

Exploring Beliefs and Stated-Actions of a Preservice Mathematics Teacher¹⁾

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The purpose of this study is to examine a preservice elementary mathematics teacher's beliefs and stated-actions in which she planned and implemented mathematical activities in a field experience within a mathematics methods course. Results show that the preservice teacher seemed to be dealing with conflicts and trying to resolve them in order to make sense to herself. Results also suggest that the preservice teacher's beliefs about how children learn seem to get confirmed through the field experiences so that she was able to articulate, which influence her experience of focusing on an individual child. This, in turn, induces her to elaborate her beliefs. These processes would explain her beliefs and actions as a sensible system.

I. Introduction

Understanding individuals' beliefs helps to understand their actions. Research studies in education have been conducted on teachers' beliefs to better understand teachers' actions in their classrooms (e.g., Kagan, 1992; Nespor, 1987; Pajares, 1992). Mathematics teachers' beliefs have been acknowledge to play a key role in reform or mathematics education. What teachers believe about mathematics teaching and learning shapes the way that they teach, make decisions and change actions in their instruction (Philipp, 2007; Thompson, 1992). In particular, preservice teachers' beliefs about mathematics and teaching and learning mathematics strongly influence their developing knowledge and understanding of mathematics

teaching and learning throughout their teacher education program. Preservice teachers bring their understanding of mathematics from their experiences with this subject matter as students before college (Ball, 1990). They largely retain their previously held beliefs about mathematics and learning and teaching mathematics, which may not be changed in the short period of time during teacher education program, compared to the length of formative years spent learning mathematics. However, it is much more likely that the beliefs of preservice teachers begin to evolve during teacher education, which ultimately is crucial to the reform of mathematics education (Cooney & Shealy, 1997).

Research studies in mathematics education have revealed that preservice teachers tend to believe that mathematics is a set of rules and algorithms in mathematics learning from their experiences in

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K-12 education (National Council of Teachers of Mathematics [NCTM], 2000; Thompson, 1992). By taking mathematics content courses throughout K-12 and college, preservice elementary teachers are likely to learn the content of mathematics without realizing the processes in which they involve. That is, they, as learners of mathematics, hardly experience processes of mathematical learning such as problem solving, reasoning, communication, representation, and connection, which is required for the development of students' mathematical understanding (NCTM, 1995, 2000).

Preservice elementary teachers are highly likely to first experience a form of mathematics learning focused on problem solving, reasoning and proof, communication, representation, and making connections while taking mathematics methods courses in their teacher education programs. In general, mathematics methods courses provide them with opportunities to explore mathematical learning processes as sense-making activities (Anderson & Piazza, 1996; Wilcox, Schram, Lappan & Lanier, 1991). Preservice teachers are encouraged to unlearn mathematical ideas and concepts by constructing meanings themselves through doing mathematical tasks. These experiences influence what preservice teachers believe about mathematics, learning mathematics, and how one should teach mathematics. Given the fact that preservice teachers bring their beliefs about mathematics and teaching and learning mathematics along with their understanding and knowledge about mathematics, they may revisit their beliefs, consciously or unconsciously, and may be challenged by the training they receive

reform-oriented mathematics methods courses (Ball, 1990; Skott, 2001; Stipek, Givven, Salmon & MacGyvers, 2001). Preservice teachers' existing beliefs or ways of thinking and understanding influence how they act and interact with elementary students in teaching practice.

The purpose of this study is to examine a preservice elementary mathematics teacher's beliefs and actions-reported, not observed, in which she planned and implemented mathematical activities in a one-on-one situation situated in a field experience within a mathematics methods course. In particular, I attempt to explore how the preservice teacher's implicit and unconscious changes, if any, in her views about mathematics and teaching and learning mathematics emerge in her activity reports and how the teacher consciously or unconsciously embrace the ideas and views discussed in a reform-oriented mathematics methods course. Also, this study aims to investigate how a preservice elementary teacher goes through making sense of her beliefs and transforming them into intended-actions.

In the next sections, I present a brief overview of literature on mathematics teachers' beliefs. I then illustrate the processes of data collection and analysis for this study. Finally, I discuss the results and implications of the study.

II. Teacher Beliefs and Teaching Practices

Teachers retain many untested presumptions that influence how they think about teaching and learning. The assumptions teachers have about

their students and how their students learn are likely to direct how they approach teaching tasks and how they interact with their students (Calderhead, 1996; Fennema & Franke, 1992; Gess-Newsome, 1999). Research studies paid attention on teachers' beliefs as a critical factor in their teaching practices (Thompson, 1984). Further, beliefs about teaching might be closely related to beliefs about learning and the subject being taught. For instance, "if a mathematics teacher believes mathematics to be about the application of techniques, this may itself imply certain beliefs about how the subject is most appropriately taught and learned and what the role of the teacher should be" (Calderhead, 1996, p. 719). Additionally, research shows that student teachers' conceptions about learning to teach affect how they approach professional learning as well as the aspects of their teacher education programs to which they attach importance (Calderhead & Robson, 1991; Stipek, Givven, Salmon & MacGyvers, 2001). Teachers tend to maintain many beliefs about the learning and teaching of mathematics that they had as preservice teachers.

Thompson (1984, 1992) suggests that teachers' beliefs about teaching and mathematics considerably influence their behavior. Thus, teachers' beliefs about mathematic learning and teaching determine the style of their mathematics instruction (Clark & Peterson, 1986; Vacc & Bright, 1999). "The process of learning is fundamentally connected to how beliefs are structured" (Cooney, 1999, p. 172). Additionally, mathematics teachers' beliefs and views about mathematics and its teaching, consciously and

unconsciously, play a significant role in shaping the teachers' characteristic patterns of instructional decisions (Fennema & Franke, 1992; Gess-Newsom, 1999).

In her study investigating relationships between the beliefs and teaching practice of a beginning elementary teacher, Raymond (1997) found that a fourth-grade teacher's expressed beliefs were not consistent with her actual mathematics teaching practice. The teacher's beliefs about mathematics teaching and learning were categorized as nontraditional in that she strongly believed good mathematics instruction should include the use of manipulatives, various ways of representing the same question, and providing many activities from different sources than textbooks. Her teaching practice, however, was traditional.

Leatham (2006), however, argues that instead of interpreting the teacher's beliefs as inconsistent with practice (Ogan-Bekiroglu & Akkoc, 2009; Raymond, 1997), the teacher's beliefs should be considered as a "sensible system," in which teachers are viewed "as inherently sensible rather than inconsistent beings" (p. 92). The sensible system assumes that "individuals develop beliefs into organized systems that make sense to them" (p. 93). Thus, an individual person tends to resolve conflicts within the system in order to make the system sensible when his or her beliefs viewed as contradictory stick together. "When belief structures are viewed as sensible systems, observations of seeming contradictions are, in the language of constructivism, perturbations, and thus an opportunity to learn." (p. 95)

Preservice teachers' beliefs about teaching and learning mathematics seem to be influenced by

their previous experiences in the past as students (Ball, 1990; Pajares, 1992). One of the purposes of teacher education program is to replace or challenge, and ultimately change, preservice teachers' existing beliefs with new beliefs about teaching and learning mathematics. Vacc and Bright (1999) found that preservice teachers' beliefs were transformed while they took a mathematics methods course that focused on children's mathematical thinking and learning processes such as problem solving, communication, reasoning, and making connections. The change in preservice teachers' beliefs about children's learning mathematics and mathematics teaching brought about change in behavior. Changing beliefs would, in the long run, result in change in actions (Mewborn, 2000). Preservice elementary teachers' beliefs can be changed through systematic opportunities to learn children's mathematical thinking in which they engaged in mathematical activities designed to consider how to act with elementary students for a field experience (Philipp, Ambrose, Lamb, J. T. Sowder, Schappelle, L. Sowder, Thanheiser, & Chauvot, 2007). Thus, teacher education programs should include the process of making implicit belief systems explicit, thereby developing a language for talking and thinking about their own practice, questioning the sometimes contradictory beliefs underpinning their practice, and taking greater control over their own professional growth (Freeman, 1991; Ogan-Bekiroglu & Akkoc, 2009).

This study attempts to explore how one preservice elementary teacher's beliefs emerged in her stated-actions in working with a child while taking a mathematics methods course focused on

children's mathematical learning and thinking processes. In addition, the study explores how the preservice elementary teacher transforms her beliefs into instructional activities of mathematics for a child as field experience. The following research questions guided this study: How do a preservice elementary teacher's beliefs about mathematics teaching and learning, and mathematics influence her stated-actions in working with an elementary student during a mathematics methods course?

III. Methods

This study used qualitative research methods for data collection and analysis. For the study, I analyzed archival data that were written by the participant and in-depth interviews that were collected for about 6 months from fall semester through mid-spring semester of an academic year at a large university in the southeastern region in the United States. The participant was an elementary education major in the teacher education program taking the first mathematics methods course of a two-semester sequence. At the same time, she was taking a second mathematics content course of a three-semester sequence. The participant was one of the students in the class who were recommended by the instructor of the mathematics methods course to participate in this study as the participant had been actively contributing to whole group discussion and willingly expressing her ideas and opinions during the class.

The mathematics methods course focused on

children's mathematical thinking and learning. Thus, the course was designed to provide preservice teachers opportunities: (a) to widen their repertoire of communication strategies; (b) to participate in a collaborative learning community; and (c) to experience teaching and learning strategies that align with current reform efforts. In addition, the methods course included a field experience at an elementary school. Preservice teachers had an opportunity to work with an individual child so that they could learn children's mathematical learning and thinking. The experience was intended to create the context in which readings, discussions, and assignments of the course could be applied.

During data collection, I interviewed the participant three times—once at the end of the semester and the other two times in the following semester. Each interview lasted about 45 minutes to an hour and was transcribed for analysis. The focus of the interviews was to explore the preservice teacher's beliefs about mathematics and mathematics teaching and learning and further, investigate in detail her mathematical activities with a first grader in the field experience. The major archival database for this study comprised the participant's documents created in the mathematics methods course such as autobiography, two beliefs statements—one at the beginning and the other at the end of the semester, and activity reports written during the field experience portion of the course. For the field experience, preservice teachers in the course visited an elementary school near the university once a week for 7 weeks and worked with first-grade children, one-on-one, for about an hour

each visit. The activity report consisted of objectives, activities, descriptions of what happened during the hour including problems or successes, questions/concerns, and ideas for next session. The preservice teachers planned by writing the objectives and activities before the field experience and wrote the rest after they finished working with children. Then, they were to submit the activity report to the instructor of the course. It, however, was neither evaluated nor graded for the course. All the data were collected from the instructor of the course and the materials were organized chronologically.

The data were analyzed using the constant comparative method (Glaser & Strauss, 1967). The process of data analysis began with finding keywords from the interview transcripts and archival documents including autobiography, beliefs statements, and activity reports. I categorized those words into themes emerging from the interviews and documents. Then, I constantly compared categories from interview transcripts and archival documents.

I began data analysis by reading the autobiography and statements of beliefs of the participant and interview transcripts. After the first reading, I was able to get a general idea about the participant's experience and beliefs in relation to mathematics and teaching mathematics. Keeping the idea in mind obtained from the first reading, I read the data once again and tried to be sensitive to catch words or phrase that stood out to me. During the second reading, I coded the words that stood out as meaningful and sorted them out according to emerging sub-themes and created sub-categories.

In much the same manner, I analyzed the activity reports written by the participant. I read first and reread once again. In doing so, categorization created by the participant in her beliefs statement was used to differentiate the words by colors. For example, she illustrated her beliefs about students, teachers, how children learn, assessment, materials for teaching, and so on, thus I coded words according to the categorization given.

Among the categories made by the participant, I, first of all, analyzed focusing on three categories, “teachers” and “students” and “how children learn.” Afterwards, I constantly compared categories, such as how children learn and the student in the situation, teachers’ beliefs and the teacher’s feelings, etc. First, regarding teachers, I collected every word and phrase extracted from the autobiography and beliefs statement in relation to the “teachers” on a blank paper. Similarly, words and phrase with regard to “students” and “how children learn” were gathered on another blank one. Next, I combined the two categories into one chart. Then, I divided each category into several subcategories using the participant’s words.

Next, in order to make a connection between the categories taken from the other two documents, interviews, and the activity reports, I again coded the words and phrases already coded in the activity reports by, basically, “teachers” and “students” and “how children learn.” Once again, I read activity reports. Two more categories came up when I reread, which were “feelings” and description about the first-grade student who was taught by the participant for

eight weeks in an elementary school, and coded words and phrase mentioning them additionally. Based on the categorization, I created another chart using the participant’s words or phrase as well. Finally, I constantly compared the columns in the chart.

IV. Findings

1. The Participant

The preservice elementary teacher, Alison Keim (pseudonym), seemed to be facing challenges to her beliefs about teaching and learning mathematics during the mathematics methods course. As a result, she appeared to undergo changes in her instruction according to her beliefs. She showed conflicts between her beliefs and practice; however, at the same time, she seemed to subtly change, which reflected in her stated-actions of teaching during the field experiences. Alison was better able to articulate her beliefs in terms of mathematics education towards the end of the course.

Alison Keim was a Caucasian female and 20-year-old college junior at the time of this study. She majored in elementary education because she believed being a teacher was her calling and she loved children. She stated that she had always been good at mathematics. Then she realized that she believed she was good at mathematics because she had always made good grades in that subject; “being good at mathematics and at grades are different” when she took mathematics content courses for

elementary preservice teachers and mathematics methods course. Alison loved mathematics because there was a right answer all the time; furthermore, mathematics was an extremely likeable subject not because it was easy to learn but because it made logical sense. She said that her love for mathematics came from her parents, especially, her mother making her feel comfortable and confident while helping her solve problems of mathematics. Prior to entering her teacher education program, Alison had opportunities to work with children, which made her realize that each individual child has both great potential and tremendous fragility in developing his or her potential. Thus, she stated that it was her duty to treat each child as a special individual worthy of respect and love.

Alison believed that mathematics was one of the most objective subjects. She said that mathematics is in nature an exciting subject in which one can translate everything into representations of numbers. She felt mathematics was “like a piece of an organ that just fits together perfectly.” Moreover, Alison believed that mathematics is something outside her that she should find and thus, doing mathematics was searching for answers, like “finding a treasure.”

2. Beliefs and Stated-Actions

Alison revealed internal conflicts between whom she was now as a preservice teacher and who she wanted to be as a teacher. Alison initially and clearly exhibited the internal conflicts in her autobiography and later, the conflicts were very apparently shown in her activity reports. She

felt a special calling as a teacher; even though she was not an ideal teacher yet, she seemed to believe that she would be an ideal teacher in the future.

Alison believed children would learn by actively constructing their world through manipulatives or physical experiences. However, she kept using controlling words, rather than listening to a child especially at the beginning of the field experience. For instance, she repeatedly used such directive words in the activity reports describing what she did: “decided to do something else,” “told him to do,” “let him do,” “point the methods for him to use,” “had him use,” etc. [italics added for emphasis] That is, in the reality, her beliefs about teaching were not yet demonstrated in actual practice situations in which she taught a first-grade student individually. She “did not want to direct students” because it contradicted her beliefs that teachers must let students “actively construct” their own world, yet she did “lead” and “direct” the first grade student.

In addition, although it was certainly true that the child was provided opportunities to use manipulatives, Alison did not let him choose manipulatives or any other materials that he most liked or with which he felt comfortable to work. This illustrates her beliefs about how children learn: “There are certain ways that I believe children learn best”—her emphasis. Furthermore, Alison, according to her beliefs, could have guided him to make a story problem when the opportunity arose with the lesson. Instead, she created and told the story, as shown in the activity reports that Alison herself “told a story”

and “posed imaginative story problems.” At the same time, in contrast, she realized that he did much better when he had the opportunity to discover mathematical truths for himself. Nonetheless, Alison chose to teach in a way to “make” him do the activities and keeping his attention by telling him what to do rather than allowing his exploration. In the interviews, she explicitly pointed out that it was more important as a teacher to intrinsically motivate a student as opposed to doing so extrinsically.

Alison believed that children have both great potential and tremendous fragility to learn mathematics, which may explain her sentiment that teachers are more responsible for their students’ learning than are children themselves. On the other hand, it was easily noticeable in her teaching the child that she appeared to unconsciously blame him for his troubles or difficulties: “he had troubles,” “a problem is harder for him,” “he gets bored very easily,” “he is getting so distracted” easily, “he became fidgety,” “he wasn’t really interested” in doing an activity she planned, “he doesn’t want to work,” and “he got really hyper today.” [Italics added for emphasis] Interestingly, like the controlling words, the frequency of using these expressions also decreased toward the end of the semester.

Alison viewed that teachers are not in the teaching profession for the “warm-fuzzy feelings.” However, in practice, she tended to depend on her feelings, using expressions such as “my excitement,” “today was awesome,” “was really amazed,” “it was great that,” etc. This seemed to influence her response to and interaction with the child. In some cases, she might have felt excited

and great when the student could answer, evidenced by her statements, “can count well,” “caught on quickly,” was “getting really quick,” “was able to figure out,” “could use,” “really enjoy,” “liked,” “listened,” “really got excited,” “knew,” “understood,” “has mastered,” “used it very effectively,” “came up with different method,” and “used newly learned counting technique.” However, when the child “couldn’t make,” “couldn’t count,” “had troubles,” “took a while to see,” was “tired,” “gets bored easily,” “wasn’t constantly engaged,” “doesn’t want to work,” “wasn’t really interested,” is “getting out of control,” and “got really hyper,” she was struggling with such situations. This led her “hesitantly” to try something else, though she turned to request help from others rather than trusting herself. For example, she questioned: “Should I maybe make it a little easier?” “How can I keep?” “Couldn’t [I] make him make the connection?” and “[I] Don’t know” even when she felt it was “important,” she ended up being hesitant to suggest her own ideas.

3. Making-Sense Processes

Despite her beliefs of letting children construct meaning, Alison kept using directive words in her reports; however, it was noteworthy that the frequency of using the words gradually and slightly decreased over the period of the field experience (<Table IV-1> and <Figure IV-1>). Considering Alison’s comments on her change after getting in the teacher education program and taking mathematics content and methods courses in the program, it could be assumed now that

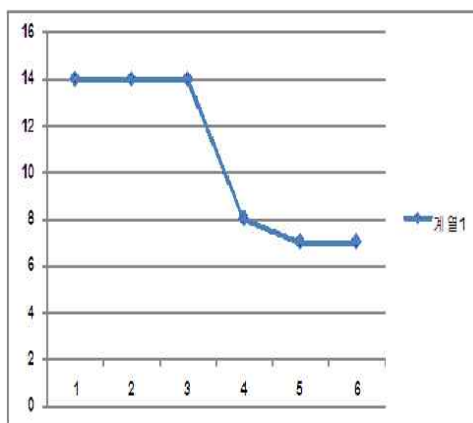
she would try to listen and let the student construct his world for himself. This is clearly apparent in her second beliefs statement after the field experience finished; Alison seemed very articulate in explaining her beliefs, describing that “children learn by having the freedom to explore topics at their own pace.”

changed since I first entered the program. I think before I entered the program I would probably [have] taught like my elementary school teachers had taught.

In addition, the changes were evident in her beliefs statements at the end of the course, which correspond to the change in her stated-actions with the first grade student.

<Table IV-1> Change of the frequency of directive words

Week	2nd	3rd	4th	5th	6th	7th
Number of the Words	14	14	12	8	7	7



<Figure IV-1> Frequency of using directive words

Changes in her behaviors in the field experience, slow and not so explicit in the first interview, were also revealed in the interview in which she expressed the change she was undergoing while taking methods courses:

It [change] is just more than shaping indirectly. It opened my eyes to the disparity between how I learned mathematics and how mathematics really operates through the eyes of a child. It's [beliefs about mathematics teaching] changed. It has

4. Stated-Actions Corresponding to Beliefs: Developing a Sensible System

Alison appeared to stick to her beliefs about children's learning. For instance, she provided the student with the opportunities to play various games. Offering various kinds of games or hands-on activities, she consequently revealed herself in accordance with her beliefs about how children learn: “children learn in a variety of ways by playing, talking, singing, and dancing, vicariously, and example” which developed in a more lucid expression: “children learn by doing [her emphasis], not just watching. Children learn by exploring and trial and error... Children learn by having the freedom to explore topics at their own pace, formulating answers and relating topics to each other.”

Furthermore, Alison expected that she would soon explore for herself the various ways that different types of students most naturally learn. While teaching an individual child, Alex, she appeared to explore and be very conscious about the most natural ways that learning happened for that child. This was disclosed in her questions and concerns: “I don't know if,” “Should I maybe make it a little easier?” “How can I keep his

attention?” and “I am hesitant to suggest.” These concerns express her beliefs that proper knowledge and tools can help in making sense to elementary students and in explaining a solution as well.

Alison’s beliefs about how children learn tended to show in her teaching, though evidence is lacking that she consistently correlates her beliefs with her instructional activities. Her inconsistency might come partly from limited experience with children and partly from her previous schooling experience as a student, which made her confused and unstable in her actions. Also, it is likely this comes from her lack of articulation of her beliefs and actions reported. Alison clearly explained in her first beliefs and autobiography statements that she believed children need “great care” from their teacher, that is, they are very dependent on teachers; however, this view was more articulated in her second beliefs statements such as “[elementary] students have many things to show teachers” “students can often offer alternative ways to solve problems if the teacher creates an open environment in his/her classroom.” Alison also recognized children being inherent learners who are eager to learn mathematics in “fun, engaging, and informative” ways. She might have recognized it before, but she was able to express it clearly in terms of mathematics education by drawing on ideas from the methods course later on in the semester. This showed that her description of her beliefs used ideas and goals of the methods course and that she seemed to internalize the ideas and goals through her field experience. For instance, Alison consistently and frequently emphasized the importance of utilizing materials or manipulatives including calculators, base ten blocks, place value mat,

literature in elementary mathematics classroom, which are the means that the methods course designed and encouraged the preservice elementary teachers to apply to their field experience. While working with the first grade student Alex, Alison constantly employed the manipulatives such as place value mat, base ten blocks, and money, number dice, and calculators for her activities. Further, Alison hardly encouraged Alex to use paper and pencil; rather, she supported Alex to work with such manipulatives and do mental computation. In particular, Alison adopted some of the games provided in the mathematics methods course so as to promote Alex’s thinking in doing mathematics.

Similarly, Alison’s views on “content and materials,” one of the categorizations in the two beliefs statements, showed the projection of her experiences: she explained first, “Content and materials are simply a means to a very noble end.” Later on, she illustrated that

Content is obviously important to a mathematics program. Without it, nothing would be taught. However, I believe materials are just as important to a mathematics program as the content. It is important to have the proper materials (manipulatives, calculators, literature, etc.) in a mathematical program to allow every student to fully explore the math being presented.

Moreover, this view was intertwined with her beliefs about “Teachers” in ways that “if teachers utilize all the resources available, they can make mathematics fun and exciting.” Alison seemed to firmly believe that elementary mathematics teachers must make mathematics instruction or activities fun in their classrooms in order to help

children like and understand mathematics and that is her responsibility as a teacher above all. This would explain internal processes in which Alice tended to resolve conflicts within her beliefs system to build the system more sensible.

V. Conclusions and Implications

This study showed how a preservice teacher's beliefs and stated-actions evolved over a mathematics methods course that is reform-oriented. The preservice elementary teacher seemed to undergo changes in her beliefs to a more constructivist view about children's mathematical learning while taking the mathematics methods courses. Rather than viewing mathematics instruction as telling or leading from her own experiences as a student, Alison appeared to change her ways as time progressed in the field experience of the course, which seemed to result from experiences and activities provided during the methods course. She acknowledged that she used some of the games she learned about in the methods course because she felt those games would be the "best motivator" for a first grader and "make him think about what he was doing." Also, Alison was better able to articulate her beliefs about mathematics teaching and learning and translate her beliefs into her instructional activities. In the beginning of the semester, she described children learn "by playing, talking, singing, and dancing; vicariously; by example." However, later, her beliefs were stated as "students learn by exposure to topics and using manipulatives," "by exploring

and trial and error" and "by having the freedom to explore topics and formulating answers." This was manifested in her activities in her field experience; she used manipulatives all the time for all the activities with which she was trying to help the first grader understand mathematical concepts.

The results suggested that gaps existed between beliefs and actions of the preservice teacher while learning to be a teacher. These gaps may hinder preservice teachers from the enactment of their beliefs. The results also suggested that Alison appeared to have still held her beliefs about mathematics teaching, which shows that her beliefs remains relatively static (Reeder, Utley & Cassel, 2009); however, her beliefs about how children learn might be getting confirmed through the experience during the field experience so that she was able to articulate in terms of how children learn and what mathematics teachers should do to support students' better understanding. In other words, her beliefs about how children learn appeared to definitely influence her experience of focusing on the child. This, in turn, induced Alison to elaborate her beliefs about children, how they learn mathematics, and teachers' role in mathematics classroom and thus, to change in some degree. She focused on teachers' responsibility for children's learning by making mathematics fun and then moved on to children's constructing knowledge by the processes of making sense. These processes would explain her beliefs and actions as a sensible system, rather than an inconsistent system (Leatham, 2006).

Alison was a first year student in the teacher

education program. As she described her beliefs about students, she too had great potential but tremendous fragility. She seemed to be dealing with conflicts and trying to resolve them in order to make sense to herself. The results of this study support that teachers' action would not easily change in a short period of time (Calderhead & Robson, 1991), but can change slowly over a long period with experiences (Mewborn, 2000). Furthermore, the results of the study parallel the findings of Philipp et al. (2007) in that preservice teachers' beliefs can change if they are provided with opportunities to learn about children's mathematical thinking and to act with children through field experiences.

The results from this study on how a preservice elementary teacher goes through making sense of her beliefs as a sensible system suggest for teacher education that designing mathematics methods courses in ways that explicitly deal with mathematics pedagogy and incorporate research findings on children's mathematical understanding would influence preservice teachers' thinking about teaching and learning mathematics. For substantial change of their beliefs to desirable beliefs that result in meaningful change in their actions, preservice teachers should be exposed to opportunities to work with children within a mathematics methods course and be encouraged to articulate their beliefs and actions in order to make sense to themselves. In particular, opportunities of working with children should be designed as a continuing one-on-one situation so that preservice teachers would be able to observe one child's mathematical thinking and understanding processes

persistently and deeply. Focusing on individual learners and learning processes is powerful to become a teacher, which further makes preservice teachers be able to relate to how children learn mathematics. Therefore, such experiences to work with children should be systematically organized throughout teacher education program so that preservice teachers are repeatedly encouraged to reflect on children's learning mathematics and their preparation.

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예비교사의 수학교수학습에 대한 신념체계와 기술된 수업행동 분석

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이 연구의 목적은 예비수학교사의 수학교수학습에 대한 신념체계와 수학교수법 중에 시행하는 예비실습을 하는 동안 기록한 활동지의 기술된 수업행동을 분석하여 예비교사가 어떻게 새로운 신념체계를 내재화하는 지 살펴보는 것이다. 연구 결과, 연구에 참여한 예비교사는 일대일 학생과의 예비실습활동을 통하여, 초등학생들의 수학교수 사고과정에 대한 지식을 더

확실하게 자신의 신념체계로 통합하는 것으로 보인다. 그 과정에서 예비교사는 기존의 신념체계와의 심리적 갈등을 겪고 해소해 나가는 것으로 나타났다. 또한, 그 과정을 통하여, 예비교사는 자신의 수학교수학습에 대한 신념체계를 보다 더 분명하고 명확하게 표현하는 것으로 나타났다.

* key words : teacher beliefs (교사의 신념체계), preservice elementary teacher (예비 초등교사), beliefs and actions (신념체계와 행동), teacher education (교사 교육), teacher learning (교사 학습), sensible system (합리적 체계)

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