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Being an Innovative Teacher: Preservice Teachers' Conceptions of Technology and Innovation

Heather Davis

Dept. of Curriculum & Instruction, North Carolina State University

402J Poe Hall, Raleigh, NC 27695, USA

Tel: 1-919-515-0288 E-mail: heather_davis@ncsu.edu

Richard Hartshorne (Corresponding author)

Dept. of Educational Leadership, University of North Carolina at Charlotte

9201 University City Blvd., Charlotte, NC 28223, USA

Tel: 1-704-687-8711 E-mail: rhartsho@uncc.edu

Gail Ring

Undergraduate Studies, Clemson University

E-103 Martin Hall, Clemson, SC 29634, USA

Tel: 1-864-656-3406 E-mail: gring@clemson.edu

Abstract

The purpose of this study was to understand how first-semester, preservice teacher education students understand the concept of innovation including its role in promoting students' learning and development. Participants included 51 (46 Female, Five Male) students enrolled in an introductory educational psychology course. As part of this course, opportunities were integrated to explore educational technologies and the role technologies play in learning and development. Qualitative data were drawn from a culminating philosophy of teaching statement and journal entries students generated as part of the normal class routine. In this paper we describe emergent themes identified across participants' understandings of technology (e.g. shared conceptions) and individual differences in preservice teachers understandings of innovation (e.g. unique conceptions). Finally, we present a grounded model of preservice teachers' perceptions of innovation. Findings are discussed in terms of the larger contexts of preservice teacher education and technology adoption in k-12 settings.

Keywords: Technology Education, Integrating Technology, Teacher Education, Preservice Teachers, Innovation, Conceptual Change

1. Being an Innovative Teacher: Preservice Teachers' Conceptions of Innovation.

The pervasiveness of technology in our everyday lives no longer causes much comment. Whether ensconced on a desk designed specifically for computer hardware or more invisibly situated within the workings of a microwave, ATM, or car, technology is exerting influence on the professional, as well as the personal, lives of twenty-first century citizens. Business people and politicians have called for the need for technological literacy in our modern world believing that this knowledge will provide students with the skills necessary to compete and survive in the new millennium. Thus, schools have been served with a mandate to prepare students for this brave, new world (NCATE, 1997; No Child Left Behind, 2001). In response to growing demands on teachers to address the increasing pervasiveness of technology in education, federal, state and local sources have sought to solve the digital divide by dealing with the issue of access to technology (Burnskie & Monk, 2001). However, in *A Report on the Preparation and Qualifications of Public School Teachers*, released by the US Department of Education (1998), only one in five teachers felt adequately prepared to work in a modern classroom. "Although many educators and policy analysts consider educational technology a vehicle for transforming education, relatively few teachers reported feeling very well prepared to integrate educational technology into classroom instruction" (page iii; Sept., 1998).

To address concerns about preparation, preservice teachers are expected to meet certain minimum standards with regard to the integration of technology in teaching and learning (Beyerbach, Walsh, & Vanatta, 2001). However, the integration new technology into teaching and learning is not seamless; and despite the support and investment public education has made in acquiring technology for schools, concern exists that the technology remains underutilized (Marcinkiewicz, 1993; Cuban, Kirkpatrick, & Peck, 2001). Moreover, recent research suggests preservice teachers may exhibit resistance both to the notion and practice of technology integration (Davis, Ring, & Ferdig, 2002). These findings leave teacher education faculty and programs wondering what happened to the promises that technology would enable the creation of students who were problem-solvers and critical thinkers and teachers who were truly innovative, those who can seamlessly integrate new tools and methods into their instruction.

In an attempt to understand the slow rate of technology integration, prior research has sought to examine teachers' perceptions of technology and what they feel *should* occur in order to more effectively and efficiently promote the integration of technology and innovation into the classroom. Beyerbach et al. (2001) found that teachers' resistance to technology and innovation was rooted in a number of areas. First, teachers reported they perceived they needed more frequent interactions with technology, as well as more step-by-step instruction with technology. Second, while teachers found technology interventions beneficial, practicing teachers were not able to iterate the manner in which the interventions were beneficial. Finally, though teachers in their study talked very positively about the technology interventions, they failed to implement changes upon returning to their classrooms. Norum, Grabinger, & Duffield, (1999) found, in reaction to the difficulties faced when implementing technology, teachers wanted more incentives for integration, more access to technology, and the presence of more technological support.

We believe, however, that uncovering preservice and practicing teachers' perceptions of the barriers and benefits to technology integration is merely a first-step in exploring the pathways to successful integration. Moreover, we believe that to truly understand why preservice and practicing teachers choose or resist technology integration, we must begin examining the underlying conceptual frameworks that shape teachers' perceptions; specifically their conceptions of innovation.

Guzzetti and Hynd (1998) discuss conceptions as organized bodies of knowledge in which individual pieces of information become interrelated with each other and with motivations and affects. These conceptions represent frameworks that can act as filters for processing new information (Pajares, 1992; Eagley & Chaikin, 1993; Gregoire, 2003). Prior research in the areas of transfer (Bransford, Brown, & Cocking, 2000) and subject matter reform (Gregoire, 2003; Tom, 1997) suggest preservice teachers' pre-existing conceptions need to be brought to consciousness and explored in order for meaningful conceptual change and the implementation of new ideas and new methods to occur. Alexander (1998) argues some conceptions are more valued than others in a field. This too is true in the field of educational technology – where some conceptions have been associated with more technology-rich, meaningful instruction. By exploring teachers' underlying conceptions of innovation we may be able to identify relevant knowledge bases as well as the motivations and affects that are involved in both promoting and obstructing conceptual change.

1.1 Defining Innovation: Views from the Field of Educational Technology

In a recent review, Straub (2009) maps the landscape of adoption theories and identifies several theories that can guide our exploration of why teachers resist or embrace technology integration in their classroom. For this project, our conceptual framework was informed by the seminal research of Rogers (1995) as it pertains to the diffusion of innovations; Hall, Loucks, Rutherford, and Newlove (1975) work as it pertains to the levels of concern faced by teachers as they confront adoption of an innovation; and Davis's (1989) research pertaining to teacher perceptions of technology. At the heart of this project was a desire to understand how teachers' conceptions of innovation and what it means to be an innovative teacher, given the pervasiveness of technology in our society. Rogers (1995) defines innovation as, "an idea, practice, or object that is perceived as new by an individual or system" (p. 11). At its broadest level, innovation can be conceptual – a new idea (Straub, 2009). Central to this conception of innovation is the emphasis on novelty, difference, and change. "It does not matter if the idea, practice or object is objectively new; rather it is the perception of novelty. Moreover, innovation does not necessarily mean 'better' or that the new idea is more beneficial to the individual," (Straub, 2009).

Rogers' (1995) research also provides insight on the factors that influence the diffusion of an innovation: the characteristics of an innovation, characteristics of adopters, and the stages of the innovation diffusion process. Rogers stated that adopters of any new innovation or idea could be categorized as innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%) and laggards (16%), based on a bell curve and each adopter's willingness and ability to adopt an innovation depends on their awareness, interest, evaluation, trial, and

adoption. Further, Rogers outlined the five stages of the innovation diffusion process as: knowledge, persuasion, decision, implementation and confirmation. Analogous to Rogers' research is the research of Hall et al. (1975) that considered the concerns of individuals as they approach change and engage in a new practice. Hall et al. (1975) proposed different levels of use of technology existence for teaching, ranging from 0 – *Non Use* to 6 – *Renewal*. "These levels characterize a user's development in acquiring new skills and varying use of the innovation" (p.54). Hall and colleagues point out the importance of understanding where people are on the change continuum and recognizing that not all people are at the same place at the same time.

While it is vital to understand the implementation and diffusion process of an innovation and the individual's concerns regarding the change process, of equal importance is what we consider to be the third dimension of the change process: *Perceived Usefulness* and *Perceived Ease of Use* (Davis, 1989). Davis identified these two characteristics of innovation as possible predictors of usage outcomes. According to Davis, the perceived usefulness of an innovation is the extent to which people will use or not use an innovation based on how they believe it will help them perform their job better. Second, even if potential users believe that an innovation is useful they may, at the same time, believe that the system is too hard to use and that the performance benefits of usage are outweighed by the effort of using the application. As Straub (2009) notes, Davis's work was important because it began the conversation about the importance of individual perceptions of a technology. By understanding and considering the concerns and perceptions of teachers, or in our case preservice teachers, we can begin to design instruction that better supports preservice teachers in their use of technologies for instruction while simultaneously making the change process less threatening.

1.2 Purpose

The purpose of this study was to understand how first-semester, preservice teacher education students understood the concept of innovation. We speculated our students might differ in their conceptions of innovation from those of the field; specifically with regard to holding conceptions of innovation and innovative teaching that are associated with technology-rich, meaningful instruction (Davis, 1989; Hall et al., 1975; Rogers, 1995). As part of this project, we examined preservice teachers' philosophies of teaching at the conclusion of participating in a course designed to infuse technology experiences into the study of learning and developmental theory. It was our goal that through this class and the associated exposure to technologies (e.g. web publishing software, wireless computer systems, courseware learning environment) students would develop both the related skills and the required tenacity to use technology effectively in their future classrooms. In other words we hoped to model technology use as a value added element of the curriculum and as a tool that can enhance student learning and development.

2. Methods

2.1 Participants

Participants in the study included 51 first-year elementary preservice teachers enrolled in an applied child development course. This represented approximately 90 percent of the course population for that semester. The students were all enrolled in a sequenced, vertically staffed, teacher education program (Tom, 1997). Prior to acceptance into the teacher education program, all students were required to complete an introductory educational technology course; thus, all students had prior experience using some technologies (e.g. PowerPoint©, web publishing, conceptual mapping, etc.) in an educational context. Approximately 90 percent of the sample was female (n=46) and 10 percent was male (n=5). All students were in their third year of college with 90 percent of the students between the ages of 20 and 25**.**

2.2 Integrating Technology into the Study of Teaching and Learning

Participants in this study were enrolled in a course titled, "Child Development for Inclusive Education." The primary goal of this course was to meet state and national teaching requirements by exposing students to theories and concepts relevant to understanding human learning and development, while at the same time providing specific opportunities to develop mastery of specific concepts relevant to the learning and development of elementary-aged children. When designing the course, two broad questions provided a framework for the adoption of learning activities: 1) How do teacher educators encourage teachers to appreciate learning and developmental theories and use these theories to make informed decisions in their classes? and 2) How do teacher educators encourage teachers to develop a "teaching identity" that includes an appreciation of the potential role of technology to support learning and development? Building on student's prior experiences, throughout the semester the instructor worked to integrate the use of a variety of media (overhead projectors, spreadsheets and PowerPoint®, audio & visual representations, technical and pop-culture video, Play-doh®, and the use of WEBCT® to facilitate an asynchronous discussion) to illustrate course concepts. At the end of each class, the instructor debriefed students by asking them to consider how their understanding of the concept might have been different without the use of the media. These debriefings generally gravitated around how integrating the technology had changed their understanding and affected their motivation.

When reviewing the plan for infusing technology experiences and vicarious learning through teacher modeling we wondered: "Do these debriefings really support teachers' in making connections between 'technology use' and learning and developmental theory?" The second attempt to integrate technology into the course was to facilitate theory-based discussions about the role of technology in promoting learning and development. Three explicit discussions occurred around the three learning developmental theories covered in class (e.g. Cognitive Science perspective, a Piagetian perspective, a Vygotskian perspective). The goal of these discussions was to highlight the role of technology from a Cognitive Science perspective in promoting cognitive development via asking students to engage in higher order thinking skills, such as problem solving, critical thinking, and self regulation; from a Piagetian perspective (Piaget, 1977) by examining promoting development by creating disequilibrium; and from a Vygotskian perspective (Vygotsky, 1985) by helping students become users and producers of technology (including the development of cultural tools, opportunities for discourse, and cognitive apprenticeship). These concepts were specifically

highlighted because they were introduced and covered in the text and the course reading-packet.

Thirdly, we believed teachers' needed opportunities to explore and reflect on their existing beliefs (e.g. teaching, learning, and technology). This was accomplished throughout the semester via teacher's completion of six reflective journals as part of the normal course routine. Topics were sequenced and their completion preceded group discussion. Three of the journals were completed within the first two weeks of the course (during the introductory units). They included: 1) Why did you choose to become a teacher? 2) How do you learn best? and 3) What makes a good teacher? Two journals were administered at the time of the midterm: 4) What is the role of technology in teaching and learning? How does technology support learning and development? (prior to midterm) and 5) How do kids learn best? (immediately following midterm). The last journal was completed following a unit on developmentally appropriate assessment: 6) What yardstick should be use to evaluate children and teachers? Students received individual feedback from the instructor and this feedback frequently asked students to clarify concepts, think of examples, and make connections with the course. Finally, as the culminating project for the course, teachers were asked to construct a first draft of a teaching philosophy (see Appendix 1). The goal of this activity was to engage students in a synthesis across and analysis of the theories they had studied and to apply what they had learned about learning and development to the context of technology.

2.3 Procedure & Data Analysis

Data for this study were drawn from the final cumulating philosophy of teaching and learning assignment and course journals. As part of these assignments, students were asked to consider the role of technology in teaching, learning, development, and assessment. Journals were submitted throughout the course and philosophy statements were due on the day of the final exam and ranged in length from two to four pages. Analysis of students' teaching philosophies began at the end of the semester. All participants were given a confidential identification number and all handwritten journals and philosophy statements were converted to word-processed documents. After an initial review of the philosophy statements, we believed that before we characterized students' conceptions of innovation, we needed to first attempt to describe how preservice teachers understood technology. To do this began by analyzing the fourth component of the philosophy statement (see Appendix 1), in which students were asked to articulate their understanding of innovation and their beliefs about the role of technology in being an innovative teacher.

Through iterations of thinking about, coding, and organizing data we were able to identify emerging themes and sub-themes across participating students' reflections on innovation. Themes were inductively generated following the constant comparative method of data analysis (Bogden & Biklen, 1982; Corbin & Strauss, 1990; Dey, 1993). Constant comparative analysis is an iterative process of data reduction and helped us to identify a higher order structure in our data and organize codes into emergent themes. Iterations were initially conducted independently by members of the research team in order to allow for comparison

and validity checks. After the initial independent iterations, the research team convened for comparison of themes, codes, and sub-themes. Once we felt confident the themes, codes, and sub-themes were stable, we created a master list of the themes (three), sub-themes (six), and codes (131). Finally, we made an additional pass through our data to look at the frequency of each theme, sub theme, and individual code as well as to identify exemplary quotes for each theme and sub-theme. This process helped us to clarify which constructs were driving the meaning of each theme as well as to examine the pattern of relationships emerging between themes and sub-themes.

In an attempt to capture and understand individual students' conceptions of innovation, we also looked for themes within each participant. To do this we constructed profiles of individual student's and examined the extent to which themes emerging across participants described individual student experiences. We then attempted to characterize each participant based on the three themes: their *Attitudes toward Technology: Facilitators and Inhibitors*, their *Beliefs about the Role of Technology in Teaching: Curricular Decisions*, and their *Beliefs about Role of Technology in Promoting Learning*. When attempting to classify the teachers using the themes, we noticed how students' discussions of technology and innovation (e.g. see Appendix 1, Step 4) were embedded within their philosophy of teaching and learning (see Appendix 1, Steps 1–3; see also Dawson & Heinecke, 2004). Therefore, we broadened our examination of the data to include the students' entire philosophy statement. We then sorted teachers based on the views reflected across the three themes, salient attributes of their philosophies of teaching and learning (Steps 1–3), and the unique relationships we found in each of their profiles. Based on this sorting we identified five unique conceptions of innovation in our data. Again, in order to allow for comparison and validity checks, initial analyses were conducted independently by each member of the research team.

Once confident about the stability of our themes, sub-themes, and characteristics, as well as our framework for classifying students' unique conceptions of innovation, we submitted our findings to a validation check by all members of the research team. Findings from the validity check revealed the themes and sub-themes we identified from the larger data set were comprehensive for describing the seven philosophy statements and the broad labels and defining characteristics we supplied for identifying unique views and were useful for classifying students. We found 80% of our students could easily be classified as holding one of the five conceptions. When attempting to reconcile disagreement over the remaining students, we learned some of the teachers appeared to be straddling two conceptions. It was at this point that we began discussing how differences on the underlying dimensions (i.e. three themes and philosophy of learning) were contributing to differences in the teachers' conceptions of innovation. Specifically, teachers who appeared to be straddling two conceptions appeared to be evidencing some tension or growth along one of the dimensions. We then developed a model that would synthesize across our two sets of findings (i.e. themes and conceptions) incorporating both shared and unique views.

In the discussion of the findings, we begin by describing the emergent themes, or *shared conceptions*, we identified in our teachers' beliefs about innovation. We then describe

individual differences, or *unique conceptions*, found in our teachers' belief about innovation. We end by describing the model we developed to understand how teachers' conceptions of innovation might be related to each other and to conceptions of innovation that exist in the field of educational technology.

3. Findings

3.1 Common Themes in Preservice Teachers' Perceptions of Technology/Innovation

In the final portion of the philosophy statement activity students were asked to, "Consider the role of 'technologies' in teaching, learning, development, and assessment. Based on your view of learning, how can technology foster your students' cognitive/social/emotional development? What steps will you need to take to be an "innovative" teacher?" (See Appendix 1). We began our analysis by looking for common themes across our preservice teachers' perceptions of technology/innovation. We characterized the final portion of their statements using three themes and six sub-themes (See Table 1).

We labeled the first theme *Facilitators and Inhibitors* because it reflected the factors our preservice teachers perceived as constraining or encouraging their adoption of technology. Specifically, we found preservice teachers' general attitudes towards technology – including their definitions of what constitutes 'technology' in the classroom - and their perceptions of (actual/potential) technology resources. We labeled the second theme, *Beliefs about the Role of Technology in Teaching: Making Curricular Decisions*, because it described the ways in which our preservice teachers' statements about how they might implement technology in their classrooms reflected their underlying beliefs about the necessary or ancillary role of technology in teaching. Sub-themes included perceptions of how technology could meet or compete with curricular goals and the needs of their students. We labeled the third theme, *Beliefs about the Role of Technology in Promoting Learning* because it described the way in which our preservice teachers' statements about the value of implementing technology reflected their underlying beliefs about the ability of technology to foster student learning beyond 'traditional' teaching methods. Sub-themes included exploring the ways in which technology might foster students' cognitive and affective development and the extent to which using technology could assist them in becoming a more effective teacher.

3.2 Theme 1: Attitudes toward Technology: Facilitators and Inhibitors.

Consistent with prior research on preservice teachers' beliefs about technology adoption, our preservice teachers' statements reflected their comfort level with and attitudes towards technology and innovation (Beyerbach et al, 2001; Davis, 1989). For example, a common characteristic constraining their view of technology was exemplified by the viewpoint that children are often more technologically savvy than teachers. One participant noted, "Since children are so much more advanced than most teachers with technology, it will be hard for me to be innovative." A predominance of such feelings indicated a discomfort with technology and was associated with a teaching philosophy that feared innovation. Another characteristic of our preservice teachers' comfort level with technology was their willingness and perceived ability to "keep up" with the latest technological advances. Another participant

noted, “To be an innovative teacher, I will have to be up-to-date on the most beneficial forms of technology and will have to know the most effective ways to implement them into my lesson.” This statement indicates a belief that teachers not only have to “learn” new technologies, but also have to integrate their knowledge and understanding of effective pedagogical methods when implementing new technologies. Thus, “keeping up” with technology was perceived as more than simply knowing what advancements are available - the teacher is also expected to use the media effectively.

Another factor that facilitated or constrained preservice teachers’ perceptions of their ability to implement technology in their classroom included their underlying definitions about *what* can constitute ‘technology’ in the classroom. Our preservice teachers defined technology in a number of ways. Some of our preservice teachers statements centered on the use of new, ‘popular’ technologies such as computers, the Internet, and electronic mail. Reflected in these statements were attempts to understand and constrain the range of possible media and/or methods that might be included in their definitions of technology and innovation. In narrowly defining technology as only including either popular technologies or traditional technologies, our participants may have been attempting to control the difficulty or complexity of their instructional practices. For example, by defining technology as only including “popular” computer technologies, our participants limit the range of media choices, while potentially increasing the difficulty level of these technology integrations.

Other preservice teachers engendered a broader definition of technology citing the ways in which innovation in the classroom could reflect the adoption of new texts, using traditional materials in new ways, and field trips as examples. One participant noted, “By technology, I also mean the ability to adapt my teaching so that it can be most effective to a student’s learning. As a teacher I will constantly seek new technology as well as new means of teaching my students so that they can learn the most from my classroom.” By adopting a broad perspective of technology to include media and methods, these preservice teachers expanded the range of possible integrations. In doing so, these preservice teachers may feel more autonomous to choose among technology integrations, matching the integration to their level of comfort and expertise.

A final issue noted by our participants, as facilitating or constraining technology integration, concerned access to resources. Access issues related to three major areas: 1) instructor and student access to technological equipment both inside and outside of school, 2) support for implementation, and 3) access to professional development. Again, the participants presented a wide range of understandings and viewpoints, mentioning a number of factors they believed affected access. These factors included whether students had access to technology at home and school, the ease of access to traditional technologies (pictures, text, overhead projectors, television, VCR/video, and games), ease of access to popular technologies (computers, software, laser disks, e-mail, internet, electronic portfolios, and web-cams), ease of access to alternative learning environments (field trips, virtual tours, and virtual reality), and the overall number of computers available in the school.

While our participants were concerned with their access to sufficient resources, of equal

importance were their beliefs about access to support services, as well as timely and appropriate professional development. Access to support and professional development appeared to be directly related to the preservice teachers' comfort level with computers. For example, one participant stated, "I do not feel I have the necessary training to incorporate technology into the classroom." We found the preservice teachers who held the view that there would be little or no resources believed that support services and professional development were necessary conditions for innovation and that, without access to resources and support, innovation was difficult and unlikely to occur. In contrast, our preservice teachers who did not perceive lack of resources as obstacles tended to write statements that embraced innovation. This is because they believed being innovative involved the effective use of all the resources at their disposal.

3.3 Theme 2: Beliefs about the Role of Technology in Teaching: Making Curricular Decisions.

Consistent with prior research (Pajares, 1992), our findings suggest our preservice teachers came to the program with a number of preconceived, deeply held beliefs about what it means to be a teacher. We found their beliefs about what it means to be a teacher had important consequences for their view about the role technology plays in the classroom. For example, our preservice teachers' beliefs about the role technology plays in designing and delivering innovative instruction reflected their perceived importance of technology to many sectors of society. Some of the statements we found our preservice teachers reflecting the view that in order to fully participate in 21st century society, citizens will need to have mastered the skills necessary to make use of the new technologies. In their statements, they observed how school districts have responded to societal pressures and equipped their classrooms with the necessary hardware and software, so that students are prepared to meet the demands of living in an "information age." Many of these preservice teachers contended their children's needs could be met simply by their frequent exposure to technology. In some cases they appeared enamored by the 'bells and whistles' of technology. These preservice teachers were arguing that part of the responsibility of teachers is to ensure their students are keeping up with the tasks they will face as citizens; in other words, technology as the curriculum.

In contrast, some of our preservice teachers argued the value of relying on the "tried and true" methods and media they had experienced as students believing that the "old way is the best way." When they wrote about their future implementation of a piece of technology, they did not match their technology choices with the curriculum. Sometimes, they explicitly argued all student needs could be met using traditional instructional media. Ultimately, when they described the instructional choices they would make, they seemed oblivious to the demands of the curriculum and needs of their students. In this case, technology use was described as accessory to the curriculum. A third view about the role of the teacher emerged from the philosophy statements. A small group of students stressed the need for considering the entire range of technologies available when making instructional decisions, basing their choices on curricular goals and student needs. These preservice teachers evidenced thinking 'outside the box.' One participant noted, "My teaching practices will be shaped by the new aids and programs that help teachers make curriculum more accessible for different types of

students. These types of technology, along with teaching skills, will work together in shaping a classroom that is open and nurturing towards every student." These students argued the curriculum and their children's needs should drive their decisions about technology integration. They believed that technology could be used to address the individual differences among children, could be used to create nurturing learning environments, and design interesting learning activities; technology was represented in their statements as a vehicle for curriculum. As one participant explained, "I need to be open to new possibilities and understand what the needs of my students are and how best to meet these needs using the technology and resources available to me." In their philosophy statements, these preservice teachers were able to effectively integrate their understandings of access, children's needs, and curriculum when making decisions about the role technology would assume in their future classroom.

3.4 Theme 3: Beliefs about the Role of Technology in Promoting Learning.

When asked to consider the role technology and innovation can play in learning, our students considered dual roles for technology: facilitating students' cognitive and socio-affective development and facilitating effective teaching (See Table 1). Regarding their future children's cognitive development, our preservice teachers most frequently noted the potential benefits of utilizing technology to help build on children's prior knowledge and to increase motivation in the classroom. One student noted, "My students will benefit from using technology by learning patience, adaptation and coping skills, integrating new schemes into their [existing] knowledge, and becoming familiar with computers and the Internet in a world that is increasingly dependent upon them." Our students explored how technology could be used to increase the amount of time children spent working on instructional material by using software programs to reinforce, rehearse, and organize information presented in class. In this way, innovation might represent a means of employing memory strategies to increase student work. However, our students also recognized the important role of technologies in capturing and maintaining children's attention, as well as increasing children's interest. Likewise, several students recognized the potential of technology integration for fostering cognitive flexibility. Specifically, they explored the possibility of utilizing technologies to provide opportunities for students to elaborate their ideas, to produce creative work, and to develop higher order or abstract thinking skills.

Many of our preservice teachers explored the potential role of technologies in supporting socio-affective development. Our participants frequently commented on the potential of technology to support making connections and increasing communication between children and adults. One student stated, "They could set up a pen-pal system with a neighboring school and share their thoughts on school and social events with these students. At the end of the year they could have a party with the neighboring school to meet their pen pals that they have been communicating with throughout the year." Specifically, they discussed the role of the Internet in building relationships between children and teachers, among students, and with parents. An example of this is evident in the student statement, "On my teaching portfolio I can have students go to the site to look up assignments, grades, and/or games to reinforce their knowledge. I can also make it accessible for parents. They can view how their children

are doing and e-mail me if they have any questions, concerns, and/or suggestions." Another student noted, "Students could keep personal logs of how they are feeling that day and how they are feeling about their success in school. At the end of the year they could print it up and make their own personal diaries for them to keep and view later in their school years."

Additionally, a few students noted the potential of technologies to provide opportunities for students to experience diversity. We also found that our participants explored the ways in which technologies could support the teaching and learning process by helping them to become more effective as teachers and by enabling them in the creation of unique learning contexts (See Table 1). Our participants frequently noted the potential of technologies to save time and increase their efficiency in the classroom. Specifically, our preservice teachers recognized the utility of using technologies to store lesson plans and grades, as well as to regulate student behavior. For example, they discussed the use of technologies such as PowerPoint to create presentations and lessons. Moreover, they recognized the power of the Internet as a resource to help them find ideas and lessons, information about their curriculum, possible "teaching strategies" to use in the classroom, and to conduct general research. One student noted, "The Internet can keep me updated on all the newest research regarding my students' cognitive, social, and emotional characteristics and how to best educate them using these new theories and idea." From this perspective, our preservice teachers may be recognizing the role of technologies in supporting the process of lifelong learning within the domain of teaching.

A number of our students recognized the potential of integrating technologies in order to create unique learning contexts. One participant noted how the utilization of technologies could be used to support student research and assessment, "A good thing about taking exams on the computer is that they can find out their grades after they complete the exam. I would make sure that I modify the assessments to adjust to each student's needs/abilities." Moreover, many participants noted the potential of activities that integrate technology for providing opportunities to explore, to create challenges to children's current understandings, and to foster the creation of a supportive class climate that supports individual, as well as group learning.

Unique Perspectives in Preservice Teachers' Conceptions of Innovation

When attempting to classify the preservice teachers using the themes, we noticed how preservice teachers' discussions of technology and innovation (e.g. Appendix 1, Step 4) were embedded within their philosophy of teaching and learning (Appendix 1, Steps 1–3; see also Dawson & Heinecke, 2004). Therefore, we broadened our examination of the data to include the preservice teachers' entire philosophy statement. We then sorted our preservice teachers based on the views reflected across the three themes (e.g. Table 1), salient attributes of their philosophies of teaching and learning (Steps 1–3), and the unique relationships we found in each of their profiles. Based on this sorting we identified five unique conceptions of innovation and innovative teaching in our data. Table 2 provides a profile for the five unique conceptions including the ways in which preservice teachers holding each conception shared similar views regarding their attitudes toward technology, the role of technology in teaching

and promoting learning, and their philosophy of learning.

Table 1. Table of shared conceptions including themes, sub-themes, and characteristics across preservice teachers' philosophy statements.

Themes & Sub-Themes		Exemplary Quotes from Data
Beliefs about the Facilitators and Inhibitors of Technology Integration		
Attitudes Toward Technology		
	Definition of Technology *Comfort Level with Computers* *Ability and Willingness to "keep up" with technology*	"By technology, I also mean the ability to adapt their teaching so that it can be most effective to a student's learning. As a teacher, I will constantly seek new technology as well as new means of teaching my students so that they can learn the most from my classroom.
Beliefs About Technology Resources		"To be an innovative teacher, I will have to be up-to-date on the most beneficial forms of technology and will have to know the most effective ways to implement them into my lesson."
	General Access to Technology *Access to Traditional and Popular Technologies, as well as alternative learning environments.*	
Beliefs about the Role of Technology and Innovation		
Technology's Effect on Curricular Decisions	*Match with Curricular Needs* *Thinking "Outside" the Box*	"My teaching practices will be shaped by the new aids and programs that help teachers make curriculum more accessible for different types of students. These types of technology, along with teaching skills, will work together in shaping a classroom that is open and nurturing towards every student."
Technology's Role in Addressing the Needs of Children	*Addressing Individual Differences Creating Nurturing Learning Environments* Providing Interesting Activities	"I need to be open to new possibilities and understand what the needs of my students are and how best to meet these needs using the technology and resources available to me."
Beliefs About the Relationship of Technology and Innovation to Teaching and Learning		
Technology's Role in Fostering Children's Development		
	Technology's Role in Fostering Children's Cognitive Development	"My students will benefit from using technology by learning patience, adaptation, and copying skills, integrating new schemas into their (existing) knowledge, and becoming familiar with computers and the Internet in a world that is increasingly dependent upon them."
	Technology's Role in Fostering Children's Affective Development	"Students could keep personal logs of how they are feeling that day and how they are feeling about their success in school. At the end of the year, they could print it up and make their own personal diaries for them to keep and view later in their school years."
Technology's Role in Fostering Effective Teaching	*Increasing Effective Instruction*	"I hope to create real-world lessons incorporating the use of technology and being flexible enough to adjust the curriculum to the needs of the students."
	Creating a Learning Context	"When content is delivered in an attractive way, children understand better and are more motivated."

To understand the how preservice teachers' conceptions of innovation and innovative teaching were related to each other we developed a grounded model (Figure 1). In the model, the preservice teachers' conceptions of innovation and innovative teaching are represented as a series of rings. We chose a "target" as a visual metaphor in order to depict how each view, or ring, represents a qualitatively different conception of innovation, with some views of innovation more aligned or valued with the conception of innovation and innovative teaching held by the field. Starting from the outer ring and moving inward, these views include *Resistance to Innovation*, *Awareness of Innovation*, *Exploration of Innovation*, *Identification with Innovation*, and *Integration as Innovation*. This is why as we move from *Resistance to Innovation* towards *Integration as Innovation* we move closer to the center of the target. Lastly, four arrows are depicted as converging towards the center of the target. Each arrow represents an underlying dimension contributing preservice teachers' conceptions of innovation. In the following sections we describe each conception and discuss the ways in which preservice teachers' understandings along one dimension drove their conception of innovation.

Preservice teachers classified as *Resistant to Innovation* argued across their statements that, 'the old way is the best way.' We labeled students as resistant based either on their decision to omit, from their philosophy statements, any discussion of the role innovation plays in learning (despite it being an explicit component of the task) or on their view that all children's needs could be met using traditional instructional media. We believe these students may be driven by a fear of technology or a lack of confidence in their abilities to use technology (see also "Laggards" in Rogers, 1995). These students tended to hold very teacher-centered philosophies of learning, focusing on themselves and their roles as teachers, rather than discussing the needs of the children in their class. This idea is exemplified by the student quotation, "I think it is the teachers' role to set up the conditions conducive to learning and support the kids as they teach themselves." Because of their teacher-centered focus, they view the integration of technology as a mandated, inconvenient, time-consuming, addition to the curriculum. Because of these beliefs, we anticipate these students are likely to resist the pressures to integrate innovative methods and technologies advocated by their teacher education programs, their schools, and their districts (See Table 2).

Preservice teachers who professed an *Awareness of Innovation*, believed "innovation is using technology." They were driven by the belief that children need to know about technology in order to become competent citizens and often espoused the belief that technology instruction should be the curriculum. These students were very aware of the "newer" technologies and tended to place a higher value on exposure to these popular innovations. Because of this, they believed children's instructional needs could be met by simply providing frequent exposure to technology. While they felt that technology could support learning, there was often no support for "how" or "why" a particular technology might support learning. They also saw limited access to technology as a major barrier to integrating technology into the learning environment. We believe this may cause apathy or indecision regarding the integration of innovative practices in their future classrooms (see Table 2).

Preservice teachers who were beginning to *Explore Innovation* tended to view, "innovation as being an efficient teacher." They often discussed the difficulty of staying current with the continually accelerating pace of technological change. Their philosophies often emphasized the "active" nature of learning and the importance of involving children in "hands on" technology activities. Many reported concerns of having children in their classes who would be more technologically savvy than their teachers. Similar to preservice teachers who held an *Awareness* view, the preservice teachers who endorsed *Exploration* tended to place higher value on integrating popular innovations in their instruction. Unlike preservice teachers who held an *Awareness* view, *Exploring* preservice teachers tended to be more confident about their abilities to use technologies in their classroom; thus, their philosophy statements were loaded with multiple examples of how they might use technologies in the design of their instruction. Unfortunately, many of these preservice teachers exhibited limited or incomplete understandings of learning and developmental theory. While they could list the central concepts they identified as relevant to their teaching their understandings of these concepts were limited in that they were not yet able to articulate how these concepts might influence their instruction. In general, these preservice teachers had good ideas for technology integration but their examples were inconsistent with the developmental needs of the children they anticipated teaching. Moreover preservice teachers who were *Exploring* often held perceptions of unlimited access to technology. We believe these preservice teachers were enamored by the 'bells and whistles' promises of new innovations. We saw them as integrating new methods and technologies at all costs; potentially rushing in, embracing each new innovation with limited thought for the needs of their children and goals of the curriculum (see Table 2).

What characterized our preservice teachers who *Identified with Innovation* was their clear application and articulation of learning and developmental theory in understanding the anticipated population and instructional demands of their future classrooms? These preservice teachers excelled in identifying relevant concepts, situating these concepts within the context of their future classroom, and synthesizing their understandings across cognitive and affective developmental domains. Moreover, they endorsed the belief that "innovation is being an effective teacher." From this perspective, curricular goals and children's needs were viewed as the priority for making decisions about how to integrate new technologies. Similar to preservice teachers who were *Exploring Innovation*, they expressed openness towards novelty, endorsing a role for technology in education. However, while they possessed a teaching philosophy that emphasized being effective and innovative, they continued to hold somewhat traditional views of what role technology could play in meeting children's need and curricular demands. We believe this may reflect their limited views of what technology is or what technology could be. These preservice teachers appeared unaware or unclear about their access to, as well as the types of instructional resources available. Thus, they struggled when the task demanded they hypothesize about how technology could foster their children's learning and development and what steps they would take to become innovative. Frequently, their synthesis of method, with needs, and with media held inconsistencies or contradictions that we believe may reflect their uncertainties about how to merge these understandings (see Table 2).

The last view we identified among our students, *Integration as Innovation*, reflected an understanding of innovation that went beyond the narrow view that equates technology with media. These preservice teachers saw, "innovation as a process of lifelong learning and continuous improvement" (See Table 2). We characterized them as 'teachnologists(Note 1),' future teachers who envisioned a seamless blend of teaching with technology. They appeared open to novelty, exuded confidence in their abilities to work with technology, and held a view of innovation that was liberated from any specific form of media. As with *Identified* preservice teachers, *Integrated* preservice teachers espoused the belief that the needs of children and of the curriculum should drive the decisions they make about the media, as well as the instructional methods they choose. These students also tended to express a liberated view of access in which they reported they would not only use all resources available, but would also explore the possibility of new resources. In this way they tended to view technology integration as shaping how they would more effectively teach (see Table 2). These preservice teachers expressed views of technology, innovation, and innovative teaching most aligned with the field of educational technology.

Table 2. Unique conceptions of preservice teachers' understandings of innovation and innovative teaching.

Understanding of Innovation & Innovative Teaching	Attitudes about Technology: Facilitators & Inhibitors	Role of Technology in Teaching: Curriculum and Students' Needs	Role of Technology in Promoting Learning & Development	Philosophy of Teaching & Learning	Exemplary Quotes from Data
Resistance to Innovation: *The old way is the best way.*	Driven by a fear of technology or a lack of confidence to make use of technology. May express feeling "forced" to integrate technology.	All children's needs can be met using traditional instructional media.	May hold the belief that technology/innovation does not /cannot affect learning.	If does have articulated teaching philosophy, likely to be dominated by a teacher-centered, passive view of learning.	Teachers did not mention of the use of technology nor what it meant to be innovative in their philosophy statements.
Awareness of Innovation: *Innovation is Using Technology.*	Driven by the belief that children need to know about technology to be successful. Places higher value on "popular" technologies as more effective. May perceive either limited or	Technology instruction viewed as the curricula. Children's needs can be met by frequent exposure to technology.	Children learn from technology because they are interested in technology. Technology as classroom management.	No articulated link between technology integration and philosophy of learning.	"My main goal as a special education teacher would be to keep the children's attention and computers just may help me in doing that." "Our world is very dependent on technology and it will only continue to

	unlimited access to technology.				grow as the years go by."
Exploration of Innovation: *Innovation is Being an Efficient Teacher.*	May talk about the difficulty with keeping up with pace of, or children's knowledge of, technology. Likely to feel somewhat confident with technology. May perceive unlimited access to technology.	Access to technology may drive curricular decisions. Children's curricular needs are peripheral to the goal of technology integration.	Not able to articulate HOW technology integration benefits learning and development. Not able to articulate HOW technology integration benefits instruction.	Developing a philosophy of teaching (may have misconceptions about instruction, developmental appropriateness, etc.) Technology integrations will be inconsistent with articulated teaching philosophies.	"To be an innovative teacher, I will have to be up-to-date on the most beneficial forms of technology, and will have to know the most effective ways to implement them into my lessons." "Innovation is being an efficient teacher or student".
Identification with Innovation: *Innovation is Being an Effective Teacher.*	May express openness towards novelty. Likely to have a limited view of what is/can be technology.	Both curricular and children's needs drive decisions about technology integration.	Recognizes the diverse benefits of innovative instruction. No specific prescriptions about HOW to integrate technology to shape teaching and learning.	Developing a philosophy of teaching (may have misconceptions about instruction, developmental appropriateness, etc.) Technology integrations will be inconsistent with articulated teaching philosophies.	"Technology will shape how I teach." "Technology is something that comes up every day of my teaching career."
Integrated view of Innovation: *Innovation as Lifelong Learning and Continuous Improvement.*	Expresses a confidence and interest for working with new technologies and methods. View of innovation is "liberated" from any specific form of technology.	Both curricular and children's needs drive decisions about technology integration.	Views technology integration as shaping how we teach.	Philosophy of learning will drive decisions about technology.	"I hope to be an innovative teacher, creating real-world lessons incorporating the use of technology and being flexible enough to adjust the curriculum to the interests of the students."

Drawing inward across the target and touching each ring are the three themes we identified throughout our data (*Attitudes and Beliefs, Role of Technology in Teaching: Making Curricular Decisions, & Role of Technology in Teaching and Learning*), with an additional arrow reflecting our preservice teachers' developing philosophies of learning. When classifying preservice teachers, we began to identify ways in which the differences we observed in preservice teachers' conceptions of innovation reflected differences along one or more of the four underlying dimensions For example, we found that preservice teachers who held *Awareness* or *Exploration* views of innovation tended to exhibit limited understandings of teaching pedagogy. Specifically, their philosophies might reflect an over-emphasis of teacher-centered pedagogies or misconceptions/misapplications of learning and developmental theory. Thus, these preservice teachers expressed similar views along three of the four dimensions. What appeared to distinguish the preservice teachers' attitudes were their views along the attitudes toward technology dimension. Preservice teachers holding an *Exploration* conception of innovation tended to express more positive attitudes toward technology than preservice teachers who held an *Awareness* view. *Exploring* preservice teachers perceived optimal access to technology resources and argued technology integration would have a positive impact on teaching and learning. Thus, in this case, differences along the attitudinal dimension resulted in preservice teachers expressing a qualitatively different view of innovation. Given the research by Rogers (1995) and Hall et al. (1975), we hypothesize these preservice teachers would need different types of interventions in order to develop conceptions of innovation more fully aligned with the field. While preservice teachers endorsing an *Awareness* conception may still need some attitudinal intervention to challenge some more pessimistic views of technology, technology integration – attitudinal interventions may not be necessary for preservice teachers endorsing *Exploration* views. Moreover, our findings suggest attitudinal interventions for both groups of preservice teachers would be insufficient in truly supporting these preservice teachers in innovative practice. This is because their understandings of teaching pedagogy will limit their creativity in designing technology rich instruction.

Another example of how preservice teachers' abilities to coordinate and integrate across the four dimensions resulted in their expressing different conceptions of innovation can be seen when comparing and contrasting preservice teachers with *Identified* versus *Integrated* conceptions. Preservice teachers holding either of these conceptions endorsed using technology to further children's social and intellectual needs (rather than making technology the focus of their curriculum). They recognized the potential impact of technology on their teaching, as well as their children's learning. Both groups of preservice teachers held positive attitudes toward technology and articulated relatively well-developed philosophies of teaching that reflected student-centered or content-centered pedagogies and they described potential integrations of technology that were developmentally appropriate. However, what differentiated students holding an *Integrated* view of innovation from those simply *Identified* with innovation, is that students who held *Integrated* views exhibited the greatest degree of assimilation across the four dimensions. In other words, their philosophy of learning drove their understanding of the impact of technology and their conception of innovation. Moreover, their confidence in their abilities to learn about new methods and (and if judged necessary,

new technologies) enabled them to not only hold a broader conception of what could constitute an innovation, but also to express a view that innovation reflects a preservice teacher's "state of mind," rather than a preservice teacher's specific technology behavior.

4. Discussion

Our society does not simply need teachers who know how to use computers. We need exemplary teachers who know how to effectively use all the tools at their disposal for the learning benefit of students. Technology in the hands of a merely adequate teacher will lack the experience and thoughtful motivation necessary to embed it with the context of sound teaching practice. Conversely, technology in the hands of an exemplary teacher will not necessarily result in integrated meaningful use. Unless a teacher views technology use as an integral part of the learning process, it will remain a peripheral ancillary to his or her teaching. True integration can only be understood as the intersection of multiple types of teacher knowledge and, therefore likely as rare as expertise (Pierson, 2001, p. 427).

At the outset of this study, our intuition told us that preservice teachers held differing conceptions of innovation, and what it means to be innovative, than experts in the field. Moreover, we were concerned that teacher education courses, designed to promote the adoption and integration of technology in the classroom, that assumed preservice teachers held the same conception of innovation would ultimately fail, despite having the best intentions. This is because teacher education programs would deliver instruction that might mismatch students' needs. A major goal of this study was attempt to describe the ways in which preservice teachers viewed innovation. We believe one strength of this study lies in the sample of first year teacher education students who: 1) as part of their pre-requisite to the program had already completed an initial, skill-development technology in education course; 2) who were currently enrolled in an technology-infused course in learning and developmental theory; and 3) were participants in a community that explicitly valued and provided instrumental and affective support for technology integration. Whereas prior research examining practicing teachers' beliefs about technology has documented limitations on preservice teachers' attitudes and conceptions as somewhat reflective of the actual school culture; our study explored preservice teachers' attitudes while they were immersed in the 'best case' scenario – that is supportive culture, ample resources, opportunities to explore, and instructor modeling. Thus, pessimistic attitudes about resources and impact expressed by our preservice teachers reflect either their *perceptions* of limited resources – not actual limitations. These pessimistic attitudes and limited visions of impact may also be reflective of the more general beliefs about teaching (Pajares, 1992; Tom, 1997) they bring with them to their program. Moreover, as part of this course, our preservice teachers were provided an opportunity to reflect on their exiting beliefs, exposure to and discussion surrounding theory-driven technology integrations, and an opportunity to re-evaluate their prior beliefs in light of what they were learning in their course. Thus, the course attempted to scaffold preservice teachers to use a common language to discuss innovation.

Findings from our study corroborate our intuitions: most preservice teachers in our study held conceptions of innovation and innovative teaching that differ from what the field values as

innovative (Straub, 2009) and the beliefs and attitudes prior research suggests are necessary for preservice teachers to engage in technology-rich instruction (Rogers, 1995; Davis, 1989). As instructors who worked with these students, our first reaction to the findings was to feel disappointed. What had we done wrong? Why hadn't the course worked? Why didn't some students get 'it' – whether the 'it' were the attitudes or the content of the course? But, then our second reaction was one of affirmation – "Yes! *This* is why we did this project - to understand why our students' are not, despite our best efforts, getting 'it'." On the one hand, we believe findings from our study can be use to help preservice teacher educators identify different approaches toward technology and, in turn, develop individualized strategies to meet preservice teachers' needs. Specifically, Figure 1 can be used as a heuristic to assess how preservice teachers' statements about technology and innovation reflect different understandings along the four dimensions (i.e. attitudes, philosophy, curriculum, and impact). Moreover, it can be used programmatically to help teacher educators think about how courses contribute to developing preservice teachers' understandings along these four dimensions. On the other hand, our findings broaden the scope of the problem of technology adoption and diffusion in education from being one of exposure, resource, and skill development to one of challenging preservice teachers' (pre-)conceptions of technology and innovation. In the following sections, we step back from the findings to discuss three views on conceptual change and apply them to understand how we might help these our preservice teachers develop conceptions of innovation that are more aligned with the field.

4.1 Pathways to Conceptual Change: Developing a Concept of "Innovation"

Necessary Domains of Expertise: Alexander (1998) argues that in any domain there are some conceptions that are more valued than others. For example, because the exploration of innovation was contextualized within a learning and development course, the values of innovative methods used to meet students needs, the design of developmentally appropriate and pedagogically sound instruction, and opportunities for students to engage in active learning experiences were held above other conceptions of innovation (e.g. developing technical proficiency, valuing newer, "popular" technologies). Alexander (1998) argues in order to develop expertise within a domain; students must be provided opportunities to develop domain specific content knowledge, relevant strategic processes, and domain specific interest (or motivation). She identified three different profiles of students holding different conceptions, ranging from relative novice to relative expert, within the domain of science (e.g. acclimated, competent, and proficient). These profiles were based upon the relative contribution and development of students' understandings of 1) the knowledge base, 2) the strategic processes, and 3) their interest in the domain.

Alexander's (1998) work encourages us to think about what in the possible landscape defines the "domain" of innovation. In this course, students were mostly provided opportunities to develop a specific knowledge base (e.g. learning and developmental theory) relevant to their conceptions of innovation. Findings from our study suggest the preservice teachers who demonstrated the greatest mastery of learning and developmental theory, who articulated the most sophisticated philosophy statements and the most complex understandings of curriculum, and who had the most evolved conceptions of technology tended to hold

conceptions of innovation most aligned with the field. Thus, courses and programs that seek to develop students' expertise in these four areas are most likely to create contexts where students might experience shifts or changes in their concepts of innovation.

4.1.1 Reflecting versus Owning

How much can we trust what our preservice teachers wrote in their philosophy statements? It may be that many of our preservice teachers *believed* what they wrote, but at times when we were reading their philosophy statements, we could not be certain our students had truly bought into what they were writing. These concerns were echoed by colleagues who challenged whether our students might simply be performing an academic exercise, or worse repeating what they thought their professors wanted to hear (i.e. peripheral conceptual change; Sinatra & Dole, 1998). We thought about the nature of our data and its relationship to findings from our earlier studies in which many of our students openly expressed "apathetic" or "resistant" attitudes towards technology education at the start of the course (Davis, Ring, & Ferdig, 2002; Davis & Ring, 2003). Indeed, we suspect that for many of our preservice teachers, the explicit value of "innovative teaching" may not only have represented an external value; but also one that might threaten or challenge their existing views of themselves as teachers (Gregoire, 2003). These perceived external presses, combined with a lack of confidence with technology, might result in what Gregoire calls stress, challenge, or threat appraisals of technology experiences. In other words, even the mere discussion of technology and innovation may have inherently challenged their naïve understandings of *what is* a teacher and *how* a teacher acts. Gregoire argues that in order for belief change to occur, preservice teachers must come to see the value (i.e. innovative teaching) as relevant to their sense of "self." While many of our students reported innovative technologies and methods might support their students' learning and development, few reported innovative methods and technologies that could be used to support their own learning and development. Gregoire might call this a "benign-positive" appraisal of the context (p.166, 2003). In light of these types of appraisals, preservice teachers may lack the necessary motivation for central conceptual change.

At what point does integrating technology become a self-determined activity (Ryan & Deci, 1985) for preservice and practicing teachers? And how can teacher educators facilitate the aligning of the value of innovation with preservice teachers' sense of self? In that we classified so few of our students as holding an *Integrated* view of innovation, and in that we were unsure of the commitment of our students to the views endorsed in the philosophy statements, we wondered how we could judge the "success" of a course explicitly designed to promote the types of behaviors (integrated teaching methods, infusion of technology) exemplified by alignment with the value of innovation? What roles might our activities have played in supporting students' "owning" rather than simply "renting" a philosophy about teaching, learning, and innovation?

Sinatra and Dole (1998) argue there are two pathways to conceptual change: peripheral and central. Peripheral change tends to reflect more superficial processing of new information about a concept while central change occurs when there is more effortful, elaborative

processing of new information. Peripheral change can occur when students process information based on a credible source, in the presence of a temporary reward, or to accommodate contextual constraints. In contrast, central processing where preservice teachers critically evaluate their existing conceptions in light of a new concept, can lead to more permanent conceptual change. On the one hand, the journaling and philosophy statement activities were designed to 'push' our preservice teacher to engage in more elaborative and effortful processing of knowledge related to their understanding of innovation. However, in evaluating the data, we wondered whether the activities may have served as a peripheral cue (or temporary reward/accountability structure) supporting only superficial change. In other words, were the discussions and journals too broad, given what we know now about the specific domains? Are discussions and journaling activities enough?

On the other hand, Kelly and Green (1998) argue that in order for students to develop new conceptual ecologies, in other words experience central conceptual change, they must engage in conversations within the culture about the concept and ultimately learn to articulate beliefs that mirror the existing cultural conceptions. In other words, a critical step in changing preservice teachers' conceptions of innovation may be to 'force' reflection on and the articulation of the values held by their instructor and teacher-education program. Kelly and Green (1998) suggest that students may benefit by providing them with a discourse, or framework, that will enable them to articulate their existing views while at the same time press them to confront cultural norms about innovation. Moreover, activities such as group discussions, electronic discussion boards, reflective journals, and the sharing of written products will be more likely to promote more permanent change if they press students to reconcile why cultural norms exist. Simply experiencing the discrepancy between their own views/skills and the views/behaviors encouraged by their culture is not enough. Outsiders to the culture must be engaged in negotiations in which they will ultimately reconcile the discrepancy between the two ecologies in a way that matches existing cultural practices. "The key problem facing educators is how this cultural negotiation or transmission will occur; that is how, in what ways, under what conditions, and with what outcomes will students and scientific knowledge and practices come together" (Kelly & Green, 1998, p. 156).

4.1.2 Spiraling the Technology Curriculum

Previous research has documented that interventions designed for long term conceptual change may not bring about immediate results (Gregoire, 2003). Upon closer examination of our model (see Figure 1), we realized that in order to be aligned with the field's conception of innovation, preservice teachers need to develop a multi-dimensional concept; in which each dimension they are attempting to integrate is, itself, multi-dimensional. In this sense, students are being asked to develop a concept that has at least two levels of abstraction. These findings parallel those of Ertmer (1999), who argues the integration of new technologies are not readily assimilated into teachers' existing routines because change is required along multiple dimensions of practice (e. g., personal, organization, pedagogical). Changes that are required can be categorized as one of two types. First order changes merely adjust teachers' current practice, making it more effective or efficient, leaving underlying beliefs unchallenged. In

contrast, second order changes confront educators' fundamental beliefs about current practice, leading to new goals, structures or roles (Ertmer, 1999).

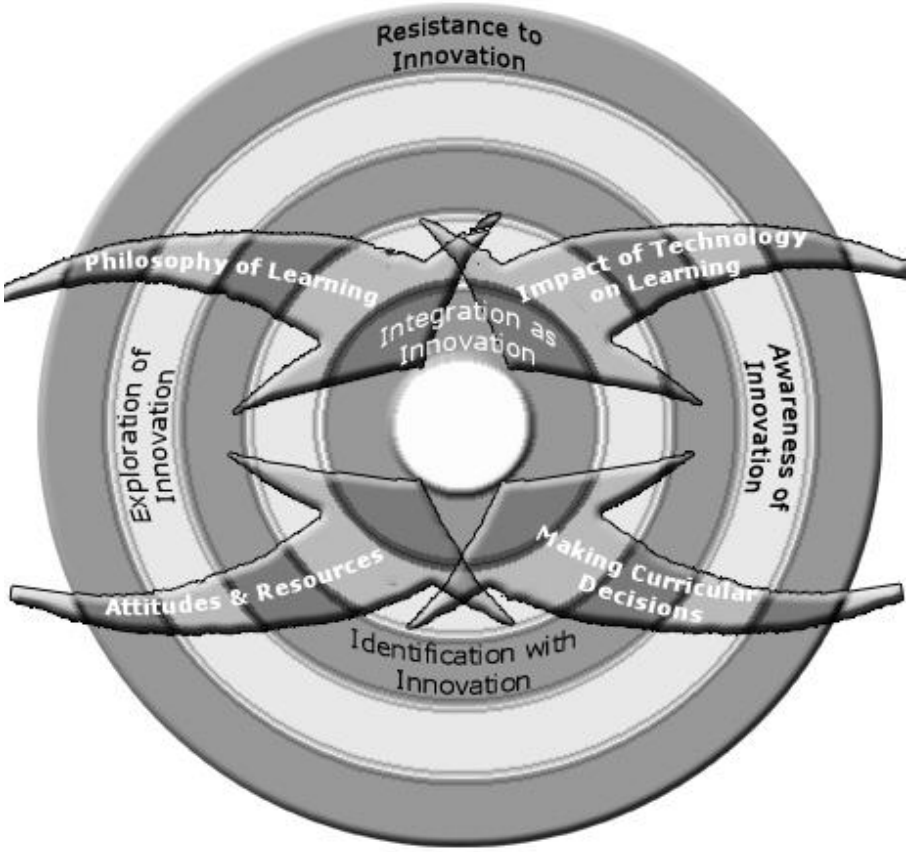

Figure 1. Grounded Model of Differences in Preservice Teachers' Beliefs About Innovation.

Is it reasonable to expect second order changes, and the kind of synthesis, abstraction, and integration necessary for central conceptual change, from 1st semester preservice teachers? If conceptual change is truly a slow process, particularly for elaborate conceptions, then how do we evaluate success in promoting change within a single course or across a teacher education program? This may be particularly true of technology education where by preservice teachers may need multiple opportunities (both successes and failures) to reconcile contradictions across dimensions. Moreover, we wonder what role different pathways to change, different discourses and integrations, may play in sustaining preservice teachers as they face resource, attitudinal, and conceptual obstacles. Is change on certain dimensions more critical than along others? Does early change along one dimension promote different "types", or "rates" of conceptual development? Throughout the following year and half of course work, our preservice teachers would be provided different opportunities to develop domain specific knowledge bases (e.g. content courses) as well as strategic processes for integrated teaching (e.g. integrated semester in math, science, and technology). We wondered: How will students who participated in our innovation experience their subsequent preservice teacher education

courses? Future studies may want to examine whether the sequence of exposure to a specific discourse (Tom, 1997), including opportunities to develop mastery of this domain initially, versus exposure to opportunities to develop technical, or content-specific proficiency is important in shaping teachers' understanding of innovation.

On the one hand, we might ask, are these preservice teachers ready to be immersed in a course that provides technology experiences? According to Gregoire (2003), immersion in educational technology courses too early, and without addressing affective and motivational concerns, may be perceived by preservice teachers as a challenge or a threat to their developing identities as teachers. Thus, from this perspective, providing early opportunities to reflect on beliefs about teaching, learning, development, and technology may be necessary in promoting permanent change in beliefs. On the other hand, if we do not attempt to integrate early, and model our "cultural values/conceptions" of innovation, how can we expect our preservice teachers to internalize values many of them may not share (Ryan & Deci, 1985). Our findings suggest there isn't an easy answer to this question. Some students (*Exploring, Identified, Integrated*) may indeed be ready to be immersed in courses that provide technology experiences. Because students in these courses have positive attitudes toward technology and toward themselves as technology users, instructors may be able to assist them in developing integrated understandings of learning and instruction. However, preservice teachers who are *Resistant* and *Aware* may not be ready to be immersed in technology-rich courses. Without support, these experiences may leave them feeling more threatened, and more resistant to integration. Hence, it is critical to determine the most appropriate time in a preservice teacher education program to provide opportunities to explore technology and push preservice teachers to confront what it means to be an innovative teacher.

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Note

Note 1. This keyword has been used before in the literature in technology education (see also Shih, 2000) though not in the same context.

Appendix

Appendix 1. Developing a Philosophy of Teaching

Child Development for Inclusive Education (EDF 3115)

Part 3 Final EXAM / Final WEBCT

Developing a Philosophy of Teaching

Final Exam and Final WEBCT Posting (for April): Your task is to construct your *second* draft of a philosophy of teaching based on the theories of learning, development, and individual differences that we have studied. I consider this a second draft because throughout the semester we have been reflecting on our views of learning. Use your required journals to construct this next articulation of your beliefs. This philosophy will be a dynamic document that you will adapt throughout your progress through the PROTEACH program.

Your Philosophy statement should be both *focused and brief*. I expect you to integrate concepts we have covered throughout the semester. However, you do not need to provide definitions the concepts you integrate. I anticipate most teaching philosophies will range in length from 2 – 3 pages.

Step 1: Consider the population of children you plan to teach (pre-K - 1st, 2nd - 3rd, 4th - 6th, special educator). What do you think are the "typical" cognitive, social, and emotional characteristics of this population of children?

Step 2: How do you think children learn best? In your response I will be looking for your views on the best ways to "teach" and "assess" your students including how you plan to make your lessons and assessments "developmentally appropriate."

Step 3: What individual differences in learning do you think are the *most* important? (Consider the role of intelligence, personality/temperament, culture, identity, social/emotional/moral development, and motivation). What differences do you anticipate?

Step 4: Consider the role of "technologies" in teaching, learning, development, and assessment. Based on your view of learning, how can technology foster your students' cognitive/social/emotional development? What steps will you need to take to be an "innovative" teacher?