

Pre-service Teachers' Learning to Teach: Theory Into Practice

Youngsun Kwak* and Seung-Urn Choe

Department of Earth Science Education, Seoul National University, Seoul 151-748, Korea

Abstract: This study investigated preservice teachers' perceived constraints in implementing their ideal pedagogies and the influence of the teacher education program on their pedagogical beliefs changes. Unique features that the university-based coursework and field experiences had on preservice teachers' learning to teach were also explored. This preservice teacher education program employs constructivist aspects of teacher education and generates applications of constructivism to the practice of teaching. Major findings include: preservice teachers' having traditional pedagogy as the default, recovery of prior beliefs, constraints on implementing constructivist pedagogy, and being overly confident in themselves as teachers. With the influence of constructivist epistemology, these preservice teachers' pedagogical beliefs evolved and were refined over time as they incorporated various constructivist ideas. The benefits and influences of the M.Ed. program's theoretical coursework and the field experiences on these teachers' learning-to-teach experiences are addressed with rich data. The implications for teacher educators as well as for the instructional practices of preservice teacher education programs are discussed. Recommendations for future research are also presented.

Key words: constructivism, constructivist teacher education program, pedagogical beliefs, methods courses, teachers' prior beliefs, qualitative research, conflict between theory and practice

INTRODUCTION

A constructivist approach is advocated by some as the appropriate core component of the method courses of teacher education programs, which employ the constructivist aspects of teacher education and generate applications of constructivism to the practice of teacher education. That is, a team of educational psychologists recently advocates the tenets of a contemporary psychological perspective (i.e., constructivism) as a guide to assist in the preparation of prospective teachers (Scheurman, 1995).

Considering that teachers can not be expected to learn effective science pedagogy on their own, teacher educators are mainly responsible for preparing them to meet this challenge and teacher education programs should address the issue of preservice teachers' pedagogical knowledge (Stofflett, 1991; Shulman, 1986). Along this line, the development of a solid base of knowledge about preservice teachers' pedagogical perspective changes will be instrumental in providing a framework for considering both the

learning processes involved in changing their conceptions, as well as providing a framework for designing instruction that facilitates those changes (Hewson and Kerby, 1993). That is, such knowledge is fundamental to efforts to design preservice models that will be successful in helping individuals acquire more appropriate conceptions of science teaching (Hewson and Kerby, 1993).

The purpose of this study was to describe the nature of preservice teachers' pedagogical perspective changes as they went through a constructivist teacher education program's theoretical coursework along with field experiences. This study sought to answer the following questions:

Throughout their preservice teacher education program, what impact does a preservice teacher education program—which employs constructivist aspects of teacher education and generates applications of constructivism to the practice of teaching—have on preservice teachers' conceptions of teaching and learning? What are the preservice teachers' perceived constraints in implementing constructivist learning theory in the real classroom? Although the effects of a teacher education pro-

*E-mail: ykwak@hanmir.com

gram appear to be erased by classroom practice (Kagan, 1992), it is important to provide instruction on constructivism for preservice teachers as a knowledge base at this stage in their professional development. Unless preservice programs can make pedagogical perspective changes firstly at a theoretical level, it is hard to expect preservice teachers to implement a constructivist epistemology in their classroom teaching practices. This would be far more complicated with other contextual dilemmas, given the stress of daily student teaching. That is, to try to realize constructivist pedagogy in the classroom, preservice teachers should know what constructivist epistemology is, and how it is different from their own previously held beliefs at the theoretical level first. Implementation or realization of their ideal pedagogy in daily practice is then the next step.

A larger study associated with the results reported here investigated change in sixteen preservice teachers' understanding about constructivism and the reasons for changes in their understanding (Kwak, 2001). Constructivism was a major theme in the instruction these students received as will be demonstrated later. This investigation is fundamentally descriptive in nature. The study aims to describe unique features that the university-based coursework and field experiences had on preservice teachers' learning to teach. That is which one (methods courses or field experience) is more helpful to become a teacher? In the following section, we presented a brief review of past research on preservice teacher education programs that incorporated constructivist pedagogy.

THEORETICAL OVERVIEW

In this section, based on researches on how beginning teachers learn to teach, we summarized emerging themes in terms of future research implications, which, in turn, will provide a backdrop for our own research. We primarily focused on researches that were concerned with prior beliefs of beginning teachers and program interventions occurring during teacher education, which examined the perceptions

and developing beliefs of beginning teachers related to preservice teacher education (Wideen *et al.*, 1998).

Prior Beliefs of Pre-service Teachers

Through longitudinal studies, researches examined the importance of the beliefs held by beginning teachers prior to entering programs of preservice teacher education in that these well-established prior beliefs about teaching are hard to change and act as filters through which teacher education program experiences are interpreted (Hollingsworth, 1989; Pajares, 1992; Richardson, 1996; Wideen *et al.*, 1998). The origin of beliefs or experience that influences the development of beliefs are personal experience (e.g., parenting, life decision, family influences, etc.), experience with schooling and instruction (e.g., years of pedagogical modeling from teachers, the apprenticeship of experience based on their own experiences as students, etc.), and experience with formal knowledge (e.g., experiences with formal pedagogical knowledge) (Wideen *et al.*, 1998).

Using interviews, elicitation of metaphors, narrative semiotic analysis, concept maps, journals, personal biographies, and portfolios to examine conceptual changes in teachers' beliefs in preservice teacher education, a number of researchers found that the student teachers' perspectives are difficult to change (Kagan, 1992; Richardson, 1996) whereas teacher reeducation programs that approach learning to teach in a constructivist manner are successful in engaging and changing their beliefs and practices (Richardson, 1996).

The Impact of Teacher Education Program: Pre-service Interventions

Richardson (1996) contends, except for the student-teaching element, preservice teacher education seems a weak intervention in that it is sandwiched between two powerful forces: one is the previous life history of being a student that sets images of teaching, and the other is the classroom experience as a [student] teacher that provides practical knowledge through the socialization process of the school. However, the

academic elements of preservice teacher education in terms of an introduction to the new and alternative conceptions and beliefs, which have beginning teachers examine their beliefs, have an impact on teachers although there could be a lag time to make an impact on practice or perhaps not recognized by them. In the following section, studies on the impact of teacher education program interventions during university coursework are examined.

According to Richardson (1997), to date, research on constructivist teacher education takes on two quite different forms: One form attempts to teach preservice teachers how to teach in a particular constructivist manner, whereby the teacher educator directly instructs preservice teachers in a constructivist theory (e.g., Piagetian) whereas another form involves the investigation of preservice teachers' tacit, prior beliefs of teaching and presentation of alternatives to those held by them, through modeling of a constructivist classroom by a teacher educator. Considering the importance of developing constructivist psychological perspective in this study, it seems that any teacher education program could not function adequately without knowledge of their students' personal epistemologies, defined as beliefs about learning, dispositions toward thinking, and assumptions about knowledge itself (Scheurman, 1996). Teacher educators need to consider and articulate their students' evolutionary ways of thinking about pedagogy to promote conceptual change in preservice teachers by incorporating this tenet into their curriculum design and instruction so that this sequence of conceptual advances can serve as the goals for a developmentally based curriculum. Like children's preconceptions, preservice teachers' epistemological orientations as well as concepts entering a teacher preparation program affect what and how they learn (Pajares, 1992; Scheurman, 1995).

Along this line, if the objective of teacher education is to equip teachers with a contemporary psychological perspective of teaching and learning (known collectively as constructivism), then teacher educators need to anticipate the developmental variations in preservice

teachers' personal epistemologies (Scheurman, 1995). On the other hand, for pre-service teachers it is important to anticipate the developmental variations they are likely to encounter as teachers (Scheurman, 1995). In sum, based on emerging themes from the previous research, suggestions as to how this research might inform preservice teacher education can be summarized as following:

- Considering the fact that the big advances in understanding about student learning with a constructivist orientation have not been matched by equivalent advances in understanding about teaching. Research in science teacher education needs to move in this direction as well, that is, researching how to teach teachers to teach in a constructivist manner (Anderson and Mitchener, 1994).
- The constructivist theories of learning suggest that students bring beliefs to a teacher education program that strongly influence what and how they learn (Richardson, 1996). Therefore, the goal of teacher education is to help teachers transform tacit or unexamined beliefs about teaching, learning, and the curriculum into objectively reasonable or evidentiary beliefs.
- Research on teacher educators' (within a faculty of teacher education) beliefs and practices will be particularly helpful in the improvement of teacher education practice (Richardson, 1996), along with the research that examines the influence of teaching by academic subject-matter professors on the entering pedagogical beliefs of preservice teachers (Mayer-Smith, *et al.*, 1994; Wideen *et al.*, 1998).
- Faculty recognizes that if students are to acquire a non-traditional orientation, curriculum messages must be reinforced and supported in all facets of the program (Wideen *et al.*, 1998).
- The solution proposed by most researchers [who studied the beginning teachers since they are the central problem in teacher education] is to have preservice teachers reflect more on their practice and to employ teaching approaches more consistent

with constructivism (Wideen *et al.*, 1998).

- Programs to develop teachers with a constructivist view need to provide prospective science teachers with a model for constructivist learning situations and help them develop practical knowledge, the type experienced expert teachers possess (Anderson and Mitchener, 1994).

METHODS

This section provides an overview of the MSAT constructivist preservice teacher education program (fifth-year master's program) along with a time line of the study and a description of the subjects.

Overview of the MSAT M. Ed. Program

The program assumes five quarters of full-time registration, beginning in the summer quarter and continuing until the following summer. The integrated Master of Education (M.Ed.) program in the Mathematics, Science, and Technology Education (MSAT) department aims to provide a comprehensive master's program in mathematics, science, and technology education leading to grades 7 through 12 teacher certification. In terms of classroom experience, the MSAT M.Ed. program features a gradual increase of classroom experiences through fieldwork where preservice teachers can engage extensively in the active exploration of classroom contexts from the second quarter. From the second quarter on, preservice teachers typically receive over 270 hours of field experiences through their university coursework prior to their 10-week student teaching experience (practicum experience) in the fourth quarter.

Subjects

We followed one cohort of thirty-four preservice science teachers through the theoretical coursework in their M.Ed. program (i.e. from the summer quarter to the end of the winter quarter). We tracked perspective changes toward constructivist epistemology for all students. Data were collected periodically over the

three-quarters and included four in-depth interviews (e.g. interview about instances, general open-ended questions, and forced-choice questions) and the Constructivist Learning Environment Survey (CLES) questionnaire. All thirty-four science preservice teachers accepted into the MSAT teacher certification program completed questionnaires and a subset of sixteen--nine female teachers and seven male teachers--were interviewed periodically throughout the study. Interviews were conducted at four points in the M.Ed. program: during the first week of university coursework and at the end of the first, second, and third terms of coursework (i.e. right before student teaching experiences, or internship in the following spring quarter). During the last interview, subjects were also asked to compare their own pre- and post-interview responses and to explain changes we identified through a member check process.

This study investigated preservice teachers' perceived constraints (or challenges and variables) in implementing their ideal pedagogies and the influence of the teacher education program on their pedagogical beliefs changes. Following them into their student teaching and subsequent induction year (s) was not part of this study, although we recognize the importance of doing so in the future.

Interview Design

Participants made statements regarding inferred practical pedagogical outcomes and principles as well as the means to facilitate learning based on his or her unique epistemology. Each preservice teacher's CSTL included statements of ideals which include behaviors, values, dispositions, the role of herself as a teacher, the expected role of students in her science class, how to teach, how she thinks students learn, rationales of her ways of teaching, as well as rationales of expected learning outcomes.

We also examined the perceptions that these teachers had about the feasibility (or viability) of constructivism in actual classrooms they visited during their field experiences. These findings emerged from case stories of the sixteen participants of the larger

study (Kwak, 2001).

For example, to elicit each preservice teacher's conceptions of science teaching and learning, general open-ended questions about pedagogical beliefs were used throughout the four times of interviews in an attempt to reveal how each preservice teacher defines science teaching or learning, what she considers to be the founding principles of teaching as well as the learning outcomes of science teaching, how she describes the processes by which a learner learns, how she could judge when students have learned something, what teaching strategies she is going to implement, what she considers to be the ideal role of the teacher or the expected role of the students in her future classroom, and what role she sees herself playing as the teacher in her classroom.

RESULTS

This study was conducted during the first three quarters of enrollment in the MSAT M.Ed. program during which preservice teachers were first introduced to constructivism by MSAT faculty. Views of constructivism formed the basis for much of the instruction that faculty presented throughout the MSAT M.Ed. preservice teacher education program. The majority of the MSAT M.Ed. faculty explicitly stated that one of the goals and objectives of the university-based coursework was to promote

constructivism as a way of understanding how students learn. A second goal for this faculty was that their students understand teaching strategies for improving and stimulating change in students' conceptions (course syllabus, July, 1999).

In addition, the instructors of the methods courses modelled what they believed to be constructivism, where they interpreted constructivism as a perspective on how people learn. By allowing the preservice teachers to participate in activities that are blatantly constructivist in nature as learners of science content, the methods instructors wanted them to gradually move away from viewing teaching from a student's viewpoint to knowing teaching from a teacher's perspective. The instructors thought, "this idea of constructivism is the strongest way to help our preservice teachers understand that they need to meet the needs of every learner by maintaining engagement on the part of the students" (personal communication with a professor, May, 2000). Moreover, having experienced constructivist learning firsthand themselves in individual or group settings, the MSAT preservice teachers were expected to implement constructivist-based approaches in their classroom practices.

This section focuses on the implications that this study has for teacher education programs that present constructivism as a significant component of their programs, as well as research-related connections and issues. We extracted common themes regarding

Table 1. A summary of significant findings

Research questions	Findings
Characteristics of preservice teachers' pedagogical beliefs changes	<ul style="list-style-type: none"> • Traditional pedagogy as the preservice teachers' default pedagogy. • Recovery of prior beliefs from the second quarter. • Being overly confident in themselves as teacher from the beginning of the teacher education.
Conflicts between theory and practice	<p>Constraints on implementing constructivist pedagogy standardized tests, the amount of lecturing and content to cover, time constraints, student resistance to new ways of learning, etc.</p> <p>Influences of the M.Ed. theoretical coursework:</p> <ul style="list-style-type: none"> • It provided the ideas and theories on different educational theories that these preservice teachers have never heard before. • It helped them to see that there are many different ways of learning other than rote memorization. • It helped them move from focusing on teachers themselves to trying to focus on the students more, or trying to shift some of the responsibility from teachers to students. • The M.Ed. program's exemplary professors who taught preservice teachers as they want us to teach. <p>Influences of Field Experiences:</p> <ul style="list-style-type: none"> • The field experiences provided groundwork for translating theory into practice • preservice teachers were able to watch positive role models during the field experiences.
Influence of teacher education program	

how preservice teachers who expressed a preference for a constructivist approach to learning perceived the viability of this approach during their field experiences. Significant findings to the research questions are summarized in Table 1.

Traditional Pedagogy as the Default

In the first interview, all 16 participants revealed a traditional view of teaching and learning (i.e. a transmission model of science instruction) to a certain extent, which was constructed based on their prior experiences as students in classrooms (Kagan, 1992; Richardson, 1996). In the second interview, 14 out of 16 participating preservice teachers, with the exception of Ben and one of the teachers in the composite case, completely replaced their traditional views with constructivist notions of science teaching and learning in light of the role of the teacher, how to teach, and how to learn. Accordingly, it was rare to find any text unit coded within the traditional pedagogy category for these 14 teachers' CSTL profiles during the second interview. In addition, it is interesting to note that all the participants, after examining their profiles presented during the member check, expressed their satisfaction with their individual changes that they had got away from the traditional category of conceptions of science teaching and learning over time. Young's comment epitomizes their common responses: "complete moving away from traditional, which is an accurate reflection of my beliefs" (Young 4).

On the other hand, one participating teacher stated, "as I look back, whenever I was frustrated, that traditional pedagogy was my default, giving out students the information through lecture. I think that's how I have been taught and I am obviously comfortable with that. I still have that latent traditional concept of teaching" (Young 4). Furthermore, she acknowledged, "if I get uncomfortable with trying other nontraditional ways of teaching, I will probably revert back to what I was taught, or what's worked in the past" (Young 4). Overall, with the influence of constructivist epistemology advocated

in the MSAT teacher education program, these preservice teachers conceptions of science teaching and learning evolved and were refined over time as they incorporated various constructivist ideas (Kwak, 2001).

Recovery of Prior Beliefs

After their Autumn quarter coursework and field experiences, where they mainly participated in classrooms as observers and taught at least five full-class lessons, some of these teachers reverted back to their previously held pedagogical beliefs that they brought with them to the teacher education program. In other words, these teachers reemphasized their traditional pedagogical beliefs right after their autumn quarter field experiences. During this first field experiences, they were frustrated by real classroom settings in which students resistance to new ways of teaching, time constraints, a certain amount of curriculum they felt required to cover, *the amount of lecturing they felt required to do*, pressure to prepare students for standardized tests, and missing connections between theory and practice when they met negative role models or observed their mentor teachers' traditional ways of teaching.

Being Overly Confident in Themselves as Teacher

As has been noted by Richardson (1996), three of the participants were highly confident of their own abilities as teachers from the beginning, and contended, "there is not much we can learn in preservice teacher education except during our field experiences". In other words, "deep down philosophically the program hasn't changed me. Nothing has presented itself for a reason for any change" (Ben 4). Moreover, they argued that 'their theoretical framework in teaching is more from their prior experiences, and they learned how to put names and theories to the ideas and views that they already believed before they came into the program, such as constructivist or conceptual change' (Ben 2,

and Young 2). Overall, they valued the MSAT teacher education program only in that 'it helped them to put some vocabulary and words, such as constructivism, to their previously-held beliefs about science teaching and learning, and have put their ideas a little bit more concrete because of readings'. As they put it:

In all honesty, a lot of what we've learned, a lot of what they done for me is to put words to thing that I already believed. I think the basic tenets of constructivism in terms of active learning, student making connections to the real world, students making connection to their own lives, I think I believe in those things before I came into this programme. I think that learning about constructivism in the concrete has perhaps given me more ideas, how to actually implement it in the classroom. But the idea of constructivism, I feel that in large part I already had generated from my own experiences as a student. (Young 2)

I really don't think the M.Ed. program has influenced my beliefs about teaching and learning very much. The M.Ed. program helped me to put some vocabularies to it, like constructivism, but in general my ideas about what students should get from a science classroom and what a teacher should be doing to facilitate haven't really changed. The program may have helped me put my ideas in a little bit more concrete ways because of readings that I did and learning what other people believe whether it's my peers or Piaget or even the self-reflections that we have been asked to do (Ellen 4).

Constraints on Implementing Constructivist Pedagogy

All of the teachers talked about their perceived constraints on implementing their beliefs about science teaching and learning acquired in the methods courses. Some selected constraints include standardized tests, the amount of lecturing and content to cover, time constraints, and student resistance to new ways

of learning, and the society to which the teachers belong. In their own words:

Some of the things that they teach us in the program are they sound really good, but when you try to implement them in the classroom, you can't because as a teacher, you are restricted to a certain amount of time and you have to complete a certain amount of curriculum. I think as a teacher you have to get very creative in how to cover several topics at one time and hopefully do it in a way that students understand all of those. (Len 3)

There are two categories of constraints. There is the constraint that has to do with students who maybe resist learning in a style that I propose. They may not be able to see what I am getting at and so they will become frustrated and then will give up early. That's one kind of constraint. And the other kind of constraint would have to do with the actual mechanics of teaching. If I have a school district curriculum that says you have to cover this much material in this short of time, and I don't have enough time to cover the way that I want to while provide students the time to construct their own ideas, go through and interpret them, and then apply them. If I don't have time to do that all the time, then I may have to go back to some of the traditional ways. Or, if I have enforced to cover something for the proficiency test then maybe lectures could be a dominator, your group activities aren't going to be real prolific. I think, it's not a happy situation, but sometimes it's the way the real world is. (Young 4)

There are lots of constraints on implementing my beliefs about instruction. I have a lot of them already because there are a lot of different stakeholders in the education of children. They may not necessarily have the same ideas or beliefs that I do. I am not omnipotent. I can't do everything that I just want to do. Unless I haven't the same beliefs, they can put restrictions on how much you can carry on, apply your own beliefs, how things should be done (Ben 4).

Accordingly, they mentioned that they would wait until they have full control over their own classrooms. Several teachers indicated that when they have full control over his or her own classroom they want to implement what they learned in the M. Ed. program. They also indicated that implementing what they learned in the methods courses would be extremely hard in the beginning of their career, not to mention in the field experiences and in others classrooms. As they put it:

My field experience is just ultra-practical, and those methods classes are ultra-not [laughter]. I think the methods courses were fantastic for me just to keep in mind, and to kind of, say [there is a different way and there could be a better way to teach], but in the end, at least in my field experience, I couldn't make a 180 degree turn and try taking some complete constructivist view, so perhaps when I have my own classroom, methods classes might be more useful. (Lynda 3)

I think that implementing constructivism in my classroom is difficult. I think, I as someone as starting now for the first time, and I have not yet had a lot of classroom experiences that I can use some other things. But I think if you really work hard, you can get there. (Ginny 3)

If I was going to do that [social constructivist kind of teaching styles] again, it would be better to have students for the whole year and be able to take them from the beginning, knowing where their process and science skills are, whereas as a student teacher you don't really know that. You are just put in there; it was just very frustrating. (Young 4)

This quote indicates that academic goals for this science teacher preparation program could have an impact on these teachers but with a possible lag time (Richardson, 1996).

The second question of this study addressed what experiences within the program influenced the participants to develop understanding of constructivist ideas. The benefits and influences of the M.Ed. program's

theoretical coursework and the field experiences on these teachers' learning-to-teach experiences are examined.

Influences of the M.Ed. Coursework

Of the selected factors related to the MSAT M. Ed. program--such as, coursework, field experiences, group discussions with peers, interactions with families, their student-teaching supervisors, and a teacher educator--that helped them to form their beliefs about teaching and learning, the teachers put a great emphasis on the M.Ed. theoretical coursework in that (1) they were unsure of whether they would have come up with some of those ideas on their own if they had gone out into the field experience first, (2) in the field experience there is a chance that they could not have been placed with teachers that had the same beliefs with this program and thus they might have just kept teaching like they were taught in college. As they put it:

Had it not been for the M.Ed. program, I would have been more of a lecturer, and telling students what it is and having them process that information, and now I think I see that it's very important that they need to understand that concept in their own way, and categorize that information so that it makes sense to them (Len 2).

The M.Ed. theoretical coursework was the most influential because the ideas and theories that were presented to me totally changed the way I thought I would teach and if I had not gone into this program. I probably would teach like the way I had been taught in college (Young 4).

The M.Ed. theoretical coursework showed me lots of articles and theories on different educational theories, and this is important because some of them I have never heard before (Lynda 4).

What I have learned most throughout the M.Ed. coursework is that there are many different ways of learning and therefore there should be many different ways of teaching, which is quite different from the type of teaching I have been exposed to,

that is, rote memorization (Rob 4).

The structured coursework of the MSAT M.Ed. program was the most influential factor that helped me to see what the alternatives were in terms of different learning theories. From the beginning of the program, I could teach right now in a lecture format that people are used to. You can always get in front and you can lecture. That's not the problem. The problem is trying to make it engaging so that kids will actually learn something. What I needed is to know and understand how we might be able to implement something else and the program provided me with alternative points of view, *particularly in terms of this program talking about integration and constructivism and active hands-on learning* (Ellen 4).

The coursework started me out by giving me basis such as the conceptual change model whereas the field experience was where she really came to understand about things that she can and can't do in a classroom. Had it not been for the M.Ed. program, I would not have done that before (Ginny 2).

With respect to the M.Ed. coursework they summarized what they have learned most as: (1) definitely constructivism, constructivist theory, where I learned a lot about how students actually think and how knowledge is gained, (2) a lot of learning theories such as the Conceptual Change Model, (3) how to make teaching more student-centered where students are more interactive in their own learning, instead of more teacher-centered with the teacher presenting knowledge, and (4) how to incorporate more group work, although she did not experience it very much as a student.

In addition, these teachers believed, the most significant change they made as teacher is, "I have gone from focusing on myself to trying to focus on the students more, or trying to shift some of the responsibility from me to my students." In particular, they were not predisposed toward lecturing anymore. As Young put it:

Even if you tell them, students still get all kinds of misconceptions that I think need to be addressed unless they walk out of the classroom with all sorts of crazy ideas about science. I felt almost guilty about doing lectures after this program because they [the faculty] de-emphasized it so much. But I don't think this program has helped me to figure out how not to do lecture. I still think we need some lecture but to become more interactive and to be rooted in some knowledge (Young 4).

In the meantime, Ginny, Lynda and Young acknowledged one M.Ed. program professor who "taught preservice teachers as they want us to teach" as one of the most influential factors that helped them to form beliefs about teaching and learning (Lynda 2). In Lynda's own words:

He has really challenged me in this area, maybe teaching and learning is not at all what I came in thinking it was. He put some of his theories and ideas into practice and it works in the classroom. He used all sorts of different ways of teaching and he actually incorporated those ways of teaching into his classroom. He has provided so many different methods and ideas and just general classroom management, and small, little things that he has used and he will use it with us. He will be an example of what he is teaching. And so far, he has been the main one who was an example when he starts teaching. So I think that's what's speaking the loudest (Lynda 4).

Influences of Field Experiences

Some of the teachers particularly valued field experiences, arguing learning to teach can only be accomplished through experience (Richardson, 1996). They valued the field experiences over the M.Ed. methods courses in that (1) the field experiences provided groundwork for translating theory into practice, where they could actually try things out and do their experimenting with ideas presented in the coursework and then make a link between practice

and theory such as constructivism and conceptual change theory, and (2) some were able to watch positive role models. That some of the preservice teachers had mentor teachers who have taken the conceptual change theory and implemented it in their own classrooms in practical ways and showed the feasibility of conceptual change model or other theories and constructivist ideas in real classrooms. These preservice teachers summarized the values of field experiences as follows:

Field experiences are more beneficial than M.Ed. methods courses because teaching is a practice type of profession, just like being a doctor. There is nothing like being out there and practicing teaching in a true life setting because it exposes you to the actual processes of teaching and learning (Ben 4).

In the field experience, I could not only observe my mentor teachers teaching style, but also do my experimenting and my testing based on some of the coursework. When combined with the coursework, the field experiences provide the groundwork for translating theory into practice (Lynda 4).

I valued more the field experience over the M.Ed. methods courses because ultimately the students define how you are going to be a teacher in that they give you clues on how they learn, and what's the best. Being in the classroom, interacting with other teachers, watching other teachers, and interacting with the students has really kind of laid down where I am and where I think I am going (Ginny 4).

If I didn't have this field experience, I wouldn't have had a big disequilibrium, between my original idea of what I thought a teacher should be and what was effective in the field. Without the field experience I would have never really have understood what it was, what a science teacher is, so I think the biggest thing is the experiences (Young 4).

On the one hand, asked to provide the most influential factors in helping him to form beliefs

about science teaching and learning, Len contended his supervisor that he had during the field experiences was the most influential in helping him learn to teach (Len 4). He provided the reason as follows:

Although cooperating teachers can be models, they may be good models or they may be bad models. They may want you to become more like them so anything different than that they would tell you as bad or not good. Some of them are not open to new ways of teaching. I would say that I got less from my mentor teachers or cooperating teachers than I did from my supervisor. Supervisors provide experiences from the teaching classroom but also have a broad base in knowledge of research and instruction (Len 4).

On the other hand, although new theories and methods that differ from existing teachers' classrooms appear to be washed out in the real world of the classroom *during the practicum*, preservice teachers can learn those alternatives when they are coached by informed supervisors (Hollingsworth, 1989). In other words, for preservice teachers to translate constructivist philosophies of learning that could supplant traditional ideas through pedagogical practices, directed supervision or coaching with preservice teachers and communicating program expectations to cooperating teachers appeared to be necessary. Hollingsworth (1989) contended that cooperating teachers' encouragement to experiment with important ideas presented in method courses helped changes in preservice teachers' knowledge and beliefs about teaching and learning.

Along this line, considering that student teaching is a critical (or even the most valuable) component of teacher education programs and that cooperating teachers have great influence on student teachers' professional development (Hollingsworth, 1988; Guyton, 1989; Sudzina *et al.*, 1997; Borko and Mayfield, 1995), cooperating teachers are expected to become directly involved in teaching student teachers by providing positive support of experimental behavior

(Grimmett & Ratzlaff, 1986). To help classroom teachers make the transition to teacher educators, teacher education institutions provide preparation and support for their new roles through ongoing training programs (Hollingsworth, 1989; Borko and Mayfield, 1995).

To prepare experienced classroom teachers participating in teacher education programs for the cooperating role, a substantial inservice component needs to be implemented so that the classroom teachers can be informed about the content and philosophy of teacher education programs as well as about university sponsored practices (Hollingsworth, 1988; Guyton, 1989; Borko and Mayfield, 1995). Based on this information, cooperating teachers could give substantive feedback to their student teachers by integrating theoretical and research-based ideas from their university courses into their teaching practices followed in the classroom. In her experimental program, Hollingsworth (1988) conducted inservice seminars around classroom teacher needs within the preservice program in an attempt to connect schools and universities. By incorporating inservice work within the preservice teacher education program, teacher educators in her program could improve the quality of supervision as they increased cooperating teacher knowledge of the teacher education program and new instructional strategies (approaches) through inservice seminars. It further contributed to bridging the gap between the university-sponsored theoretical pedagogy and the real world of the classroom. This is accomplished through the inservice training program that nurtured the theories and practices introduced in preservice education and promoted the transfer of research findings to classroom settings (Hollingsworth, 1988).

In sum, cooperating teachers need to be prepared to mentor student teachers through inservice training provided by the university teacher education programs. This inservice seminar should provide training in both the principles of practice and the principles of effective supervision and mentoring practices (Sudzina *et al.*, 1997; Wolfe, 1992; Bey, 1992). Based on

this, cooperating teachers are expected to help preservice teachers in making the transition between theory and practice by not only being a role model, but also promoting an atmosphere in which risk taking is regarded as safe. Moreover, several studies suggest that this preparation through inservice training also results in various positive effects on cooperating teachers' side, including enhancement of the cooperating teachers' active listening, use of different teaching models in their own teaching, autonomy and self-direction, improved communication between cooperating teachers and student teachers, and more specific feedback to student teachers (Borko and Mayfield, 1995; Guyton, 1989). Several research corroborates that by providing adequate preparation and support for cooperating teachers' roles, teacher education programs can maximize the likelihood that student teaching will be teacher education by enabling student teachers to move beyond the status quo and explore new ways of teaching (Borko and Mayfield, 1995).

Regarding the most practical way to learn as a teacher, some of the participants recommended the combination of coursework with teaching or observing experiences where they could not only apply theory to practice, but also understand why they needed to know a specific learning theory (Ellen, Ginny, and Young). This theme corroborated one of Kagan's (1992) evaluations drawn from her review of learning-to-teach studies: the separation of theory (i.e., university coursework) and practice was unproductive. As these preservice teachers put it:

It could have been better if the M.Ed. program had a little more practicality which could have helped me to understand why she needed to know a specific theory (Ginny 3).

And I don't think field experience without methods courses isn't helpful. I think what's been most beneficial for me is seeing so many different teachers. After observing teachers' practices, we should also relate back to what we have learned in methods courses. So I think that will be important

too, to make a link between practice and theory such as constructivism and conceptual change theory (Lynda 3).

Overall, these preservice teachers contended that it's really a combination of both (the field experience and the coursework) that helped them to become teachers.

CONCLUSIONS

The MSAT M.Ed. program provided a personal experience with constructivist views of learning and teaching. The participants who evidenced significant changes in their views of teaching and learning attributed their perspective changes to those who taught the MSAT preservice program by putting some of their theories and ideas into practice and by incorporating those ideas into the M.Ed. methods classes (Lynda 4). This finding corroborated one of the implications recommended by Gunstone *et al.* (1993): those teaching the preservice program should behave pedagogically in concert with their principles.

Implications for Science Teacher Education

The implications for preservice science teacher educators as well as for the instructional practices of preservice teacher education programs can be summarized in three points. First, instructors of preservice methods courses should model constructivist teaching and learning approaches advocated in their programs rather than presenting constructivist principles and ideas as propositional statements. The importance of this was indicated by the participants in this study through positive evaluations of their program and instructors. These preservice teachers identified both as contributing to their pedagogical beliefs. These participants clearly indicated that consistency between the teacher education programs espoused constructivist principles and teacher educators actual practices not only challenged their views, but also provided exemplary role models for learning to

teach in a constructivist manner.

Another implication of this research is that preservice teacher education programs should purposefully place preservice teachers in classrooms with experienced teachers who not only understand but also use new ways of teaching, such as conceptual change learning or cooperative learning approaches, and be prepared to discuss opposing beliefs rather than demand blind conformity. The participants were frustrated upon meeting the inconsistency between what was advocated in the university methods courses and what was practiced in their field experiences by their mentor (or cooperating) teachers who favored traditional teaching and wanted the preservice teachers to become more like them. Faced with this inconsistency and pressure from their mentor teachers, the participants reverted back to their default approaches (i.e., traditional pedagogical beliefs about teaching and learning). It is interesting to note that one participant identified his supervisor as the most influential person who helped him to form his beliefs about teaching and learning in that this supervisor not only provided experiences from teaching but also was open to new ways of teaching with a broad knowledge base in research and instruction.

It is also important at this point to recall Lynda's high inspiration upon meeting her constructivist-oriented cooperating teachers who had taken the conceptual change theory and implemented it in their classrooms in practical ways. These mentors demonstrated the feasibility of the conceptual change model in their classrooms. To reduce the discrepancy between university methods courses and field experiences, a possible approach would be to reeducate in-service teachers through staff development programs that approach learning-to-teach in a constructivist manner (Hollingsworth, 1988; Guyton, 1989; Borko and Mayfield, 1995). Through staff development that is designed to inform experienced teachers about what student teachers learn on campus (i.e., the content and philosophy of university teacher education program)

and effective mentoring practices, cooperating teachers could be expected to provide both an opportunity and an expectation to apply important ideas presented in methods courses (Hollingsworth, 1989). With the support and encouragement of cooperating teachers, preservice teachers could make the transition between theory learned in the university program and classroom practice by taking risks and experimenting with new forms of pedagogy (i.e., university-sponsored practices) (Hollingsworth, 1989; Bey, 1992; Sudzina, *et al.*, 1997). In trying to teach in different ways than how they were taught throughout their own schooling, preservice teachers could apply new theories and methods (e.g., the constructivist concept of learning) that supplant traditional curriculum (Hollingsworth, 1989; Borko and Mayfield, 1995).

Recommendations for Further Research

The features of this constructivist teacher education program were that it was firmly grounded in constructivist epistemology and had exemplary methods courses instructors who behaved pedagogically in concert with constructivist epistemology or constructivist theories of learning. Continued examination of changes in preservice teachers' beliefs towards constructivist ideas (epistemology) will provide important implications for understanding the extent to which future teachers can internalize contemporary constructivist epistemology, which in turn lead them at least to try to implement constructivist theories of learning and teaching in their science classrooms. Therefore, further research is needed to inquire more into characteristics of constructivist teacher education programs, including the settings and the dynamic interactions that occur between teacher education faculty and preservice teachers, curriculum, and instructional activities (e.g., topics of discussion, logistics and patterns of discussion, group activities, group evaluation, etc.) throughout the programs that approach learning to teach in a constructivist manner.

Moreover, as noted earlier in the conclusion section, the participants involved in this study attributed the most influential factor in developing a

constructivist perspective on teaching and learning to one or two faculty members of the MSAT program. In other words, above anything else, these exemplary teacher educators left a deep impact on preservice teachers' formation of their beliefs towards a constructivist learning and teaching framework. Accordingly, further research is needed to find out characteristics of exemplary teacher educators or what factors are associated with exemplary teacher educators in terms of their beliefs about teaching and learning, dispositions and practices.

REFERENCES

- Anderson, R.D., and Mitchener, C.P., 1994, Research on science teacher education. In D. L. Gabel(Ed.), *Handbook of research on science teaching and learning*. New York: Macmillan. p. 598.
- Bey, T.M., 1992, Mentoring in teacher education: Diversifying support for teachers. In Bey, T. and Holmes, C.T. (Eds.), *Mentoring: Contemporary principles and issues*. Reston, VA: Association for Teacher Educators. p. 122.
- Borko, H., and Mayfield, V., 1995, The roles of the cooperating teacher and university supervisor in learning to teach. *Teaching & Teaching Education*, 11(5), 501–518.
- Grimmett, P.P., and Ratzlaff, H.C., 1986, Expectations for the cooperating teacher role. *Journal of Teacher Education*, 37, 41–50.
- Gunstone, R.F., Slattery, M., Baird, J.R., and Northfield, J.R., 1993, A case study of development in preservice science teachers. *Science Education*, 77(1), 47–73.
- Guyton, E., 1989, Guidelines for developing educational programs for cooperating teachers. *Action in Teacher Education*, 11(3), 54–57.
- Hewson, P.W., and Kerby, H.W., 1993, Conceptions of teaching science held by experienced high school science teachers. Paper presented at the Annual Meeting of the National Association for Research in Science Teaching. Atlanta, GA. (ERIC Document Reproduction Service No. ED 364 426).
- Hollingsworth, S., 1988, Making field-based programs work: A three-level approach to reading education. *Journal of Teacher Education*, 39 (4), 28–36.
- Hollingsworth, S., 1989, Prior beliefs and cognitive change in learning to teach. *American Educational Research Journal*, 26(2), 160–189.
- Mayer-Smith, J., Moon, B., and Wideen, M., 1994, Learning to teach: The journeys and entering beliefs of four beginning teachers. *Journal of Professional Studies*, 1(2), 11–25.

- Kagan, D.M., 1992, Professional growth among preservice and beginning teachers'. *Review of Educational Research*, 62(2), 129–169.
- Kwak, Y., 2001, Profile change in preservice science teachers' epistemological and ontological beliefs about constructivist learning: Implications for science teaching and learning. Unpublished doctoral thesis, The Ohio State University, 342 p.
- Pajares, M.F., 1992, Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research*, 62(3), 307–332.
- Richardson, V., 1996, The role of attitude and beliefs in learning to teach. In J. Sikula, T. Buttery, & E. Guyton (Eds.), *Handbook of research on teacher education* (2nd ed.). New York: Macmillan. p. 1190.
- Richardson, V., 1997, *Constructivist teacher education: Building a world of understanding*. London: Falmer Press. p. 191
- Scheurman, G., 1995, *Constructivism, Personal Epistemology, and Teacher Education: Toward a Social-Developmental Model of Adult Reasoning*. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.
- Scheurman, G., 1996, *Constructivist Strategies for Teaching Educational Psychology*. Paper presented at the Annual Meeting of the American Educational Research Association, New York, NY.
- Shulman, L.S., 1986, Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4–14.
- Stofflett, R.T., 1991, Conceptual change in elementary teacher candidates content and pedagogical knowledge of science. Unpublished doctoral dissertation, University of Utah, Salt Lake City, UT.
- Sudzina, M., Giebelhaus, C., and Coolican, M., 1997, Mentor or Tormentor: The role of the cooperating teacher in student teacher success of failure. *Action in Teacher Education*, 18(4), 23–35.
- Wideen, M., Mayer-Smith, J., and Moon, B., 1998, A critical analysis of the research on learning to teach: Making the case for an ecological perspective on inquiry. *Review of Educational Research*, 68(2), 130–178.
- Wolfe, D.M., 1992, Designing training and selecting incentives for mentor programs. In T. Bey & C.T. Holmes (Eds.), *Mentoring: Contemporary principles and issue*. Reston, VA: Association for Teacher Educators. p. 122.

Manuscript received October 31, 2001

Revised manuscript received January 15, 2002

Manuscript accepted January 15, 2002