Interpreting Elementary Teacher Candidates' Images of Science Teaching

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Despite efforts to prepare elementary teacher candidates to teach science, there is a common perception that many graduates feel unprepared or reluctant to teach within this discipline for a variety of reasons. Meanwhile, the Interstate New Teacher Assessment and Support Consortium ([INTASC], 1996) and the National Science Education Standards (National Research Council [NRC], 1996) have listed standards that require elementary teacher education programs to produce graduates who are competent in planning learning experiences and instructing students within various academic disciplines, including science. As Anderson and Mitchener (1994) described, science methods courses serve as a bridge between several providers of a teacher education program, including the links between education and science departments to achieve this goal. In addition, Bentley, Ebert, and Ebert (2000); Carin, (1997); Gega, (1994); Howe (2002) and many other scholars recommend that science educators provide opportunities for reflection that lead to developing competence. In light of their recommendations, they advocate the use of constructivism as a referent for preparing preservice teachers to provide effective instruction. Given the relatively recent focus on constructivism, this journey begins with an understanding of how teacher candidates view science teaching and learning.

The use of illustrations that research participants draw to obtain a greater insight into psychological processes is not new. As Coughlin and Seldin (2001) indicated, Arnheim, (1969), Goodenough (1926), Piaget & Inhelder (1969) and several other educators have studied children's intelligence, as well as their emotional and cognitive development through the pictures that they drew. Drawing from this existing body of research, Coughlin and Seldin (2001) explored conceptions that 40 elementary and secondary preservice teachers had of teaching. Their investigation confirmed the understanding that preservice teachers enroll and participate in teacher education classes with prior experiences (as learners) in classrooms for which they prepare to teach. Therefore, it is important that certification programs incorporate these perceptions course activities and field placement experiences.

More specifically, illustrations have been used to assess views on science and science education for several years. The Draw-A-Scientist-Test (DAST) has been used to assess pre-college students' views on science and scientists. For example, Barman (1996) administered Draw-A-Scientist-Test (DAST) to elementary students to probe students' perceptions of who does science under specified conditions. Hill & Wheeler (1991) combined the use of DAST to investigate pre-college students' ideas about science, scientists, and technology. Mason, Kahle, & Gardner (1991) used this instrument to study gender differences and the marginalization of girls in high school biology classrooms. More recently, researchers have used DAST to study views preservice teachers have on science and science teaching. Rosenthal (1993) administered the DAST to 76 liberal studies majors who planned to become elementary school teachers and 90 biology majors. Carnes (2000) used the instrument to study the views of M.A.T. interns who planned to teach in early childhood, elementary, and middle school settings.

Drawing from the DAST design, Thomas, Pedersen, and Finson (2001) developed and validated the Draw-A-Science-Teacher-Test- Checklist (DASTT-C) to understand how teacher candidates viewed science teaching. In developing the DASTT-C, Thomas et

al modified the DAST checklist to provide a way to assess stereotypical and non-stereotypical views of science teachers. This instrument invites research participants to draw a picture of themselves as science teachers. There are prompts that encourage the participants to explain what the teacher and students in the illustrations are doing, resulting in a brief narrative that accompanies the drawings. The protocol for analysis requires the analyst to score the illustrations into three broad categories: the teacher, students, and the classroom environment (Thomas et al, 2001).

Theoretical Framework

This study used constructivism as a referent for understanding the mental constructs that underlie the images that teacher candidates drew. While there are several variations on the theme of constructivism, there are common characteristics associated with this epistemology. Within the context of science teaching and learning, constructivists state that authentic learning results from the learner's active participation in the education process, connections made with prior knowledge, and manipulation and interaction with ideas and/or objects to facilitate understanding (Arons, 1989; McDermott, 1991; von Glasersfeld, 1993; Tobin, 1993; Wheatley, 1991). Therefore, knowledge is always contextual and personal (O' Laughlin, 1992; Tobin & Tippins, 1993; von Glasersfeld, 1989; von Glasersfeld, 1993; Wheatley, 1991). Information that is obtained through experiential processes is assimilated within the learner's existing cognitive schema. Inherent in the acquisition of knowledge, the learner develops the ability to interpret and apply knowledge to situations outside the context in which it was initially acquired (McDermott, 1991; Wheatley, 1991). Therefore, it is important that science educators gain insights into teacher candidates' existing knowledge and perceptions of science teaching and learning to provide meaningful activities that prepare them to work effectively with elementary students.

Research Questions

Using a protocol that was similar to the one prescribed by Thomas, et al. (2001), I investigated three elementary preservice teachers' perceptions of elementary science educators. Two questions guided this investigation. What images did these elementary Master of Arts in Teaching (M.A.T.) interns have of science teaching at the beginning and end of a science methods course? Based on their narratives and elaborations, what did their illustrations of science teaching really mean? Even though the number of research participants is decidedly limited, their responses shed more insight on the investments that science educators should make to influence preservice teachers' perceptions. In doing so, this study provides an interpretative approach that Anderson and Mitchener (1994) say is needed to improve science education.

Methods For Generating Data

In the third and most recent version of the DASTT-C instrument, Thomas, Pedersen, and Finson (2001) added an illustration and narrative data component. These developers came to the conclusion that short, personal narratives might provide additional

insight on certain components and aspects of illustrations that research participants drew, replacing the oral interviews that would be impractical with large groups of participants. Thomas et al. (2001) asked, "Draw a picture of yourself as a science teacher at work**"** (p. 300). Also, the developers provided their preservice teachers with #2 pencils or markers. While their work provides a strong foundation for understanding research participants' views and perspectives on science teaching and learning, the analysis protocol converted the data generated from the illustrations to numerical scores, losing the richness of the illustrations.

Research Participants

The interns were three M.A.T. interns who were fifth year interns and had recently completed the science methods course that was described earlier. They each successfully earned an undergraduate degree at the university and 18 credit hours in its Education Minor program. In meeting the science content portion of the admission requirements, these interns completed a minimum of seven semester hours of science courses offered outside of the College of Education. Each of these interns only had the minimum number of credit hours and had varying background experiences.

Modified Administration

The research questions lend themselves well to an investigation that informed by and interpretive discourse. Within this theoretical framework, Woods (1992) indicates that it is important for researchers to conduct studies that are grounded in the daily "lived experiences" of research participants. These investigations may include, among many possibilities, how preservice teachers make sense of science teaching and learning within the elementary classroom. In addition, the research questions positioned the researcher in the role of a knowledge seeker, a perspective that is consistent with constructivism and other interpretive discourses. Therefore, I modified the method for generating data in a way that was more consistent with interpretive research. Specifically, I modified the protocol for gaining an understanding of the images preservice teachers had of elementary science teaching and learning. I made the drawing prompt more generic, asking the three participants to draw a picture of a science teacher at work, providing them with the opportunity to draw themselves or another individual. The participants used the pencil or pen that they brought to class and had 15 to 20 minutes to complete the test.

Analysis

I used these illustrations to begin several dialogues with three Master of Arts in Teaching (M.A.T.) degree candidates to understand what their drawings represented. I gave specific attention to the images that the candidates drew and the narratives that accompanied their illustrations. Currently, the researcher is analyzing the written narratives and the research participants' elaborations on those statements in light of these research questions. The research participants were unique to each other with regard to past science learning experiences and levels of confidence in teaching elementary

science. This data collection spanned the yearlong internship during which the teacher candidates were enrolled.

Initial Findings

Betty was a white female who had negative experiences with science during her elementary and secondary school years even though she performed very well in academic areas and was in the gifted program. In the following quote, she shares her vivid memory of her dislikes for science and the experiences that contributed to them. As a result of her experiences, Betty sought opportunities to avoid taking additional science courses. Although she did fulfill the required number of science courses for the teacher preparation program, she began the science methods course with a high level of anxiety. In the following quote, she detailed her reservations.

> I wish I could stand before you and say that my elementary experiences with science were rich and fulfilling and that I developed a passion for science due to my wonderful experiences; the truth is quite the opposite. My science teachers used direct instruction. The teacher would stand in front of the class and proceed to ask us to open our textbooks to whatever page we were to be on that day and continue to read almost straight from the book. Some days the teacher would use an overhead projector, but most days he/she would not. No connections were ever made to my life and there was no correlation to other subject areas like math, art, literature, music, P.E., etc. I never had much experience with hands-on activities. So, you can imagine my anxiety level every year when we were mandated to enter the science fair. I felt ignorant, inferior, defeated, and utterly embarrassed *every year* [her emphasis] at the science fair. I even remember crying and begging my parents not to go to see the displays at the school because I was so ashamed.

On the other hand, Olivia, an African-American female, shared mostly positive experiences in her elementary and secondary education. The following quote serves as a summary of her sentiments.

> I have had the enlightened experience of being educated in both public and private schools in 3 different states along the east coast; Georgia, South Carolina, and Connecticut during my young life. Each experience in my science education was quite different. I had the most memorable experiences in my eight grade Physical Science and ninth grade Biological Science classes. During these two years, we spent significant time on class experiments, uncovering course content, and researching various projects.

Hal was a White male who had very positive experiences since his early childhood days. For example, his father bought him a telescope when he was very young, allowing him to explore the sky and heavenly bodies. As he related in the following quote, his second grade teacher contributed to his growing interest in science.

> My second-grade teacher was a positive influence in science teaching. She allowed me to do demonstrations for the class out of our textbooks that

were normally overlooked by other teachers. She was also always willing to allow me to share any science ideas with the class.

Unlike the first two interns, Hal completed a science methods course that was designed for classroom teachers prior to his entry in the M.A.T. program. In addition, he delayed his entry into the degree program for one year, working in an observatory at the university to earn money for his graduate education. In various conversations, he consistently related his enthusiasm about science and science teaching.

Regardless of their prior experiences in learning science at the elementary, middle school, high school, and university levels, all of the interns drew scenarios inn which students were actively involved in the learning process. In Betty's case, her illustration represented what science teaching and learning ought to be. Olivia drew scenario that was most reminiscent of her positive experiences. Finally, Hal's illustration was fairly consistent with his learning experiences and the manner in which his teachers taught.

The different backgrounds of the interns and their similar illustrations highlight the importance of including interviews and non-threatening opportunities to explore the significance of illustrations. On the surface, a researcher might assume that the interns may have illustrated science teaching and learning in a manner that was consistent with their prior experiences. Subsequent interviews indicated that this was generally not the case. However, the interns' explanations of their drawings consistently revealed aspects of teaching that they valued.

Over the years, researchers have realized and underscored the complexity of the nature of teaching. Given the many aspects of this profession, it is impossible for preservice teachers or other research participants to share their views on science teaching in a manner that captures all of their prior experiences and present thoughts. However, the drawings to provide basis for reflection to support teacher preparation and long-term professional development for teaching science at the elementary level, as Thomas et al (2001) suggested.

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