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Full Length Research Paper

"Me? Teach science?" Exploring EC-4 pre-service teachers' self efficacy in an inquiry-based constructivist physics classroom

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In this qualitative and interpretive study, we investigated factors that influenced elementary preservice teachers' self-efficacy in a constructivist, inquiry-based physics class. Bandura's (1977) theory of social learning was used as a basis to examine preservice teacher's self-efficacy. Participants included 70 female EC-4 preservice teachers enrolled in two sections of PHYS 3400. Data collected included individual and focus group interviews, pre and post-concept tests, and participant lesson plans. We present a model showing the impact various factors have on increasing preservice elementary teachers' self efficacy. Results show modeling of (1) grade appropriate science teaching activities, and (2) strategies and participatory experiences in inquiry-based activities were major factors influencing elementary preservice teachers' self-efficacy and outcome expectancy expectations.

Key words: Elementary preservice teachers, elementary science methods course, self efficacy, Bandura.

INTRODUCTION

"Me? Teach Science? No way! I probably will have to, I know. Is that not what textbooks are for? I hope so 'because I have no clue whatsoever how to teach it'" (Keira, interview 1, January 17 2007). It is not uncommon to hear statements like this voiced by preservice elementary teachers. It is well documented that many pre-service and in-service elementary teachers avoid teaching science in their classrooms (Caton, 1997; Ramey-Gassert, 1996). Researchers have attributed several reasons for this such as having naive views about science (Abd-El-Khalick and BouJaoude, 1997), or a superficial understanding of concepts and processes (Ginns and Watters, 1999), a lack of formal reasoning ability (Anderson and Mitchener, 1994), scientific misunderstandings and inadequate science knowledge that leads to negative attitudes toward science and the teaching of it (Butts, 1997). In this qualitative, interpretive study we explore the factors that influence elementary preservice teachers' self-efficacy in a constructivist, inquiry-based physics class.

Review of related literature

We used Bandura's (1977) theory of social learning as a basis to examine pre-service teachers' self-efficacy. According to Bandura, 'perceived self-efficacy is defined as peoples' beliefs about their capabilities to produce designated levels of performance exercising influence over events that affect their lives. Self-efficacy beliefs determine how people feel, think, motivate themselves and behave (Bandura, 1994). Bandura believes that the concept of self-efficacy is made up of two constructs, outcome expectation and self-efficacy expectation. People are motivated to perform an action if they believe the action will have a favorable result (outcome

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expectation) and they are confident that they can perform that action successfully (self-efficacy expectation).

Bandura (1977, 1986) delineated four sources of efficacy information that interact with human nature: (1) enactive mastery, (2) vicarious experience, (3) persuasory information, and (4) physiological state. Enactive mastery experience is most effective in creating a strong sense of efficacy. The perception that one's teaching has been successful (mastery) raises expectations that teaching will be proficient in the future. Conversely, the perception that one's teaching has been a failure lowers efficacy beliefs, contributing to the expectation that future performances will also be inept (Lent and Hackett, 1987). Vicarious experiences are those in which someone else models a skill. Seeing people similar to oneself succeed by sustained effort, raises observers' beliefs that they too possess the capabilities to master comparably successful activities. People who are verbally persuaded that they possess the capabilities to master given activities are likely to mobilize greater effort and sustain it, though the potency of persuasion depends on the credibility, trustworthiness, and expertise of the persuader (Bandura, 1986). Interpretations of emotions and physiological arousal can add to the feeling of mastery or incompetence.

In a more recent study, Palmer (2006) identified three other sources of self-efficacy beyond those originally proposed by Bandura. The first factor, 'content cognitive mastery', is differentiated from enactive mastery in that the focus is on content understanding. "It involves success in understanding something rather than doing something" (Palmer, 2006). The second experience, referred to as 'cognitive pedagogical mastery' for science teaching, corresponds to success in mastering and understanding effective techniques for teaching science. The third source involves a type of vicarious experience called 'simulated modeling' where the professor and students simulate conditions in a primary classroom by role playing.

Teacher efficacy can be defined as teachers' beliefs in their abilities to organize and execute courses of action necessary to bring about desired results (Tschannen-Moran, 1998). Teachers' self-efficacy beliefs have been repeatedly associated with positive teaching behaviors and student outcomes. A significant indicator of an effective teacher is the extent of the teachers' belief that his/her efforts affect student learning. Ross (1994) reviewed 88 teacher efficacy studies in pre-college settings and identified links between the teachers' behaviors and their self-efficacy. According to Ross, teachers with higher levels of self-efficacy are more likely to (1) learn and use new approaches and strategies for teaching, (2) use management techniques that enhance student autonomy, (3) provide special assistance to low achieving students, (4) build students' self-perceptions of their academic skills, (5) set attainable goals, and (6) persist in the face of student failure. Riggs and Enochs (1990) distinguished chemistry teaching efficacy from science teaching efficacy. They found that among middle-school science teachers, personal science teaching efficacy (PTE for teaching science) was correlated with preference to teach science, and that chemistry teaching self-efficacy (PTE for teaching chemistry) was related to preference to teach chemistry.

Researchers have examined the self-efficacy of preservice elementary science teachers using different foci; hence related literature covers a wide range of topics. Schoon and Boone (1998) reported there was no relationship between the number of alternative conceptions participants held and their science teaching efficacy. Enochs (1995) determined that while pupil control ideology significantly correlated with personal science teaching self-efficacy, no correlation was found with outcome expectancy. Settlage (2000) showed that an understanding of the learning cycle was predictable by science teaching outcome expectancy but not by personal science teaching efficacy or attitudes toward science; Appleton and Kindt (2002) revealed that beginning teachers with low confidence preferred to use reading and writing based strategies to teach science rather than use hands-on activities. Bleicher and Lindgren (2005) determined that increasing the number of science courses a preservice elementary teacher completed would have no effect if some of the science learning did not occur in a constructivist environment; Palmer, (2006) believed that the main source of self-efficacy amongst these preservice teachers in a science methods course corresponds to success in mastering and understanding effective techniques for teaching science.

Several researchers have employed the STEBI-B to explore issues of self-efficacy in preservice elementary teachers. Bleicher (2001, 2002) and Bleicher and Lindgren (2005) used the STEBI-B to help examine the relationship between success in learning science and development of self-efficacy showing that students were able to understand science concepts and construct connections between those concepts as they progressed in the methods course. Earlier applications of the STEBI-B to our sample population had shown an increase in teacher confidence. However with this study, we endeavored to identify and describe individual factors that impacted the elementary preservice teachers' self efficacy.

Over the past several decades, the quality and amount of instruction in science education in elementary schools has been of concern (Tilgner, 1990; Gee, 1996). Stefanich and Kelsey (1989) found that, in elementary schools less time is allocated for science instruction than for any other subject. Researchers attribute several reasons for this such as, elementary teachers often have negative attitudes towards science (Shrigley, 1974), and do not have confidence in their ability to teach science (DeTure, 1990). These factors coupled with low science interest (Tilgner, 1990) and science anxieties (Czerniak and Chiarelott, 1990) often contribute to elementary teachers' avoidance of teaching science (Westerback, 1982). Generally, elementary teachers have been found to possess low level conceptual and factual knowledge as well as inadequate skills in the content area of science (Victor, 1962; Bloser and Howe, 1969; Wenner, 1993) and a low level of knowledge regarding the concepts, facts, and skills concerning science (Stevens and Wenner, 1996; Wenner, 1993). Hence a lack of science content knowledge and a lack of confidence in teaching science are key factors that cause elementary teachers to shy away from teaching science.

The research question investigated in this interpretive study was the following: What factors influence the EC-4 preservice teachers' self-efficacy during participation in PHYS 3400, a constructivist, inquiry-based physics class?

Context of the study

This research study was conducted at a large university in Southwestern United States. Pre-service early childhood teachers were enrolled in the EC-4 program at the College of Human Development and Family Studies. The early childhood specialization offers students the foundation for certification as teachers of young children from 3 years of age through the 4th grade. As part of their program, students enroll in PHYS 3400, Fundamentals of Physics, a four-credit course designed to prepare future educators in the basics of science, using inquiry methods of teaching to demystify science. The class met twice a week, three hours per class. An additional field experience component involved placement in an EC-4 classroom, for three hours, twice a week for a six week period. The field experience served dual purposes: a) observation of science as it is taught by experienced primary teachers, and b) opportunities for preservice teachers to plan and teach a physics concept.

PHYS 3400 was specifically chosen as a required course, because this is a science content class where the students would explore basic concepts in physics via well-planned inquiry-based activities, grade appropriate for the EC-4 classroom. The physics instructor emphasized the "how to" of activities to enable preservice teachers to present a similar lesson to their own students without difficulty. Basic concepts of physics such as balance and motion, sink and float, color, sound, and electricity and magnetism defined the course topics. Before each topic was introduced, students completed a pre-test composed of a few open ended questions related to the topic. Relevant science content was then emphasized via a series of hands-on, inquiry-based activities that preservice teachers participated in both individually and group wise. All the activities presented were age appropriate for the EC-4 level and incorporated varying degrees of inquiry using raw data and primary sources along with manipulative, interactive, and physical materials. Each work table was provided with a small whiteboard and pens with which preservice teachers could share their data and answers with their classmates.

A post test was administered at the end of the topic and the answers were discussed with students in a subsequent class. At the end of each class, preservice teachers were required to submit an original lesson plan based on one of the activities emphasized in the course. In the lesson plan students specified the objectives of the lesson, the grade level, the applicable Texas Essential Knowledge and Skills (TEKS) objective(s), new vocabulary, and the procedure for conducting the activity. Students were also required to write about (1) the science content they learned during the activity, and (2) how they would modify the activity for use in teaching a different grade. Throughout the course, students were encouraged to engage in dialogue with the professor and one another, and to ask open ended, meaningful questions. To some extent, the professor allowed student responses to drive lessons, shift instructional strategies, and alter content.

Phys 3400 has been taught by the same professor since 1999. Currently, 3 or 4 sections are offered each semester. The professor, who conceptualized this course and has taught every section, provided his rationale for the design and conduct of the course as follows:

> I got away from the text because the students were afraid of it. Physics is almost universally taught as a math course and with lots of formalism. This is counterproductive, particularly at the primary level. They (the preservice teachers) wanted to learn things they could use in their classrooms. I gave them lesson plans AND taught them how it worked. I used the lesson plans to lead them into caring about the material. I kept developing additional hands-on activities that were better and better suited to the capabilities of the pre-service teachers and their students (Dr X, Interview 23 April, 2007).

Participants

Participants included seventy female students enrolled in two sections of PHYS 3400 offered during the 2007 spring semester. From this participant pool, six Caucasian and one Hispanic female volunteered to be interviewed and videotaped throughout the semester during class time. These participants were sophomores or juniors enrolled in the Bachelor of Science: Early Childhood Teacher Certification EC-4. None of the participating students had any formal experience in teaching science at any level. For the purpose of this study, the participants who volunteered to be audio and video taped were asked to work together at one table.

Data collected

Data was collected and analyzed using a constructivist framework. All participants were interviewed three times using a semi-structured interview guide and open ended questions (Merriam, 1998). Each interview lasted 45 minutes and was audio taped. Each participant was referred to using a pseudonym of her choice. The first interview was at the beginning of the semester, the second at the midterm and the final interview was after the final exams. The first interview focused on the participants and their experiences with the teaching and learning science. The second interview focused on their experiences with inquiry-based activities during the course and their understanding of the physics content taught. The prompt for the third interview was "What experiences in this course stand out as giving you the most confidence to teach science?"

Others from the participant pool volunteered to participate in two focus group interviews during the semester. These interviews were conducted in order to "obtain information of a qualitative nature from a predetermined and limited number of people" (Kreuger, 1988: 26). The authors functioned as the moderators, asking unstructured open-ended questions, encouraging all participants to voice their opinions. Field notes were taken to facilitate data analysis. The participants wrote a science self-story where they described their previous experiences with science teaching and learning and also generated a metaphor that communicated how they viewed themselves as science teachers. The midterm and final exams as well as participants' lesson plans were also collected as data. The pre- and post-tests as well as the midterm and final exams tested the participants understanding of the physics content taught. Questions were two-tiered with participants having to choose the correct answer from the options given, then justifying the choice made with reasons.

Data analysis

Analysis of the data commenced with a review of students' science self-stories, which helped to customize interview questions with each participant. All interviews were transcribed to a word document, with each line numbered sequentially. The interview transcripts were coded line by line and initial codes, both *in vivo* as well as researcher generated, and was used as a means of labeling units of data and assigning meaning. Each code, with its definition was recorded in the code book. Codes were scrutinized carefully and those that fell into a particular pattern were grouped together. Patterns emerging as themes were clarified by further interviews with the participants. Themes that developed were then pieced together to form a comprehensive picture of the participants' experiences. Themes that arose from participants' preliminary interviews centered on their perceptions about teaching and learning of science based on their past experiences with science. Themes relevant to data collected in subsequent interviews were related to factors that influenced the participant's self-efficacy as an elementary science teacher.

Audio tapes of the class sections were transcribed and inaccuracies, if any, were rectified while watching the video tapes. Memo writing was an important activity during data analysis. Memos served to record the codes, categories, themes and the emerging relationship between them as well as other relevant comments regarding the data analysis process (Charmaz, 1995; Lofland and Lofland, 1995). They were a means of integrating the findings into a cohesive whole. The responses for each item in the pre- and post-tests were analyzed. Students' lesson plans were evaluated and suggestions for improvement were noted as needed.

RESULTS AND DISCUSSION

Preliminary interview data revealed that self-efficacy expectations of these preservice elementary teachers arose from their perceptions of science and science teaching. These perceptions emanated primarily from their experiences in high school and college science courses and their instructors as exemplified by the following statements. "Science was my worst subject especially in high school, with all those equations and formulas. It was all so hard and boring and you keep thinking 'when am I going to use all this in real life?'" (Betty, interview 1, January 17, 2007). The following assertion by Jill also was representative:

> "I took a science class in my first semester here (at the university). It was a big lecture class and the professor just kept going on and on, slide after slide, and even in school that's how it has been. I think that is why I don't like science because it was always so dry and difficult; I had trouble with it in school and it scares me that I have to teach it this semester (during the field experiences). I have no clue as to how I am going to do that. (Jill, Interview 1, January 16, 2007).

Several participants expressed similar thoughts about not being able to relate to the science content didactically in

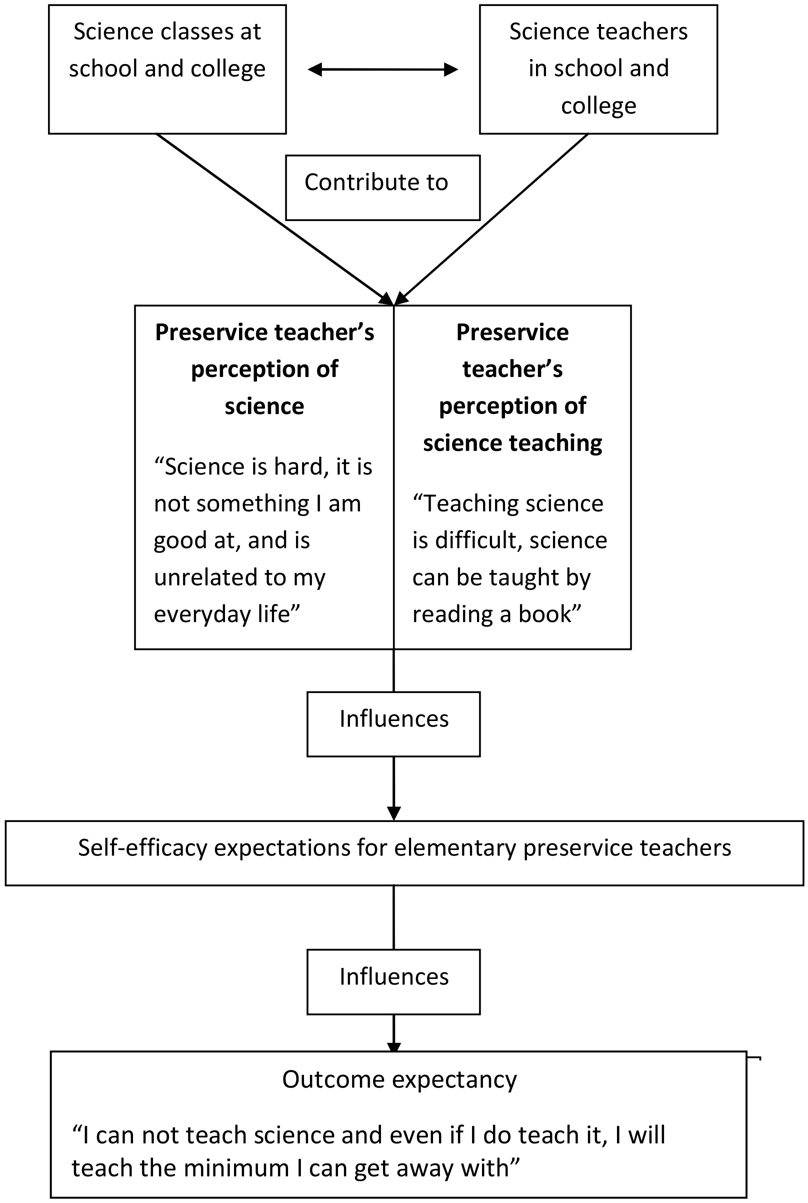

Figure 1. Factors influencing self-efficacy and outcome expectancy beliefs of elementary pre-service teachers.

science classes they had previously experienced.

> "I hate science! I am the kind of person who likes absolutely everything laid out in front of me, and everything is very clear. Science does not work out that way for me and if I do not understand everything about the entire concept, then it is really frustrating for me. I like to know why everything does exactly what it does, every particular time and I do not really get those answers from science. It is like 'well you plug this in'… well I do not like to plug this in. I do not like science. I do not like to teach science. So! I want to encourage it for my students, but I have always had really negative feelings, connotations about science, I never really felt I was doing good and therefore I did not want to do it." (Alex, Interview 1, January 20, 2007).

In Figure 1, we describe a model constructed from preliminary interview data with our participants that describes how interrelated factors influence their self-efficacy and outcome expectancy expectation. Negative experiences with science as a content area and science teachers teaching didactically in schools and university contribute to negative beliefs and attitudes regarding the teaching and learning of science. These beliefs lead to a lack of confidence in the elementary preservice teachers that they can teach science which further erodes their outcome expectancy of teaching a science lesson successfully. Further, with the emphasis placed on math and reading, science is often taught for very limited periods at the elementary level during the school week or sometimes not at all.

Factors influencing the self-efficacy of elementary preservice teachers

In Figure 2, we present a diagrammatic representation of factors that influenced the self-efficacy expectation and outcome expectancy of our elementary pre-service teachers. We believe that the participatory nature of the inquiry-based activities as well as mentor modeling of practice plays a key role in influencing the self-efficacy of our elementary pre-service teachers.

Participatory nature of the inquiry-based activities

"The class was very different from a traditional science class. There were many activities for us to do each class and they were simple and interesting. I liked the mobiles and rollercoaster and the bagel pendulum ones the best" (Sera, interview 3, 23rd April 2007). PHYS 3400, being more activity based, was very unlike a traditional science content course. Students learned science content by doing several relevant, grade appropriate activities that they either worked on individually or group wise.

For instance, the topic "Balance and Motion" was covered in a three week period during which participants explored balancing with scales (and arbitrary units often represented by plastic animals), and building mobiles. They studied Newton's laws using a bowling ball and a broom, and the conservation of energy and period of a pendulum using bagel pendulums. They constructed roller coasters with loops out of tire lengths to study about potential and kinetic energy. The Galileo-on-an-incline activity allowed discussion about measurement and acceleration. Students learned about the center of gravity and conservation of mass from the balancing bird activity.

Modeling

Berliner (1986) described a mentor as an expert who modeled practice. According to Barab and Hay (2001), a "mentor models, then coaches, then scaffolds, and then gradually fades scaffolding." We also know that modeling of practices can aid preservice teachers towards understanding their own practices (Moran, 1990) and that self-efficacy for teaching can be enhanced through modeling (Bandura, 1981). Palmer (2006) described "simulated modeling" as "when the tutor and students simulate the conditions of the primary classroom by a type of role playing."

Participant interviews indicated that their high school and college science instructors tend to lecture and use didactic approaches that lessened their interest in science. It appears evident, that they did not view their previous instructors as ideal models. However, if the common belief that teachers tend to teach in the manner they were taught, these previous experiences had much potential to shape how they would teach science.

In the PHYS 3400 classroom, the professor was a mentor and frequently used simulated modeling as he involved the students as if they were preservice elementary science teachers and at other times in the role of EC-4 students learning science. Thus, as he used well-designed science lessons he also expected the students to participate in the activities from the perspective of both EC-4 student and teacher. As he modeled effective science teaching, the preservice teachers had an extended opportunity to learn science in an environment that was different than previously experienced as exemplified in the following statement:

> "It was not like one of those boring science classes. He (the professor) did not just tell us what to do. He went around and showed us and then let us take it from there" (Krista, Interview 2, February 14, 2007).

During the lesson, he engaged the preservice students with the language of science enhancing their understanding of science learning and teaching. The professor also provided information with regard to the grade level the activity was directed at, the materials required where to procure the materials (or alternate ones if required) and children's literature related to the science topic taught. For each activity the professor also discussed the safety aspects involved and pointers on what to expect from an elementary child while conducting the activity. His focus on logistics of teaching a particular topic was seen as very useful by students as reflected in the following statement:

> "What I really liked was all these little tips he gave us as to what to expect from little kids, things that I would not even think about you know, and how to do the activities and where to get the stuff to do them from." (Jill, Interview 3, April 24, 2007).

Mastery experiences

While Bandura's conceptualization of the term "mastery

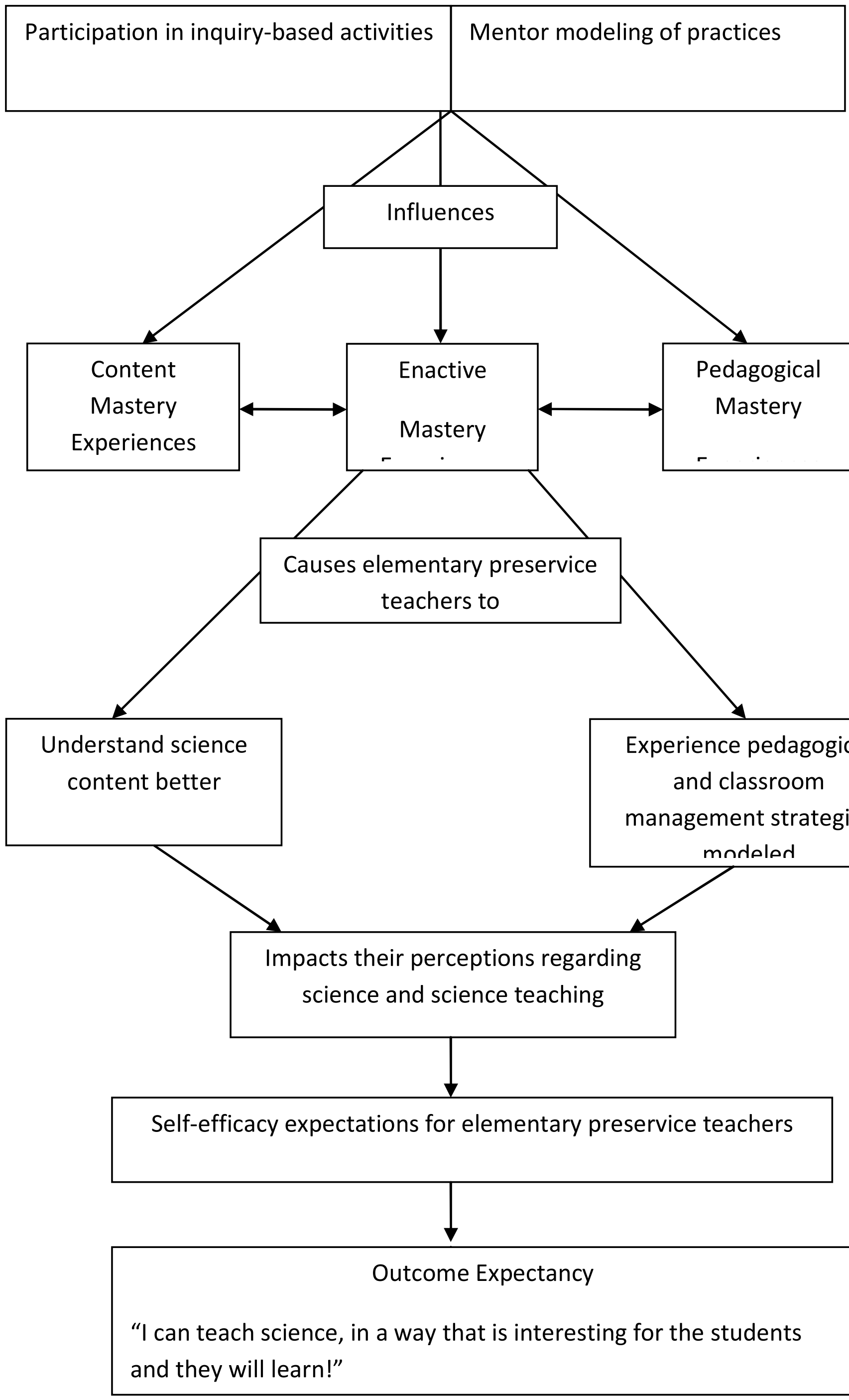

Figure 2. Factors influencing the self-efficacy expectation and outcome expectancy of elementary pre-service teachers.

experiences" was broad, our participants delineated three separate but inter-related mastery experiences. Participants attributed changes in their self-efficacy due to (a) success in understanding the science content taught, (b) success in learning different pedagogical techniques and practices appropriate for the EC-4 level and (c) success in being able to teach the science content learned to primary school children during their field experiences in this course.

Content mastery

During their first interview, the elementary preservice teachers expressed anxiety regarding their ability to understand the science content taught. However, as the course progressed, the anxiety diminished and student confidence in their ability to master content increased. For example, Anna explained how active participation in the activities helped her understand the concept of buoyant force.

> “I always knew that buoyant force was the force pushing up. But until I did that experiment with the metal cube and measured its weight and volume, when I submerged it in water and measured the volume of the water that spilled over, then I understood that it was not just the upward force but also equal to the volume of the cube and the weight of the water displaced. And what was really nice was that he (the professor) has got all this stuff in class we can play with and test, so we were able to test if that was true with different objects. I think because I learned it that way, I will never forget it.” (Anna, Interview 3, April 9).

All the activities used to teach the concepts involved materials that were inexpensive and accessible. Students were encouraged to use different materials to vary their experiments and share their results in class. We believe that it was the participatory nature of the activities presented in simple; easy to understand yet interesting formats, as well as mentor modeling of practices that contributed to student content mastery.

Pedagogical mastery

According to Palmer (2006), success in mastering and understanding of some effective pedagogical techniques can contribute to developing self-efficacy in preservice elementary science teachers. Interviews with participants provided evidence to support Palmer’s assertion. Preliminary interviews revealed that most participants had vague ideas, if any at all; about the pedagogical techniques they would use to teach elementary students. Responses ranged from a common “I do not know” to “read a book aloud” to “do some activities”; the last category when probed for more detail often drew a blank. Madeline’s responses when asked what would be the best way to teach science in an elementary classroom were representative of the student’s lack of knowledge regarding quality science instruction.

> “I remember my elementary teacher reading a lot of stories, plus I am into language arts, so I would probably read them a story too, if I could find a science related story, that is” (Madeline, Interview 1, January 19, 2007).

Later, Madeline dismissed the value of reading science books to student in the following exchange.

> Madeline: I am glad I took this class because it taught me so many ways to teach science to elementary students.
> Researcher: So no more reading to your students?
> Madeline: Noooooo! Reading a book is not teaching science. You should know better than to ask me that! The other day when I was at school for my field experiences, the teacher was talking about heavy and light liquids and drawing them on the board, it was so boring, and I kept thinking if I were her, I would do the density columns, using different concentrations of salt water solutions and food colors with them and they would understand the concept so much better (Madeline, interview 3, April 18, 2007).

Success in mastering an understanding of the science content reciprocally influenced student success in mastering an understanding of effective pedagogical techniques to teach elementary science.

“What I liked best about this class was that he (the professor) didn’t just teach us the science content, but also taught us how we could teach that content to elementary children. To me that was what was most valuable. It’s like having a two-in-one, the content and the “how to” combined. If this was the science content, then these were the ways in which you could teach it to elementary kids and that helped.” (Lani, Interview 3, April 18, 2007)

Hence, our results revealed that student’s active participation and the professor’s modeling of activities that were age appropriate to the EC-4 level incorporating inquiry in a constructivist classroom positively influenced the development of the preservice teachers’ self-efficacy as their content and pedagogical mastery grew.

Enactive mastery

Participants experienced enactive mastery experiences when they developed lesson plans informed by their experiences in the physics class and when they taught the content they had just learned to EC-4 students during their field experiences or informal settings. We believe that enactive mastery experiences are interrelated to and enhanced by simultaneously occurring content and pedagogical mastery experiences. In the excerpt below, Kim expresses:

> "I think what really helped me most was the lesson plans. It was a pain doing them, but at least when I teach I will have something to fall back on. Plus he modeled all the activities for us. So I used that as a base to modify the activity for a different grade. That was challenging and something I will have to do as a teacher, so it is good to learn to do it now." (Kim, Interview 3, 17 April, 2007).

In the example below, Nicola attributes her increased confidence in teaching science both to her content mastery of a topic (Newton's laws of motion), but also her ability to successfully help her daughter learn the concept.

> "I remember learning about the laws of motion. I mean, I remember the statements of the laws, but I never really knew how and where to apply them. My daughter is in the 5^{th} grade and I went home and asked her if she knew about Newton's laws and she was just like me. She knew what the laws were but didn't know what they meant. So we borrowed my husband's bowling ball and a broom from the kitchen and I had her roll the bowling ball with the broom up and down the hallway and explained how the laws applied, and it felt real good I must tell you. I told my husband afterwards "Well maybe I can teach science after all." (Nicola, Interview 2, 19 February, 2007).

As stated earlier, we found convincing evidence that the participatory nature of the activities and consistent mentor modeling present throughout the course influences the mastery experiences of the elementary preservice teachers in a positive manner, as they developed a sound understanding of the physics content emphasized in the course. They also observed and experienced age appropriate pedagogical and classroom management strategies that were modeled throughout the course, which in turn influenced the student's perceptions of what constituted age-appropriate science instruction as noted in the following student comment.

> "I think this class changed things around for me. All my other science classes were so hard and dry, and I did not really like science. I often thought how it would work out with me teaching science, especially when I did not like it. But it is not really like that, is it? Science is not that difficult or boring. In fact it is very funny and I have wayyyyyyyy lot of ideas now how to teach it. I think I am going to be a very good science teacher" (June, Interview 3, 24 April, 2007).

Pre-service elementary teachers with positive images of science and science teaching tend to have stronger self-efficacy expectations which in turn contribute to stronger outcome expectancies regarding science teaching. We realize the findings of our study are limited with the participants being female elementary science teachers in an elective science content course. The major factors influencing preservice elementary teachers' self-efficacy may vary according to the course and the mode of teaching. Hence, the extent to which findings from this study can be generalized and applied to other courses must be determined on a case by case basis.

Implications

The significance of the results of this student extends beyond the preservice preparation for EC-4 teachers to the preparation of teachers of science at all levels of schooling. Elementary preservice teachers, both under-graduate and post baccalaureate seldom have a strong science background or positive experiences in learning science which directly impacts the manner in which they both learn as well as teach science. Elementary preservice teachers often report how alienating large science lecture classes with endless content material to be memorized are. The design of PHYS 3400 is rather unique in that it integrates the science content with relevant, age appropriate, inquiry-based pedagogical strategies. Preservice teachers have the opportunity to learn a science concept by participating in hands-on activities and testing their gains in content knowledge by applying it to a teaching situation. The design and conduct of this physics course promoted the development of self-efficacy in the students. Self-efficacy beliefs give a measure of the sense of how teachers perceive their strengths and preparation to teach science effectively. Hence, it is important that teacher education programs design and conduct science/science methods courses that resemble Physics 3400 rather than isolating the content and methods.

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