describing the volume of a prism of cubes in different ways. Do you remember this problem? Can you start by talking about how/why you selected this particular task. What were you hoping it would afford you or the students mathematically?
    a. Let's look at the set up of this task. (Show clip.) (video #2 – 19:20 – 21:10) Can you talk specifically about what went into making the choices that resulted in these particular actions?
    b. How did you decide on how much to give them in this particular case?
    c. What do you think may have been gained/lost from this particular choice?

22. There are some other examples of your set up/introductions that appear to do similar things. This is a clip from last Wednesday's class. You are setting up the problem that employed the distributive property. (Show clip.) (Video #4 – 12:17-13:38). Can you talk some about the decisions you made here?
    a. In this clip, you asked what I thought was a very good question, "Why do I say that the distributive property allows us to switch the order of operations?" But instead of actually posing it to the class for them to think about, you immediately went ahead and answered it for them. Can you talk about why you made that choice?
    b. Is there another approach you might have taken instead?
    c. What may have been afforded in making that other choice?

I now want to talk some about what I have observed during the time the students spend solving problems during class.

23. I have noticed, and you have said yourself, that you do not interact with the students as they solve and discuss problems anymore. You had said that you felt as though you were intruding in some way. Can you talk some more about this intrusion – in what way did you feel like you were intruding?
    e. If there is a sense of teacher lust involved – could this hands-off approach be a way that she deals with the phenomenon?
    f. What is gained/lost by making this choice? (E.g., she cannot anticipate what students are going to present at the board if she doesn't know what they're thinking)

24. Let's talk about what happens in class when the students are students presenting their solutions to problems. I have observed on several occasions, that you often restate a student's solution, sometimes augmenting it slightly by using your own words/language, and then write your version of it on the board. What do you see as the purpose of you restating the solutions/ideas that the students have presented?
    a. Are there other ways that this could have been accomplished?
    b. If you make a different choice, what might have been gained/lost from that choice?

25. Let's look at an example of this. In this next clip, Anne is explaining her solution to the problem of how many square feet are there in a square yard. (Show clip – stop after Anne has finished her explanation.) (Video #1 20:13.) What did you think about Anne's version of the explanation?
    a. Do you know what happens next in the clip? Let's see. (Run clip forward). Can you talk about your decision to restate what Anne had said?
    b. Is there another way that you may have accomplished this same goal?
    c. What might have that other option afforded you/the class?

26. Here is a different example. In this one, Ashley uses her drawing to explain the commutative property of multiplication. She uses the ideas of rows and columns to do so. Let's watch. (Video #1 – 40:16). You state that this is a very thorough explanation.

Yet, you still went ahead to talk more about it. Can you explain why you thought that was needed or what the intent of that was?

I'd now like to switch gear one more time and talk about the approaches you take in bringing closure to problems after the students have discussed them.

27. It seems to me that it is important to you that the students see the mathematical ideas that are embedded in the problems that you have chosen. How do you try to do this?
    a. Did you consider other options that might accomplish this same goal?
    b. What goes into the decision to make one choice versus another?
    c. What do you think may have been gained or lost from making this choice?
28. I am going to show a clip that is an example of the wrap up process you go through in doing summarizing the task the students have completed. In this clip the students are sharing their solutions to the multiplication and associativity task we talked about earlier. (Show clip.) (28:16 – 31:31) Can you talk about your decision to talk about what you saw as important in this problem?
    a. Is there another way you might have accomplished this same goal?
    b. What might have been gained/lost by making a different choice?

29. Are there any other examples that you would like to talk about?

This concludes our interview. Thank you for your time.

Elizabeth -Video Viewing Interview Protocol #2

1. Thank you for setting aside time for this, our second of three interviews based on by classroom observations. As we talked about last time, I am particularly interested in examining the phenomenon of teacher lust. I have selected clips that I would like to ask you about, but I would like to begin this interview as we did the previous one, and ask you to think back over the classes from the past two weeks and back to any moments where you think you may have experienced teacher lust - this desire to do or tell more than you may have planned.

Now that you have had a chance to talk about some places where you think you may have experienced teacher lust, I am going to offer some other clips of moments where I thought you may have experienced teacher lust. For each of these instances, I would like you to tell me as much as you can about your thought processes and what went into your pedagogical decisions. Again, it is not my intent to judge your choices, only to better understand what went into making them and how you may have felt in the moment of teaching.

[It is quite possible that the participant will raise some of these issues and obviously I will not need to revisit them]

2. Can you begin by talking about the last two weeks of classes in general terms as compared to the first round of observations?
    a. Would you say that you have been operating in the same ways?
    b. If not, how are you doing things differently?
        i. Calling on students randomly during whole group discussions
            1. Why start when you did?
    c. Why have you decided to make this shift?
3. There have been times in the past two weeks when you have set up a task by doing nothing aside from assigning the page and number. Why?
4. When you do say something about the task, it seems you have a different intent than I had seen in the past. For example let's talk about the postage stamp problem. Here is how you introduced the task. Show clip [3172 – video 8 ends at 25:52]

a. Was this a conscious decision to set up the task in this way? Can you talk about why you chose this approach to the set up of this task?
    i. What was afforded or not by this choice?
b. Did you consider anything else?
c. Did you feel a desire to say more than you had planned within the moment of presenting it?

5. Let's talk some more about that task in particular. There seemed to be genuine discussion in small groups during this task. What do you attribute that to?
    a. How does knowing that this material is more difficult for your students impact the types of decisions you make when discussing these problems with them?
    b. Here is Nikki's solution that she shared with the class. Show clip [3173 video 8 ends at 37:37]. You asked the students to connect the representation to the problem – was this something you considered doing yourself?
        i. Did you find yourself wanting to anyway? – Or experience an urge to jump in at any time?
        ii. Talk about the intent of the questions that you posed during this exchange.
6. Here is a discussion. [video 9 3215 / 3216– ends at 21:40] This is the summary of 2/3 x 5/8. Elizabeth begins by saying "I wanted to emphasize that this is how we are thinking about multiplication" and then asks questions to facilitate this idea. What was the purpose of the opening statement?
    a. What was the intent of the questions?
    b. Did she feel the impulse to tell more than pose questions at any time? Did you have to be consciously thinking about questioning vs. talking?
7. As you conclude the discussion on this problem (second part of the clip) – you seem to just recap what has been done, and did not add any new information. What was the intnent of tying the discussion back to the equation you wrote on the board?

I am going to switch gears from the structure of your class and ask you to respond to a couple of ideas outside of the "set up-discuss-wrap up" routine.

8. There appears to be times in the class where you will answer a student question with a question, and some times with an answer. Could you first talk in general about how you make those types of decisions?
9. “If this were a test” type questions
    a. What if this was a test? Questions posed before review day – Do we need to show that step?
    b. During test review: ***The explanation of the FOIL method vs. The dance partners problem.*** The dance partners Elizabeth begins a solution path, for the FOIL method - Elizabeth poses the problem (2+9)x(6+4) and asks the students to write the equation connected to this and, have them draw a picture to see how the 2 equations are connected. This is a different approach than how she addressed the first question. Why this way here and not before /vice versa?
10. This clip is interesting because it is one of the only times I have seen you interact directly with a student during the time you have given them to work on a task. [video 9 - 30:44]. Can you talk a little about this exchange?
    a. You seem to operate in two different ways during this exchange. In the beginning, you respond to her questions with answers of sorts, as she continues to pose questions, you then ask her to talk about it in group – why the shift? How did you decide to use which approach?
11. Are there any other class examples you would like to discuss?
12. I am hoping that if you feel anything similar to teacher lust in the moment of teaching that you would be willing to jot down some notes about the incident. I’d like the final interview to be more focused on your conceptions rather than my own.

This concludes our interview, thank you for your time and cooperation

Elizabeth -Video Viewing Interview Protocol #3

Thank you for setting aside time for this, our final interview based on my classroom observations. As we talked about last time, I am particularly interested in examining the phenomenon of teacher lust. I have selected clips that I would like to ask you about, but I would like to begin this interview as we did the previous one, and ask you to think back over the classes from the past two weeks and back to any moments where you think you may have experienced teacher lust - this desire to do or tell more than you may have planned.

Now that you have had a chance to talk about some places where you think you may have experienced teacher lust, I am going to offer some other clips of moments where I thought you may have experienced teacher lust. For each of these instances, I would like you to tell me as much as you can about your thought processes and what went into your pedagogical decisions. Again, it is not my intent to judge your choices, only to better understand what went into making them and how you may have felt in the moment of teaching.

[It is quite possible that the participant will raise some of these issues and obviously I will not need to revisit them]

division by zero

1. There was a lot of discussion during the problems involving division with zero. Can you start by talking about what you had hoped the students to get out of writing the story problems for the two situations?
    a. [clip 3333] In Ashley's problem – you made a wording change when writing it on the board – changing "zero hours" to "no time". Then later on during the discussion, you changed it back to her original wording. Can you talk about both decisions and what you were thinking or feeling when you made them?
    b. It seemed to me that you were trying to get at the notion that division by zero violates the fundamental theorem of arithmetic. On two different occasions, you raised a question like "if Maisy could walk 2 miles in no time, couldn't she also walk 10 miles in no time?" And "Could I also say that each children gets five cookies? Would that be wrong?" I was hoping you would talk about the idea you were trying to get across to them and how you had decided to accomplish it.
        i. Do you think you were successful in doing this?

c. Had you considered using any other “proofs” for this situation?

using the meaning /definition

2. Another theme I saw during these observations deals with your emphasis on the students using the meaning of the operations and the definition of the properties in their explanations. Was this an intentional decision on your part, and if so, can you talk about why this was important to you?
    a. There were several examples where students had made reasonable explanations – [3351, 3352, 3353] which were largely based on arithmetic reasoning – and you had asked them to go further – specifically targeting using the meaning of an operation. Can you talk about your choice to follow up their explanations with specific questions regarding the concepts behind the mathematics they were talking about?
        i. Was there a conscious choice to pose these questions instead of making the points yourself? Did you want to make these points yourself?
    b. [3403, 3405] During the test review class – you made a point to explicitly explain where the meaning of operations was being used within problems. Did the fact that it was a review class influence your actions?

Answers w/ questions and answers w/ answers

3. I’d like to talk some more about the test review class, and return to the notion of answering questions with questions, and answering questions with answers. There were three main questions asked by the students during the review. The explanation of why a negative x negative = positive, explaining decimal multiplication, and explanation of fraction multiplication. You responded to the first one directly, and asked the students to talk about the last two, based on an example you gave them to do. Can you tell me why you made each of these choices and what else you may have considered?
    a.

Outright telling

4. Sometimes it seems that your students do not want to respond orally to your questions. Do you agree with this assessment?
    a. Can you talk about some of the ways you have tried to deal with this?

i. For example, I saw you ask for a show of hands once.

b. How has this impacted your choices of when to tell something to them directly?

5. When you introduced the scaffolding division technique – you began by modeling it directly for them. Had you considered any other approaches?
   a. If so, why did you decide on this one?
   b. What might have been afforded my making a different choice?

I want to complete this interview by asking you some questions directly related to your participation in this study and about the construct of teacher lust.

6. What would you say you have gained, if anything, from participating in this study?
7. What is teacher lust for you?
   c. How do you know when you feel it?
   d. How have you dealt with these feelings in the moment of teaching?
8. Has your newfound awareness of teacher lust had any impact on your practice?
   i. Does it influence your planning?
   ii. Does it influence your choices in the moment of teaching?
   iii. Do you see it in other educators?

Is there anything else you would like to talk about? This concludes our final interview thank you for your time.