Thinking about Thinking: An Exploration of Preservice Teachers' Views about Higher Order Thinking Skills

By

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Abstract

Thinking skills have long been regarded as an essential outcome of the educational process. Yet, research shows that the teaching of thinking skills in K-12 education does not follow a coherent path. Several factors affect the teaching and use of thinking skills in the classroom, with teacher knowledge and beliefs about thinking skills among the strongest influences (Snyder & Snyder, 2008; Torff, 2006). Research addresses the beliefs that practicing educators hold about thinking skills, yet little investigation has been done on the knowledge of thinking skills and the factors which influence their understanding at the preservice teacher level. This study examined the knowledge preservice teachers, at a large midwestern university, hold about thinking skills, specifically *Taxonomy of Educational Objectives: Book 1 Cognitive Domain* (Bloom, 1984), and their stated perceptions of the factors influencing those beliefs. Bloom's Taxonomy was chosen as the basis for describing thinking skills as this Taxonomy is frequently used in K-12 classrooms. Using mixed methods, this study gathered data from preservice teachers in a teacher education program. Data were gathered from the entire sample through a survey and an instrument using instructional vignettes to determine the thinking skill level of K-12 classroom activities, as well as through interviews with a small sample of the participants. Results showed no significant differences in determining the level of Bloom's Taxonomy on the survey vignettes for participant year in school. A difference was found among participants who expressed less comfort in thinking about teaching Higher Order Thinking Skills when choosing the correct thinking level on the vignettes, than the participants who expressed being somewhat comfortable or very comfortable about teaching higher order thinking skills. Interview participants identified influences on their thinking skills, which included challenging high school courses, some college courses, interactions with peers, and student teaching experiences involving Bloom's Taxonomy. More research is needed to determine if expressed

comfort level with teaching thinking skills is a predictor of preservice teachers' ability to differentiate levels of thinking of Bloom's Taxonomy. In addition, research is needed to discover the ways preservice teachers implement higher order thinking skills in their practica.

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and are willing to pay the price to make them come true.

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CHAPTER ONE

INTRODUCTION

> "At the core, it is the knowledge, belief systems, willingness,… that determines whether or not teaching for thinking is to be a primary focus of instruction" (Gruberman, 2005, p. 88).

Conceptual Framework

Critical thinking skills have been declared necessary for people in the 21st century, both in the workplace and in making reasoned choices in daily lives. The Council of Chief State School Officers and the National Governors Association, in the *Introduction to the Common Core Standards for English/Language Arts* (2010), stated that kindergarten through grade 12 (K-12) students should "demonstrate the cogent reasoning and use of evidence that is essential to private deliberation and responsible citizenship in a democratic republic" (p. 3). Appleby (2001) called the ability to think critically one of the lifelong learning skills that should be fostered by the undergraduate-college-student experience. The Council for Chief State School Officers (2010) in the new professional standards for teachers, *Interstate Teacher Assessment and Support Consortium* (InTASC), also stated that "key cross-disciplinary skills (e.g. … critical thinking ...) would be woven throughout the standards because of their importance for today's learners" (p. 6). Critical thinking, or higher order thinking skills (HOTS) as it is more commonly phrased in K-12 education, is seen as vital to our teachers and students both in college and in K-12 schools. However, several issues interfere with the successful learning and development of HOTS among students. Among those issues are several at the crux of the dilemma. This research examined the issues affecting the successful teaching and learning of HOTS and the development of teacher beliefs that shape how and what teachers do in the classroom. Then, the

conjunction of teacher beliefs, preservice teacher belief formation, and thinking skills was reviewed in light of current research findings.

Among the curriculum goals of higher education, critical thinking has long been a universal goal (Bleedorn, 1993; Burbach, Matkin & Fritz, 2004; Snyder & Snyder, 2008). Appleby (2001) called the ability to think critically one of the lifelong learning skills that should be fostered by the overt and covert curriculum of the undergraduate college student experience. Terenzini, Springer, Pascarella and Nora (1995) stated, "It is an appropriate (if not essential) skill for colleges and universities to develop among students" (p. 24). However, attempts to teach thinking skills to college students, including preservice teachers, have not been totally successful, due to several factors.

A major dynamic impacting the teaching of critical thinking skills to preservice teachers appears to be that these attempts are filtered through their already-held beliefs concerning critical thinking (Joram & Gabriele, 1998; Webb, 2005). Beliefs are the unconscious schemas people develop through their experiences and the interpretation of those experiences (Richardson, 2003). The beliefs of teachers are affected by many determinants in their lives, with those beliefs evolving as teachers progress through the initial stages of their teaching careers. Pajares (1992) described teacher belief formation as bound by the K-12 educational experiences of the teachers themselves. Raths (2001) seconded this finding that preservice teachers pass new information through the unknown filters of their prior experiences as students in the school system.

Beliefs are tremendously resistant to change, often due to the length of time they have been held by a person and the unconscious structure of belief systems. Stuart and Thurlow (2000) discovered that preservice teachers would not change their unstated beliefs until they saw the difference in teaching and students for themselves. In a study of elementary preservice

teachers in a mathematics and science methods class, Stuart and Thurlow found that preservice teachers often were unaware of their own beliefs about mathematics, which in turn influenced the methods the preservice teachers chose to teach microlessons. Until the students became aware of their own beliefs through activities and classwork, they did not connect their chosen teaching methods in mathematics with their underlying beliefs about mathematics. The authors reported that the students did not change their actions until they could "see it (the change) with their own eyes" which "confirmed their new beliefs" (p. 118). Their study illustrated the impediment of these often-unrecognized belief filters for information learned in college education courses.

Another aspect affecting students' knowledge and usage of critical thinking occurs during their practica or student-teaching experiences. These experiences in schools provide preservice teachers with a different perspective, albeit one that is based more upon the preservice teachers' practicality of surviving the initial teaching experiences than on understanding the basis for their teaching beliefs. Mahlios (2002) and Webb (2005) found that secondary-education students participating in their student teaching experiences changed their initial beliefs about the role of the teacher, instructional methods, and content due to the pressures to cover content, to manage student behaviors, and to meet the expectations of their cooperating teachers. Earlier, Pajares (1993) had clarified the impression that practicum experiences may tend to mold the preservice teachers' beliefs into the existing school structure and teacher mentality.

Unfortunately, to date, few published studies have examined the beliefs related to HOTS in the preservice teacher. This lack of knowledge is concerning as the preservice teachers of today are the teachers of tomorrow's students. What do preservice teachers believe about higher-level thinking? What has influenced those beliefs? How do they manifest those beliefs in instruction in relation to their educational practices?

The few published studies about preservice teachers tend to show that these teachers have good intentions toward critical thinking, but they do not express comfort with teaching critical thinking. For example, Piccolo (2008) found that preservice elementary teachers "felt the least competent in encouraging critical thinking skills" (p. iv). Harrison (2013) found that preservice teachers did not have clear explanations of their thinking and actions when they used higher-level thinking skills. Likewise, when applying pedagogical knowledge to practice, Isa (2011) discovered that preservice education students in Malaysia planned to use critical thinking in their microteaching, but tended towards the use of less-abstract thinking skills of identifying, categorizing and cause-effect elements. Although preservice teachers may have positive intentions towards teaching thinking, they can comfortably only teach the practices they have learned in their own education coursework or which they recall experiencing as students.

When it comes to the realm of K-12 education, the implications of the beliefs that teachers and teacher educators express about critical thinking as related to their teaching practices are only beginning to be investigated. Their beliefs may be influenced by the students' demographics: socioeconomic status, special education status, and so forth. (Torff, 2006, 2008; Torff & Sessions, 2006; Torff & Warburton, 2005; Zohar & Schwartzer, 2005). Beliefs about critical thinking also appear to be dependent upon the expertise of the teacher, with master teachers expressing more commitment to critical thinking among all their students. However, this practice is not necessarily being followed by new teachers nor ~~and~~ those ~~not~~ considered master teachers (Stronge, Ward, & Grant, 2011; Torff, 2003, 2006, 2008).

Generally, the participants in these studies have typically been practicing teachers. Scant research exploring the critical thinking beliefs of teachers has been published. However, critical thinking is included among the skills stated in the Common Core Standards for both Reading and

English/Language Arts. Since the Common Core Standards are being adopted by many states of the country, critical thinking is seen as having importance in K-12 education.

Statement of the Problem

Critical thinking has increasingly come to the forefront in education in recent years with the acceptance of the Common Core Standards (2010) by many states and the resulting new teacher-education standards espoused through InTASC, "we want students to be critical thinkers, problem solvers" (Hill, McWalters, Paliokas, Seagren, & Stumbo, 2010, p. 4). The Partnership for 21st Century Skills (P21) includes critical thinking and problem solving among the skills delineated as necessary for college and the workforce (Lai & Viering, 2012). However necessary thinking skills are deemed to be for students, issues arise in the teaching and development of those skills.

Among the key issues is the lack of a singular definition of critical thinking. This lack in the K-12 school system leads to a lack of cohesiveness when discussing and teaching critical thinking skills (Bereiter, 2010). Agreement is also lacking about the best way to teach thinking skills to students (Thompson, 2011). Frameworks, such as the *Taxonomy of Educational Objectives: Book 1 Cognitive Domain*, hereafter referred to as Bloom's Taxonomy, exist to provide guidance. Teachers are introduced to Bloom's Taxonomy (Dettmer, 2006) and various thinking skills, often situated within the academic disciplines (Asp, 2001; Willingham, 2007), during their preservice teacher programs.

Additionally, many programs purport to teach critical thinking or higher-level thinking skills with neither a solid awareness of the beliefs held by teachers (Torff, 2003; Warburton & Torff, 2005; Zohar & Schwartzer, 2005), nor definitive information as to the effectiveness of the programs beyond the initial program usage (Beyer, 2001). Without knowledge of teacher

beliefs, the effects of the programs may not persevere. A few studies have investigated the critical thinking beliefs and practices of secondary-level teachers (Torff, 2005; Torff & Sessions, 2006; Ulmer & Torres, 2007; Warburton & Torff, 2005).

Even among teachers who understand the need to teach and use HOTS, discomfort may persist due to other issues in K-12 education. For example, Sezar (2008) noted, "even teachers, who believe critical thinking is essential, feel unequipped to teach those skills" (p. 351). Systemic issues that affect the teaching and use of HOTS include lack of planning time and appropriate materials and the need to prepare students for standardized assessments (Snyder & Snyder, 2008). As they begin their teaching positions, beginning teachers face these hurdles in addition to lacking awareness of their belief structures concerning thinking skills. With a few exceptions (Griffin, 2003; Piccolo, 2008; Sezar, 2008; Stuart & Thurlow, 2000), the beliefs and applications of critical thinking by preservice teachers appear to be largely absent. This background underlies the research questions guiding this study.

Purpose of Study

This study explored the intersection of higher-level thinking-skills beliefs expressed by preservice teachers and their ability to interpret those beliefs in practice. Scant research is available regarding the influences on the beliefs of preservice teachers toward and about HOTS. Several studies investigated the thinking of preservice teachers who were becoming secondary teachers (Pajares & Bengston, 1995), but less is known about the persons who will be teaching elementary children. As the Council of Chief State School Officers (Hill et al., 2010) stated in their paper, *Transforming Teaching and Leading*, "We know from research and from common sense that effective educators are not born, they are grown" (p. 10). Wagner (2010) noted, "For the most part, teachers haven't been trained to teach students how to think" para 7). Teacher

training in the use and teaching of thinking skills must be an explicit element of teacher education (Abrami, et al, 2008). To grow a teacher effective in using critical thinking in the classroom and teaching it, an awareness of the teacher's background beliefs about teaching for critical thinking and its usage for all students must be understood.

Accordingly, this investigation employed a mixed-methods research design to explore preservice teachers' beliefs about critical thinking and their aptitude in identifying those beliefs in classroom scenarios. Two quantitative instruments gathered data from 155 preservice teachers. The Demographic Survey provided data on the backgrounds of participants in relation to thinking skills and teaching plans. The researcher-developed Classroom Thinking Skills Assessment (CTSA) investigated preservice teachers' identification of levels of Bloom's Taxonomy in instructional vignettes. Bloom's Taxonomy was chosen for the levels of thinking on the CTSA due to its prevalence in K-12 education and because it "offers a straightforward way to classify instructional activities as they advance in difficulty" (Duran, Limbach & Waugh 2006, p. 160). Qualitative interviews, from 4 participants, offered insights into the stated influences on HOTS and explanations of future plans and concerns regarding HOTS in teaching. Participants' insights into their current awareness of the application of HOTS in K-12 classrooms, in addition to personal narratives concerning the origins of each participant's beliefs, were analyzed. These initial findings explored the patterns of beliefs these K-12 preservice teachers held about critical thinking, their description of the forces that helped to shape these beliefs, and their identification of these thinking skills in classroom instructional activities.

Research Questions

The following questions were central to the research:

1. How do preservice teachers describe critical thinking?

2. How do preservice teachers identify the thinking level of instructional activities?

Personal Disclosure

My own experiences as an educator of elementary through college-level learners led me to this investigation. In addition to formal training in elementary, middle level, and gifted education, I have many years of teaching experience as a regular classroom teacher, a gifted-program facilitator, and a teacher for struggling students. Part of my time with gifted students involved co-teaching in the regular classrooms. I remember my surprise, as a new teacher, when the students who seemed to struggle with memorization often easily completed the critical thinking activities I taught. This observation seemed so different from the view I had gathered from my own undergraduate classroom experiences: students who struggled with basic learning tasks would not be able to manage higher-level thinking skills. This insight became a defining teaching characteristic for my own classrooms: all students are capable of learning and thinking at higher levels. As I applied for various teaching positions around the country, several administrators told me that I was hired due to my gifted education background. They expected me to use more critical thinking, creative, and hands-on activities with my classrooms of general education students.

Since those early days, I have wondered what other preservice teachers absorbed about the ability of all students to think critically. How would their beliefs translate into teaching experiences with students? What had the preservice teachers experienced that led them to these beliefs? My teaching experiences provided the background canvas, allowing me to understand and relate to the participants in this study.

Summary

Chapter One introduced the topic of teacher beliefs about thinking skills and the lack of research focused on preservice teachers. Chapter Two provides the relevant background into the conceptual framework underlying this study. Chapter Three describes the participants of the study, the research methods, and the pertinent instruments used to gather data. Chapter Four explains the results of the study in terms of the research questions. Chapter Five discusses pertinent conclusions and implications for practice.

Definitions

Higher Order Thinking Skills *(HOTS)*: Those thinking skills generally considered selected from the top three levels of thinking skills in Bloom's Taxonomy of Thinking Skills. They are analyzing, evaluating, and synthesizing or creating.

The following definitions for the thinking skills are adapted from the *Taxonomy of Educational Objectives: Book 1 Cognitive Domain* (Bloom, 1984) and *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives* (Anderson & Krathwohl, 2001). The definitions include the terms from both the original and revised Taxonomies, in that order, for each of the pair of thinking skills. They are arranged from lowest levels of thinking to the highest levels of thinking skills according to the Revised Taxonomy.

Knowledge: Knowledge involves the recall of specifics and universals, the recall of methods and processes, or the recall of a pattern, structure, or setting (Bloom, 1984, p. 201).

Remembering: Remembering is retrieving relevant knowledge from long-term memory (Anderson & Krathwohl, 2001, p. 67).

Comprehension: Comprehension is making use of material or an idea being communicated without necessarily relating it to other material or seeing its fullest implications (Bloom, 1984, 204).

Understanding: Understanding constructs meaning from instructional messages, including oral, written, and graphic communication (Anderson & Krathwohl, 2001, p. 67).

Application: Application is using abstractions, in particular, and concrete situations; the abstraction may be in the form of general ideas, rules of procedures, or generalized methods, including the application of technical principles, ideas, and theories (Bloom, 1984, p. 205).

Applying: Applying is carrying out or using a procedure in a familiar or unfamiliar task (Anderson & Krathwohl, 2001, p. 67).

Analysis: Analysis is the breakdown of a concept or created work into its constituent elements or parts so the relative hierarchy of ideas is made clear and/or the relationship between the ideas are made explicit (Bloom, 1984, p. 205).

Analyzing: Analyzing is to break material into its constituent parts and determine how the parts relate to one another and to an overall structure or purpose (Anderson & Krathwohl, 2001, p. 68).

Evaluation: Evaluation is using criteria to make quantitative and qualitative judgments about the value of material and methods (Bloom, 1984, p. 207).

Evaluating: Evaluating is to make judgments based on criteria and standards (Anderson & Krathwohl, 2001, p. 68).

Synthesis: Synthesis is putting together elements and parts to form a whole, a pattern, or structure that was clearly not there before (Bloom, 1984 p. 206).

Creating: Creating is to put elements together to form a coherent or functional whole; reorganize elements into a new pattern or structure (Anderson & Krathwohl, 2001, p. back cover).

CHAPTER TWO

REVIEW OF RELATED LITERATURE

In order to investigate this topic, several background areas of issues in the field were reviewed. First, the area of teacher belief formation was scrutinized to develop appreciation for the context of this developing field. Then, the area of critical thinking was examined in order to understand the depth of this topic, its points of dissension, and its value in the education field. Finally, existing literature about the impact of teacher beliefs on critical thinking was appraised. Special emphasis was given to the conjunction of preservice teacher beliefs in relation to thinking skills.

Theoretical Foundation of Teacher Beliefs

Beliefs provide a structure in which to view the world and interact with people. Beliefs provide a means for people to understand the experiences life offers and to seek causal reasons for especially perplexing events. Macrae and Bodenhausen (2000), in examining recent knowledge from the field of cognitive neuroscience, stated that beliefs "…accumulate gradually through repeated exposure to particular stimulus events" (p. 94). As beliefs are not under a person's conscious control, they can be termed implicit attitudes, and "…are not necessarily available for introspection or control" (Oskamp & Schultz, 2005, p. 67). Explicit attitudes form the basis for opinions, which allow the beliefs to be expressed as a person desires. Beliefs and opinions differ in the amount of conscious control a person has over them and in the ways the person expresses them. Teachers hold beliefs about teaching, about learners, and about the subjects they teach; and they may be unaware of these beliefs.

Teachers' beliefs are not tangibles, but must be inferred from the practices used by teachers. Teaching beliefs affect the knowledge, instruction, and classroom management used

with students. "As a result, visible teaching practices that occur in the classroom, is partly a result of invisible processes that occur in a teacher's mind" (Aydin, Baki, & Kogce, 2008, p. 634). The expression of teacher beliefs directly affects what, how, and when students learn in a classroom. Ertmer (2005) emphasized that "beliefs are far more influential than knowledge in determining how individuals organize and define tasks and problems. This, then, makes them stronger predictors of behavior" (p. 28). Teachers' beliefs influence their interaction with students, their attitude towards and expression of subject matter, and the type of classroom management employed. Since beliefs affect so many elements of teaching, having awareness of teacher beliefs reveals insights into today's classrooms. However, these beliefs begin forming before a teacher begins education courses.

A teacher's view of reality is strongly shaped by the strength of beliefs, so that the prior-held beliefs may overcome training and college instruction. Rather than being a blank slate, ready to absorb the pedagogy and beliefs imparted in education coursework, preservice teachers come to college with many beliefs about teaching. Bullough and Gitlin (2001) explained, "…the beginning teacher brings to teacher education a plethora of often unarticulated and unexamined beliefs about schooling, teaching, learning, and the self as teacher that require scrutiny" (p. 24). These beliefs may be unknown to them, yet the beliefs manifest in unexpected ways when preservice teachers begin teaching. Preservice teachers have developed their teaching beliefs over many years before they even enter a classroom. Beliefs vary in strength with more personal and ego-related beliefs being more resistant to modification (Raths, 2001). Studying teacher beliefs yields several areas for examination, including: construction of beliefs, influences on beliefs, and elements shown to affect belief change. Developing insight into the beliefs preservice teachers hold about thinking skills guided this study.

Earlier-formed beliefs create belief filters for new information received in education coursework. The strength of earlier-formed beliefs makes a person assimilate new information into their own belief structure. A person's past experiences as a student then create an impediment for preservice teachers in using the new skills and knowledge of their education programs (Raths, 2001; Sutherland, Howard, & Markauskaite, 2010). Logic, not persuasion or pointing out holes in a person's belief structure, caused a change in beliefs (Stuart & Thurlow, 2000). Hollingsworth (1989) stated "Differences in prior beliefs became a significant factor in suggesting differential learning of other program concepts as well" (p. 172) for her 14 elementary preservice teachers in their coursework and practice-teaching experiences. Prior-held beliefs cause a rejection of new ideas that do not fit well, making new ideas less likely to be implemented in a new teacher's practice. Material taught in education courses which conflicts with prior held beliefs faces resistance to acceptance and practice.

Construction of Teacher Beliefs

The interactions and experiences of a lifetime create the beliefs that teachers hold about learning, the act of teaching, and their students. Preservice teachers have constructed teaching beliefs over many years before they even enter a classroom. According to Richardson (2003) belief formation occurs in two primary ways: social construction and psychological construction. Beliefs are constructed through both the social interactions a person has with others, including classroom interactions, and the meaning a person gives to those experiences, the psychological construction. Bullough, Knowles, and Crow (1992) explained, "The belief in self as teacher is shaped from interactions with students, colleagues, parents, administrators, and the 'press'" (p. 5). Each interaction a person experiences demands meaning be made for the interaction. The interaction and the meaning given to the experience build upon similar experiences of the person to shape and reinforce the belief the person has about that kind of experience. These similar

experiences form a schema of beliefs, with new experiences being tested against the schema of beliefs held by a person.

Preservice teachers undergo many new experiences as they begin teaching in practicum. Some of the experiences occur at the conscious level, for example managing a classroom. Others, such as socioeconomic differences of students, are experienced at the unconscious level. These conscious and unconscious belief influences can override the knowledge and skills learned in teacher education programs (Burbules, 2008; Hollingsworth, 1989; Kagan, 1992; Pajares, 1993; Richardson, 1997). The influences include personal experiences as a K-12 student, prior experiences with subject matter, and perceptions of teaching made by other close family and friends. "Beginning teachers enter their pre-service teacher-education programmes with partial, but often firmly held, conceptions of themselves as teachers and teaching schema, developed over years of life experiences including thousands of hours spent observing teachers as students" (Bullough et al., 1992, p. 186). Other covert influences interact with teachers' beliefs when they begin teaching. These hidden influences include (a) new teacher orientation (Burbules & Abowitz, 2008), (b) cultural and social backgrounds of teachers (Tanase & Wang, 2010), (c) other life experiences (Etherington, 2009), and (d) the demands of teaching which conflict with a teacher's beliefs (Webb, 2005).

All of these influences shape and modify the belief schema, or structure of beliefs, a person has of teaching. The schema shapes the instruction and interactions teachers have in their classrooms. This belief schema reflects "a model of what the individual believes that teaching is 'supposed' to be" (Bullough et al., 1992, p. 10). The prior-held belief structure of preservice teachers affects their perspectives and actions as they newly experience a teacher's position in a classroom. While prior-held beliefs may not be wrong or bad, the beliefs may not be workable or the most efficient, such as using lecture as the sole means of instruction, in today's schools.

Additionally, our knowledge of teaching and learning has changed over time, necessitating revisions of the image we hold of a teacher.

History of Teacher Belief Research.

Current teacher-belief study advances the early research done in this area over the past five decades. Early cornerstone studies introduced the ideas of belief strength, the lack of college course effectiveness on teaching beliefs, and the influence of early educational experiences. Seminal work from the years prior to 2000 include Kagan's (1992) metastudy of teacher belief research and Pajares' (1993) establishment of the effects of prior experiences. Their efforts led to the study of teacher beliefs today.

Kagan (1992) confirmed the strength of a teacher's early beliefs on teaching, despite efforts to introduce new teaching methods and techniques. Her grounded theory of teacher-belief formation substantiated earlier research on the strength of a new teacher's prior beliefs. This theory confirmed the lack of influence that college courses have on new teachers and preservice teachers. Kagan's (1992) meta-review of 40 qualitative and naturalistic studies, dating from 1987 to 1992, focused on the learning-to-teach process of teachers. The studies of preservice and beginning teachers found that participants held unchanged beliefs across semesters and courses. When discrepant experiences in field experiences or teaching videos were encountered, participants tended to mold the new experiences into their prior-held belief structures. New teachers seemed unable to move past their earliest formed impressions about the act of teaching, unless strong external forces (pupils, mentor teachers, school requirements) compelled changes in understanding the nature of being a teacher. Among the themes Kagan defined was the strength of a teacher's early beliefs on teaching, despite efforts to introduce new teaching methods and techniques. She stated, "The themes extracted from this group of 40 studies are quite consistent with learning-to-teach studies published or presented prior to 1987" (p. 158)

dating from the mid 1960's. The themes defined the impact of the influences on the belief schema of future teachers. These influences on teaching beliefs will be reviewed, with prior experiences as a K-12 student generally being most influential.

Effects of Experiences on Belief Formation.

Beliefs formed from the early and extended experiences as students create the underlying structure for the beliefs one holds as a teacher. Since those who become teachers were students for many years, they enter their new classrooms holding beliefs formed from years of conscious and unconscious observation of teachers. Pajares (1993) clarified that often people who become teachers enjoyed school as children; felt comfortable in the schoolroom setting; and, therefore, unconsciously perpetuated those practices and beliefs they learned as younger students. The beliefs formed early (Richardson, 1997; Stuart & Thurlow, 2000), making them resistant to change despite the instruction given in college education courses (Kagan, 1992; Webb, 2005). Beliefs created over long periods of time are most durable, due to the many reinforcing experiences individuals encounter. The experiences received as a student encompass the curriculum and socialization process of schools.

The early acculturation process of the entire instruction provided by schools may be referred to as tacit teaching. This instruction can be planned or unplanned and includes the knowledge, skills, values, and beliefs of the other individuals in the environment (Burbules, 2008). Tacit teaching received as a K-12 learner forms the foundation of a teacher's beliefs, which lays the groundwork for a teacher's actions in the classroom. "Research on preservice teacher beliefs can provide information on the cognitive processes they use to deal with classroom instruction…how beliefs influence instruction and how students perceive and interpret their own learning" (Pajares, 1993, p. 6). Belief research includes a better knowledge of preservice teachers' beliefs on teaching and using thinking skills. The path a preservice teacher

travels to earn the title 'teacher' offers many opportunities for belief reinforcement or reconstruction.

New teachers complete several programs while becoming licensed to teach. First, teachers generally complete an internship program, or practicum, while becoming licensed to teach. The practicum allows the preservice teacher opportunities to teach and manage a classroom under the guidance of an experienced teacher. The teacher-to-be must follow the guidance of the experienced teacher, as this teacher is responsible for the learning of the students in the classroom. According to Hollingsworth (1989):

> Teacher education programs are traditionally designed in a manner that capitalizes on preexisting knowledge of what schools and classrooms are like, thereby ensuring that preservice teachers turn out to be very much like the existing teaching force. The most predominant model of teacher education takes on an apprenticeship structure, where preservice teachers learn the dominant curriculum in the public schools and the pedagogical methods of teaching that curriculum as apprentices in existing teachers' classrooms. Both the curriculum and the methods tend to closely resemble the preservice teachers' educational backgrounds. Those that differ appear to be washed out in the real world of the classroom. (p. 162)

Preservice teachers who may wish to try new methods learned in education coursework may not have the opportunity in the practicum, as the mentor teacher functions within the school. The mentor teacher must consider the required curriculum, students' backgrounds, her own teaching beliefs, and the school norms in determining the teaching methods the preservice teacher is allowed to attempt (Bullough et al., 1992). Wang, Odell , and Schwille (2008)

discovered from a review of empirical and case studies that "mentors' beliefs of teaching and mentoring can exert both positive and negative impact on beginning teachers' learning, depending on whether mentors' beliefs are consistent with the kinds of teaching that beginning teachers are expected to learn" (p. 147). The preservice teacher's beliefs may be reinforced by the mentor teacher, or new practices and beliefs may be seen as something to try once the teacher has her own classroom. The influence of the mentor teacher may be deeply felt for many years.

Then, once the new teacher is hired, school systems often provide teacher induction programs to acclimate new teachers to the workplace. Teachers new to the profession are influenced by the mechanisms, either formal or informal, used "for initiating and orienting new practitioners into the practice" (Burbules & Abowitz, 2008, p. 268). New teachers may have a formal induction program to complete, or they may find themselves socialized into the school climate through interactions with the already-established teachers. During the orientation and socialization process, new teachers discover they must understand and accept the established norms in order to fit into their new peer group. "School contexts press conformity on the individual" (Bullough & Gitlin, 2001, p. 11). These established norms may fit with the new teacher's beliefs or they may provide contradictions. The cultural and social background of the teacher and the school present fertile ground for belief agreement or contradictions.

A teacher's belief system also evolves from their cultural backgrounds and experiences with people from different backgrounds. The schools attended as a child provide a context for beliefs an individual holds about individuals from other social and cultural backgrounds. Teachers' beliefs may reflect their background from childhood schools that provided little experience with people from other social and cultural backgrounds (Tanase & Wang, 2010). For example, when a teacher begins teaching in a school similar to that attended as a K-12 student, beliefs may be congruent with those of the teachers in the new school. So, the socialization

period may be less stressful than that of a teacher who is teaching in a school quite different from the ones attended as a K-12 student. In addition to cultural and social background, life experience prior to teaching factors into the construction of beliefs.

A teacher who has followed the traditional path of high school-then-college may hold fewer life experiences which cause reconsideration of beliefs. A teacher with an earlier job or career who then transitions to teaching has undergone more situations that bring into question the belief structures formed from prior student experiences. Raising a family or traveling extensively also offers opportunities to see and question prior beliefs. Etherington (2009) conveyed that differences in beliefs are due to life experiences, as well as the age at which the prospective teacher came to teacher education, according to interviews with 10 second-career elementary-level preservice teachers. Likewise, O'Malley Kelley's (2003) descriptive and qualitative study of preservice teachers found that non-traditional students, as compared to the typical college-aged preservice teachers, were better able to balance the expectations, hence beliefs, of cooperating teachers, college supervisors, and parents. Non-traditional students in teacher education applied the information from teacher education courses more than did those of typical college age, being more willing to question their own beliefs (O'Malley Kelly, 2003). Life experiences provide fertile ground for belief confirmation or questioning. Newly experiencing a teacher's position in a classroom, with all the inherent demands upon a new teacher, offers another outlet to reinforce or question prior-held beliefs.

Entry level teachers must contend with many demands that may conflict with their teaching beliefs. New teachers must learn to balance classroom management, other expectations of teachers, and content development for lessons. Webb's (2005) work on the emergent teacher identity found the technical nature of teaching and demands as a subject-matter expert had a larger influence on her four secondary preservice teachers in their field experiences than did their

prior education coursework. The preservice teachers had to meet their cooperating teachers' expectations in classroom management, develop lesson plans, and teach new materials. In addition, the new teachers faced coming to terms with others' views of a good teacher and the influence of their teacher education program (Webb, 2005). The presence of holidays, required testing, parent/teacher conferences and report cards influenced the lives and thoughts on teaching of the 23 student teacher interns in another study (Bullough, 2003). The time and ideas needed to meet these demands conflicted with the beliefs inexperienced teachers carry into their classrooms. For instance, teaching in a constructivist manner, as encouraged by preservice education courses, may be at odds with the expectations of standards-based teaching for assessment. This dissonance makes teaching more difficult as the new teachers may regress to a more intuitive mode of teaching, fostered by their long-held beliefs formed from years as a K-12 student.

Prior experiences in subject matter also impinge on teaching beliefs of preservice teachers. For example, past experiences with mathematics lead to beliefs about mathematics instruction. Teachers who experienced mathematics as skills-based will teach mathematics in a skill-oriented manner instead of trying to build number sense in their students. Teachers who experienced mathematics as interactive, problem-solving experiences tend to teach their own students in that manner (Scott, 2005; Stuart & Thurlow, 2000). The past experiences with a subject shape a teacher's instruction in that subject. Prior mathematics experiences also influence the beliefs a teacher has about their own abilities in mathematics.

Teachers who lack a strong comprehension of mathematics may not believe they are capable of higher level mathematics. So, they teach mathematics at a more comfortable, basic skills level. Guillaume and Kirtman (2010) stated that a teacher's "knowledge base affects mathematics instruction" (p. 124). Their qualitative study (n=144 preservice elementary

teachers) demonstrated the importance of helping preservice teachers understand the good teachers in their lives and the good mathematics practices of those teachers. Those preservice teachers with more positive mathematics experiences, or those who had teachers better able to explain mathematics concepts, were more comfortable when teaching mathematics. The preservice teachers had those memories to draw upon when teaching their own mathematics lessons. The many experiences as a K-12 student impacted preservice teachers in unexpected ways. Besides prior K-12 experiences, another major impression on teaching beliefs comes from significant people in a preservice teacher's life.

Preservice teachers were influenced by discussions with family members and friends who had taught recently. These people provided a personalized context to view teaching that is held in stronger regard than education instructors, who may seem too distant from the actual classroom. The preservice teachers viewed their advice less critically (Scott, 2005). "Everyone believes that their personal experiences and those of people whom they trust are as valid and reliable as inferences made from large-scale studies" (Halpern, 1998, p. 450). While preservice teacher coursework and newer research encourages teaching in particular ways, such as using inquiry in science, influential people sharing disparate experiences may sway the teacher-to-be along different lines. The current teacher may share teaching experiences that were not successful using inquiry. Thus, the views of preservice teachers may reflect several past people and subject matter factors in shaping their teacher beliefs.

All of these influences that shaped a teacher's belief schema provide a belief filter for new information about teaching. New teaching methods taught in college may differ from already-held beliefs. Stuart and Thurlow (2000) found that, although preservice teachers preferred ideas and methods to help them succeed in the classroom, the preservice teachers tended to trust ideas consistent with their own past experiences as students. In their study of

elementary-methods students (*n*=26), the students were resistant to changing their beliefs to those espoused by their college instructors when the instructors' beliefs differed from the students' personal experiences. They found that belief change was due more to a "matter of conversion or gestalt shift than the result of argumentation or a marshaling of evidence" (Stuart & Thurlow, 2000, p. 117, citing Nespors' 1987 article, *The Role of Beliefs in the Practice of Teaching*). Many preservice teachers had to see new beliefs successfully used in action before being willing to adjust prior beliefs (Stuart & Thurlow, 2000). Although preservice elementary teachers may have instruction on various teaching methods, their prior-held beliefs and the realities of teaching experiences may hinder their ability to incorporate new techniques into their teaching repertoire. However, specific intervening techniques effected belief change.

Methods to Effect Belief Change

Interventions, such as reflective writing and specific science programs, provide hope in helping new teachers understand their teaching beliefs and change those beliefs when necessary. The interventions encourage preservice teachers to face their own beliefs by accommodating new methods through cognitive dissonance of prior beliefs. Kagan (1992) stated that "cognitive dissonance was needed to force novices to confront and modify personal beliefs" (p. 163). Cognitive dissonance is the "state of tension that occurs whenever a person holds two cognitions (ideas, attitudes, opinions) that are psychologically inconsistent" (Tavris & Aronson, 2007, p.7). These methods encourage preservice teachers to recognize their own teaching beliefs and see the difference-in-action of new methods. They must either adjust their schema of teaching beliefs to add these new ideas or ignore the new ideas experienced in the interventions. Each of the interventions allowed the preservice teacher to understand new experiences, adjust their beliefs, and examine the implications of experiences in terms of future classrooms.

Reflective writing provides a method to challenge the prior-held beliefs of preservice teachers. Through reflective writing, a preservice teacher describes an incident and attempts to clarify the reasons for the incident and the participants' reactions in light of their new education knowledge. Griffin (2003) found the "powerful influence of prior educational experiences and a varying capacity to think reflectively and critically present potential barriers that preservice teachers face in implementing the knowledge and skills learned in their teacher education programs" (p. 207). Preservice teachers (*n*=28) explored prior-held beliefs by writing reflectively about critical incidents (135 incidents in the areas of discipline problems, student dislike of the subject, etc. reviewed by a three-person panel). The preservice teachers developed insight into the reasons for the critical incidents and their reactions to it through explicit instruction and coaching in reflective writing. The intervention helped the preservice teachers resolve the dissonance between their prior beliefs and their education coursework as discovered in the field experience incidents (Griffin, 2003). The reflective and critical writing assisted the preservice teachers to examine their own beliefs in light of the critical incidents. Another intervention that seems to effect belief change comes from science reform programs.

Specific mathematics and science programs indicate possibilities to implement belief change. Preservice teachers may hesitate to teach inquiry-based science or to use constructivist theory, believing themselves incapable of understanding science content or processes. Marbach-Ad and McGinnis (2009) found teachers were able to maintain their new beliefs and actions after their first two years as teachers after participating in a reform-minded program for preservice teachers, using pre-post measures. The study of 31 elementary and middle school teachers focused on using constructivist theory while connecting mathematics and science topics for their students. Additionally, elementary preservice teachers' beliefs about teaching science changed after the preservice teachers completed an inquiry-based science course (Shim, Young, &

Paolucci, 2010). In addition, the number of undergraduate courses and increasing years as a teacher affect a teacher's belief in ability to teach science, according to a measure of science beliefs (Lumpe, Haney, & Czerniak, 2000). The number of years taught increased the comfort level in teaching science and knowledge of science content. More science courses, as well as specific inquiry coursework in undergraduate years, increased teachers' beliefs in being able to teach science. If increasing years of coursework and hands-on experiences with science improves science teaching, the same effect may be seen with more experiences using higher-level thinking skills.

The Strength of Belief Change

Caution, however, must be observed when seeing immediate belief change in teachers, as sudden belief acceptance does not imply long-term belief change. Teachers experience coursework and training workshops in new teaching methods, which may foster new beliefs about teaching. Preservice teachers begin with college education coursework and practicum experiences, which provide an opening for belief change. Chai, Teo and Lee (2009) observed that preservice teachers' beliefs changed after their practicum experiences to reflect those of traditional teachers' beliefs. They suggested the belief change may be due to the "many uncertainties in their new role as teachers; for example, ill-structured problems in classroom management and relationship building with colleagues and students" (p. 358). The practicum experience led these participants to reverse their beliefs from constructivist learners to more traditional teacher beliefs (Chai et al., 2009). The intense demands of the new experience can disrupt the newly formed belief schema made in teacher education courses. The material may be greeted with enthusiasm, yet long-term incorporation of the material and new beliefs is not ensured.

However, the preservice teachers may not understand the new beliefs generated through coursework and practica. The lack of comprehension creates cognitive dissonance and resistance to the new ideas. Due to this resistance to new ideas, new knowledge may be interpreted in a manner that allows them to protect their existing beliefs (Kuhn, 2000). The newly formed schema of instruction loses to the strength of the prior beliefs about teaching and to the forces vying for the new teacher's attention in the classroom. Likewise, other contextual factors may influence the results of short-term interventions on teacher beliefs.

The personal context of college courses affects the rate and direction of belief change in preservice teachers. The familiarity of the subject matter and rapport made with the instructor and other students influences the knowledge, skills, and disposition a student takes from a course. For instance, Tanase and Wang's (2010) study of four preservice teachers' beliefs found that beliefs may change in the face of semester-long introductory methods-course interventions from the multiple data sources analyzed. However, the researchers pointed out that their study participants brought different beliefs about the role of teacher into the study. In addition, the preservice teachers' beliefs changed asynchronously and not always in the direction the researchers anticipated. They stated, "This conclusion indicates that the influence on preservice teachers' conceptual changes needed to be personalized and contextualized" (p. 1247). Caution is needed in light of short-term interventions and the preservice teachers' long-term interactions with belief structures. Belief change is possible, but initial beliefs must be understood before expecting change to occur with interventions. Although belief change appears promising in the effort to understand the effects of short-term interventions on belief formation, results must be viewed cautiously to see if they withstand the test of time in actual teaching situations.

School-based forces exert a strong force against new belief consolidation into belief structure. Systemic elements in schools, such as administrator expectations for specific

programs and support for new practices may adversely affect continuation of new beliefs. Flint, Maloch, and Leland's (2010) case studies of three beginning reading teachers, over three years of observations and interviews, found two of the teachers were able to maintain their beliefs about literacy practices learned in college due to the flexibility of the programs for which they were hired. The third teacher was unable to maintain her new literacy beliefs, especially in the first two years, due to the specificity of the reading program she had to use. The new program demanded specific teaching methods that countered her prior coursework (Flint et al., 2010). Although a new teacher may believe in his or her training, realities of the actual classroom and school impose constraints on belief consolidation in practice. Incorporation of new belief schema appears to be susceptible to strong outside-of-school demands.

Current school settings and the policies that drive K-12 schools today may be more powerful in determining teacher actions than teaching methods learned in courses. In addition, the demands and policies of today's reality may adversely impact teacher beliefs. Teachers may profess belief in a new program or new methods; however, actual implementation in real classrooms poses difficulties due to the strength of prior beliefs as well as reality's demands.

Yerrick, Parke, and Nugent (1997*)* realized through pre and post interviews, participant journals, and video clips that, although the teachers changed their manner of speaking about teaching science during the program, the practicing teachers merely incorporated the new information into their prior beliefs about teaching science after a summer science institute. "We think there are major forces which influence and often mandate how teachers in our study will teach. School policies, preservice training, strict accountability, rigorous state assessments, teacher socializations, and rural community conservative expectations are among them**"** **(**Yerrick, Parke, & Nugent, 1997, p. 154). Consequently, newly formed or remodeled beliefs may lack the strength to persevere in actual practice under today's requirements. Teachers may

incorporate new beliefs into their current belief structure or lose the new beliefs upon return to the classroom's demands.

While teachers may embrace long-held beliefs about teaching and learning, the actual school setting, as well as specific interventions, may steer a change in beliefs among teachers. The schema structure of teacher beliefs is formed early via experience as a K-12 student, with other forces shaping beliefs during education coursework. The belief structure of preservice teachers affects the perspectives being developed as they newly experience a teacher's position in a classroom. Zohar and Schwartzer (2005) wrote, "Teachers' knowledge and beliefs carry important significance for their practice, and thus influence students' learning" (p. 1596). Several interventions that may lead to belief change in preservice teachers have been followed in research (Griffin, 2003; Marbach-Ad & McGinnis, 2009; Tanase & Wang, 2010). Additionally, the actual school setting and current teaching climate can force teachers to teach or accept practices not compatible with earlier beliefs. However, any belief change must be viewed with the caveat of time. Do these preservice teachers retain their new beliefs about teaching due to the coursework after they have taught for a few years? Beliefs about critical thinking are barely defined in the area of K-12 education. In contemplating thinking skills, what are the beliefs of preservice teachers? Will the beliefs about thinking skills reflect the activities they choose for classroom instruction?

General Constructs of Critical Thinking

Critical thinking (CT) is necessary for most fields of study and many jobs in our world, making education in thinking skills required in K-12 and college education. Yet, CT is misunderstood in college and K-12 education, echoing the confusion extant in the non-education disciplines. A major point of dissension surfaced in the literature, that being: no singular

definition of critical thinking exists due to the varying constructs of critical thinking being dependent upon the discipline. Without a singular definition, one cannot ensure the same construct is being used, or being measured in studies. This literature review examines the issues of critical thinking, first in colleges, then in K-12 education. This literature review does not include descriptions of dispositions in critical thinking, as described by Ennis (1996), as this study did not consider dispositions in relation to preservice teacher beliefs. That is a topic for a future study.

Discipline-Based Critical Thinking

Conceptions of critical thinking extend into several areas of study. These areas include cognitive and behavioral psychology, higher education, philosophy, medicine, and K-12 education (Bailin, 1993; Bereiter, 2010; Gambrill, 2005; Hurd, 2004; Patel & Bean, 2007; Stanovich & Stanovich, 2010). This latest debate over the construct of critical thinking is a continuation of the confusion people from various disciplines argued in prior decades: is critical thinking the same construct no matter the subject area, or are certain critical thinking skills bound specifically to a particular field of study, hence making critical thinking construct bound? Willingham, (2007) cited recent research and stated, "The processes of thinking are intertwined with the content of thought (that is, domain knowledge)" (p. 8). Experts wrestled for many years with this confusion over the multiplicity of definitions for critical thinking, so an attempt was made to reach consensus on a definition. However enlightening the attempt proved for the participants, their efforts have not led to a lasting construct for critical thinking.

Delphi Method

In the late 1980s, the American Philosophical Association endeavored to establish a conclusive definition of critical thinking. Drawing upon the expertise of 46 noted professionals

in philosophy, education, psychology, physics, and so forth, the Delphi Method was used to reach a consensus of their opinions and beliefs on critical thinking. This qualitative research method attempts to reach a consensus of thought on a topic, with the moderator coordinating remarks and questions. Then, synthesized responses are circulated to the entire group for further consideration. With two years of work, Facione (1990) summarized their results, including a group definition of critical thinking:

> We understand critical thinking to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based. Critical thinking is essential as a tool of inquiry. (p. 2)

The group also defined six Core Critical Thinking Skills: (a) inference, (b) explanation, (c) evaluation, (d) analysis, (e) interpretation, and (f) self-regulation. It delineated the dispositions which assist one in thinking critically, then set forth recommendations for incorporating critical thinking into teaching for all secondary students, not only those who are college-bound. Unfortunately, the disparity of conceptions of critical thinking has remained, even after this group reached consensus on their definition.

Constructs of Critical Thinking in Education

Within education, both K-12 and higher education instructors grapple with the dilemma of when, where, how, and what to teach when considering critical thinking. Only "why" is a recognized reason for teaching critical thinking with the calls from subject matter organization and industry (see Chapter One) resounding in educators' ears. Brandt (2001) stated, "There continues to be no single compendium–other than the now somewhat outmoded Bloom's Taxonomy–widely accepted by the various proponents of thinking" (p. xiii). Note that Brandt's

statement was published before Bloom's Revised Taxonomy was well-known. Since no single construct guides the teaching and usage of thinking skills in education, instructors at both the K-12 and college level define thinking skills differently, often on a discipline-by-discipline basis. "The manner in which thinking is assessed will vary across subject areas" according to Asp (2001, p. 497). Other educators see thinking skills as being included in their textbooks so rely on the texts to provide the structure and basis for using thinking skills for students. The lack of a single construct for critical thinking means students receive varied, and not always coherent, practice in critical thinking. Education journals and teacher magazines are equally ambiguous when discussing higher-level thinking constructs.

Education journal articles often do not define critical thinking, seeming to believe that educators know what is being discussed when the term 'critical thinking' is used. The construct often is dependent upon the backgrounds and beliefs of the educator. Sezer (2008) believed these skills are context dependent, as the knowledge one has will impact the type of thinking able to be used. However, Beyer (2001) believed that some educators see critical thinking as using logical analysis or being reasonable. Yeh (2001) described critical thinking as careful argumentation using the type of thinking valued in the workplace. Perhaps in K-12 education, the term critical thinking is misunderstood and viewed as too harsh. Halpern (1998) maintained:

> In the term critical thinking, the word critical is not meant to imply "finding fault," as it might be used in a pejorative way to describe someone who is always making negative comments. It is used instead in the sense of "critical" that involves evaluation or judgment, ideally with the goal of providing useful and accurate feedback that serves to improve the thinking process. (p. 451)

In education, the feedback comes in the form of a grade, or better yet, use of a rubric that delineates the skills and behaviors necessary for successful completion of the task. The lack of

definition within the education journals leaves the construction up to the understanding of the reader. With the definition and comprehension of critical thinking so ambiguous in K-12 education, it is not surprising this conjunction of preservice educator beliefs about critical thinking has not been extensively studied.

No consistent set of vocabulary terms or skills appears for higher order or critical thinking in K-12 education, with the possible exception of Bloom's Taxonomy. Forty years ago, Taba (1971) identified the issue succinctly:

> An objective such as thinking has remained in the realm of "pray and hope" because almost anything from daydreaming to inventing the concept of relativity could be, and has been, classified as thinking. This lack of analysis of what constitutes thinking has naturally resulted in uneconomical and ineffective teaching and learning of "thinking." (p. 220)

Unfortunately, little consistent progress defining the term "thinking" in education resulted. Many terms are deemed synonymous with critical thinking in the education literature.

The term "critical thinking" takes many forms in K-12 education. In a Google Scholar search (scholar.google.com) the following terms arose for "terms for critical thinking in social studies:" decision making, reflective thinking, higher order thinking, critical reading, interdisciplinary thinking, and critical pedagogy surfaced in the literature. When searching for the same term in reading and language arts, the terms critical analysis, critical reading, reasoning, and argumentation appeared in literature. The terms spatial reasoning, reasoning skills, algebraic reasoning, and problem solving, showed up for mathematics. Science synonyms included scientific reasoning, science method, process skills, problem solving, and higher order thinking. Krathwohl (2002) stated, "one must determine the intended specific meaning of problem solving and critical thinking from the context in which they are being used" (p. 218). A construct for

higher level thinking appears to be based within the various disciplines with some terms overlapping. Hence, the thinking skill is applied differently depending upon the subject, making teaching critical thinking confusing and causing issues with transfer of skills across disciplines.

A major point of discussion within the thinking skills community comes when considering how to help students transfer learned thinking skills to other disciplines or to real-life situations. While a past argument dealt with teaching thinking skills as either a separate subject that could be then generalized to other areas (Resnick, 1987), or critical thinking as individual skills delineated within distinct topics (Sezer, 2008), that contentious issue has been converted to the transferability of those thinking skills to other contexts. While many studies show that critical thinking or higher-level thinking can be taught, transferring those skills to new contexts portends difficulty for many educators (Halpern, 1998; Tsui, 2001). However, Salomon and Perkins (1987) believed that certain general skills function in varied subjects. For instance, the term "analysis" in Bloom's Taxonomy can be equally applied to analyzing the figurative language in a literature piece, as well as the body systems of amphibians in biology, or the causes of the Revolutionary War in social studies. Yet that transfer of skills is necessary, even if students struggle to understand, and educators to realize, that many of the same skills are taught in different disciplines under different terminology. The crux of the matter becomes ensuring students ingrain the skills so naturally that the student does not have to think about what kind of skill should be used in a situation, but applies the skill(s) as needed without a second thought.

Higher-order Thinking Skills in K-12 Education

In the K-12 realm, thinking skills are often denoted as either lower-level thinking skills or higher-level thinking skills. Lower-level thinking skills include tasks such as memorizing information, reading a passage and determining the basic 4 W's (who, what, where, when), matching terms to definitions, and so forth. Higher-level thinking skills center upon using

information or interpreting meanings that are not directly stated (Halpern, 1998). "Much of the effort to teach thinking has focused on 'higher order thinking'" according to Swartz (2001, p. 266). Originally HOTS referred to a computer program which taught thinking skills to struggling students (Cotton, 1991); however, the term now refers to higher-order thinking skills in general. HOTS skills include finding underlying meanings, applying knowledge in a new context, synthesizing multiple pieces of information into a new whole, analyzing the elements of a bigger piece, or evaluating a work against criteria. Within K-12 education, Bloom's Taxonomy tends to be used when writing lesson objectives, implying the level of thinking needed by students to master the lesson.

Bloom's Taxonomy of Cognitive Skills in K-12 Education

In K-12 education, Bloom's Taxonomy of Cognitive Skills (Table 1) is often associated with thinking skills. Schools may encourage their teachers to develop lessons around levels of Bloom's Taxonomy, hoping that students will learn thinking skills in this manner. According to Dettmer (2006), "Educational taxonomies developed by Bloom, Krathwohl, and collaborators have been used for decades as frameworks for instructional objectives, curriculum design, and assessment of achievement" (p. 70). Anderson and Sosniak (1994) stated, "Sometimes the Taxonomy is so taken for granted that a traditional reference seems quite unnecessary" (p. 111) in literature concerned with critical thinking and higher-order thinking skills. Anderson and Sosniak (1994) described the Taxonomy as helpful to new teachers in defining their work, choosing priorities for lessons, and in setting the curriculum for their students. The Common Core Standards (2010) do not mention Bloom's Taxonomy by name, but use the terminology in discussions of building reasoning and thinking skills in students. In education college courses, Bloom's Taxonomy tends to be mentioned when instruction is given in lesson planning, as a

means to guide preservice teachers' use of thinking skills. This familiarity with Bloom's Taxonomy makes it the preferred type of thinking skill for this study to assist in discerning the beliefs of preservice teachers towards critical thinking.

History of Bloom's Taxonomy

Bloom's Taxonomy was created with a definite rationale and purpose emphasizing the cognitive domain. The original focus had been on better assessment and evaluation standards. However, after review by practitioners, the contributors revised the taxonomy as a means to classify "student behaviors which represent the intended outcomes of the educational process" (Bloom, 1984, p. 12). They planned the taxonomy as useful for teachers, test developers, educational researchers, and curriculum developers, with the hope that it could improve communication between the various schools of thought in clarifying terms used in education, such as "thinking and problem solving…to discern the similarities and differences among the goals of their different instructional programs" (Bloom, 1984, p. 10). The development team also desired to provide a tool for teachers, when planning teaching units, to address a broader range of goals and objectives, with a concurrent aim for curriculum developers to use the taxonomy in preparing evaluation devices. Since Benjamin Bloom led the team creating the Cognitive Domain Taxonomy, the Taxonomy (Table 1) is often referred to as Bloom's Taxonomy.

Table 1

Levels in Bloom's Taxonomy: Original and Revised

Original Bloom's Taxonomy	Revised Bloom's Taxonomy
6. Evaluation	6. Creating
5. Synthesis	5. Evaluating
4. Analysis	4. Analyzing
3. Application	3. Applying
2. Comprehension	2. Understanding
1. Knowledge	1. Remembering

Note. Levels of thinking skills in both columns begin with the lowest level, 1, and move to the highest level, 6.

The planners developed the Taxonomy with the caveat that student experiences needed to be considered when writing objectives and using the Taxonomy. The terminology used would be dependent upon the student's experience with the knowledge and skills reflected in an objective. Within a class of many students, some will have prior experiences with a particular knowledge and skill set, making the objective one of deeper thinking. Another student, however, may be newly introduced to the material and require a knowledge or comprehension lower objective, in order to encourage learning by both students. Likewise, what would be a higher-level objective at one grade level, as the students practice the skill and use it in different contexts, becomes a lower-level objective at a different grade level as the students initially learn it (Anderson & Krathwohl, 2001). However, a student-by-student basis is often not considered when writing objectives for a class, as the lesson plan may state 2-3 objectives hopefully applicable to the entire class. The teacher must determine the levels of thinking needed by the students for the lesson. The concern in this study is focused upon the skill the preservice

teachers have in determining the type and level of thinking used by students in classroom instruction.

Studies of Bloom's Taxonomy

Researchers gave contradictory answers to questions about the hierarchal relationship of the original Taxonomy. Anderson and Krathwohl (2001) summarized the data, based on the original Taxonomy, collected prior to 2001. After examination of correlational data and a meta-analysis, they concluded that "evidence from these studies lends support to the hierarchal structure to the simpler categories" (p. 292). They noted issues with lack of studies on synthesis thinking and the use of multiple-choice tests to measure the higher-level objectives in most studies. Other considerations, beyond mastery of lower-level objectives, are probably needed for mastery of higher-level objectives (Anderson & Krathwohl, 2001). Higher level thinking tends to require integrated knowledge of several topics, writing and speaking skills, and the means to create a product to express the thinking, rather than merely marking a multiple-choice answer. So, among the studies, empirical evidence was provided for a cumulative hierarchy of Comprehension, Application and Analysis, which comprise the three middle levels. However, there was little evidence for the order of the top two levels (Synthesis and Evaluation), and comprehension studies yielded conflicting results as the Knowledge category included both content and process knowledge. These findings, as well as other findings in education, led to the need for a revision of the 40-year old construct.

The Revision of Bloom's Taxonomy

A revision (Table 1) of Bloom's Taxonomy was necessitated by changes in the educational world since 1956, due to better insight into the ways people learn, and concerns about the original structure. The original developers of Bloom's Taxonomy supposed that the

lower levels of thinking demanded less complex thinking than did the higher levels and that the 6th level, evaluation, was the most abstract level in thinking.

Anderson and Krathwohl edited the revised version of Bloom's Taxonomy. They stated, "We have tried to make this revision much more practical and useful for teachers" (p. xxii) in order to encourage use of the Taxonomy. Consequently, the word choice of each category changed from a noun to a verb to facilitate ease of use in writing objectives. The revised Taxonomy lacks the knowledge level of the first Taxonomy but includes an entire second tier of knowledge categories, including metacognitive knowledge, which can be applied to each level of thinking for more precise usage. Each objective can now be categorized by action as well as type of knowledge used. Hence, the verb "remember" replaces the lowest category of the revised Taxonomy. For example, the students will remember important dates of the Civil War. The categories can now overlap in levels of complexity in order to ease use in a classroom. This may alleviate the problem teachers face when a verb can be used in more than one level of the Taxonomy (Hess, Carlock, Jones, & Walkup, 2009). The top two levels were switched so that synthesis became the highest level of thinking and was renamed as "create." The verb "evaluate" moved now to the fifth level of thinking, instead of the top level. The Revised Bloom's Taxonomy should provide easier usage in today's educational settings.

Applicability of Bloom's Taxonomy

The creators of Bloom's Taxonomy believed, after much testing among educational professionals in many spheres, that this hierarchy of objectives would be applicable to many fields of study and to many ages of students. After all, the Taxonomy describes intended behaviors of students after learning experiences. The creators attempted to write value-neutral objectives that would be useful for a wide variety of educational establishments. They assumed that essentially the same classes of behavior may be observed in the usual range of subject

matter, at different levels of education (elementary, high-school, college) and in different schools. Thus a single set of classifications should be applicable in all these instances, (Bloom, 1984, p. 12).

Bloom's Taxonomy exhibits value in a diverse set of fields outside of K-12 and college education (Anderson & Sosniak, 1994), such as engineering, the science fields, and medical fields. Nevertheless, Bloom hoped that each field would develop its own taxonomy with appropriate wording developed and modified to fit each field by experts in those fields (Anderson & Krathwohl, 2001). In addition to being used in many career fields in the United States, Bloom's Taxonomy has been translated into other languages to facilitate its use in educational systems of other countries (Anderson & Sosniak, 1994). Bloom's Taxonomy gained wide acceptance in many spheres of the world. With this wide acknowledgment of its usefulness, preservice teachers should become very familiar with Bloom's Taxonomy if they will be responsible for using it with their future students.

Why Not Bloom's Taxonomy for Critical Thinking?

The issue then becomes why all educators do not use Bloom's Taxonomy when teaching critical thinking in schools. Several reasons surfaced in the literature. Although some educators mention Bloom's Taxonomy when discussing critical thinking in education (Crookston & Richter, 2010; Mabrouk, 2010), not all agree that this is the most appropriate venue for inclusion of higher order thinking skills. Sezer (2008) stated, "Many educators are tempted to equate critical thinking with higher order thinking skills within the last steps of Bloom's taxonomy: analysis, synthesis and evaluation" (p. 349). However, according to Sezer (2008), neither Ennis nor Paul [neither of whom are K-12 educators; however they are seen as leaders in the field of critical thinking] see the original Bloom's Taxonomy as satisfactory due to its limiting hierarchal structure of moving thinking in only one direction. Following this line of thinking, students must

master the lower-order thinking skills before being capable of using the upper-level thinking skills of Bloom's Taxonomy. However, it was attempted in Bloom's Revised Taxonomy to ameliorate that issue with the inclusion of four types of knowledge, so that each level of thinking can be correspondingly placed with a different type of knowledge. This allows for more freedom in moving between levels of thinking as the objectives and tasks focus upon different thinking skills. Thinking is not presupposed to be a one-way street any longer. Additionally, the other definitions of critical thinking skills were not developed as a means for teachers to develop objectives and instructional activities. These teacher tasks were among the very uses for the original Taxonomy.

In regard to the application of Bloom's Taxonomy in encouraging the use of higher thinking skills, the original Taxonomy of Cognitive Skills was developed as the catalyst for increased thinking by students. Teachers may need to begin with less complex levels of thinking in a topic, but teachers should guide thinking upwards in complexity as students use the knowledge in new ways. As the knowledge becomes more complex, the levels of thinking can also increase in complexity. For instance, students in elementary school may begin learning about the parts of a cell; they can use higher levels of thinking to develop deeper insight into the interactions of the cell components. Then, in more advanced knowledge, students in higher education can learn about biochemistry and again use the higher levels of thinking to develop deeper understanding of the interaction between cells and chemistry. The level of knowledge does not limit the type of thinking applicable to it. Bloom stated, "It is hoped that the taxonomy's analysis in this area will facilitate the exploration of new methods of teaching for high-level problem solving and assist in evaluating these methods" (Bloom, 1984, p. 43). The new Taxonomy provides even more flexibility in using HOTS with students. Anderson and Krathwohl (2001), in their revision of Bloom's Taxonomy, stated that "critical thinking and

problem solving tend to cut across rows, columns, and cells of the Taxonomy table" (p. 312), with a diverse range of activities fitting into many cells of the revised Taxonomy. The revised Taxonomy provides more options for teachers in using diverse thinking skills with many levels of knowledge. Therefore, Bloom's Taxonomy became the obvious choice for inclusion in this study.

However, despite this Taxonomy to guide teachers, evidence indicates that teachers, especially in elementary schools, continue to overuse questions and tasks of lower-order objectives. Teachers direct students to recognize terms, knowledge, and skills from a topic, rather than extending the knowledge and the skills to unfamiliar contexts. Anderson & Sosniak (1994) stated. "Elementary students in particular are not being taught to think, reason, and defend their points of view" (p. 138), with several causes contributing to this dilemma. One reason may stem from elementary teachers lacking deep knowledge of subjects due to the number of subjects they are required to teach (Richardson, 2003). The level of instruction the teacher can provide the students is impacted when teachers lack strong conceptual knowledge of the subject. Anderson & Sosniak (1994), in describing reasons teachers may not use Bloom's Taxonomy, asserted, "Teachers, in particular elementary teachers, have little if any scheduled planning time" (p. 139). Planning a lesson and considering the students' abilities and needs in a class takes time. Elementary teachers typically need to plan for multiple subjects on a daily basis, with students at many learning levels. Creating lesson plans and activities that incorporate higher-level thinking takes more time, especially when considering the needs of students who struggle to learn.

Additionally, beliefs held by teachers about students may override their training in the use of Bloom's Taxonomy, especially when teaching students who struggle academically. Teachers tend to use and return to personal experiences when teaching rather than relying on

their training (Kagan 1992), especially when teaching difficult material. Some teachers may find using Bloom's Taxonomy difficult due to lack of training, time pressures, or assessment needs.

Third, teachers are under much pressure to teach and cover a large amount of material; allowing students the time to work towards higher-level objectives would take too much time. Also, evaluating work at the higher levels requires more time and thought as tasks at that level often cannot be evaluated on multiple choice tests, as well as having multiple correct answers to read and assess (Anderson & Sosniak, 1994). The issues that impact the teachers' use and knowledge of Bloom's Taxonomy are then reflected in the teaching they are able to provide their students. These same concerns for lack of familiarity with Bloom's Taxonomy may be manifested by preservice teachers, compelling this study.

Issues of Critical Thinking in Higher Education

Although college students need to learn and use critical thinking skills, the teaching of critical thinking in college lacks coherence. Students receive variable levels of critical thinking, determined by their instructors. Yet, critical thinking is claimed to be necessary in college majors (Burbach et al., 2004; Hurd, 2004; Paul, Elder & Bartell, 1997). However the instructors' content needs, knowledge and skill in teaching critical thinking dictates the thinking done in college classes. For instance, few college faculty had strong research knowledge of critical thinking or the in-depth awareness of means to bring it into their instruction. They also discovered that those faculty who participated in professional development on critical thinking had more knowledge on ways to use and teach critical thinking afterwards (Paul, Elder & Bartell, 1997). Faculty, who lack knowledge of critical thinking or appreciation for using it, are not able to apply these skills in their courses effectively. Training in critical thinking is just as crucial for college faculty as the training for K-12 teachers.

In addition to lack of faculty knowledge, critical thinking in college is also hampered by differing faculty training and beliefs. Faculty may believe that certain levels of students need, or are more capable of, critical thinking activities. Tsui (2001) revealed that success in building college students' cognitive skills depended upon the confidence faculty had in teaching and using critical thinking, their enthusiasm for teaching, and the need for faculty to see learning as a "process of mutual learning" (p. 22) with the students in their classrooms. Her study also suggested that critical thinking may be used more often in advanced courses rather than in general education or lower-level courses, perhaps due to the belief of faculty that students come to college unprepared for the rigors of college classes (Tsui, 2001). So, although college students need to learn and use critical thinking skills in preparation for their careers, the teaching of critical thinking in college is problematic. However, several teaching methods have been shown to be beneficial in building thinking skills in students.

Although the teaching of critical thinking in college is sporadic, several methods have proved effective in building thinking skills in college students. The techniques may be commonly used in some courses, but instructors may need assistance in implementing these methods in large lecture classes. In a qualitative study of 4 colleges in the United States, Tsui (2002) found both classroom observation and student reports of increased critical thinking when instructors consistently used class discussion, as well as writing and then rewriting after feedback. Halpern (1998) reported on several Web-based assistance and courses that instructors can use to build students' ability to think more critically. Teaching students to use critical thinking in their college courses is necessary, and may be difficult due to the nature of some courses, but not impossible.

Issues of Thinking Skills in K-12 Education

Several issues pervade the use of HOTS in K-12 education. These issues lead to differences in teaching of HOTS with students. This, in turn, leads to differences in skills acquired by the students and their ability to use thinking skills. Part of the issues stem from a teacher's personal awareness of HOTS and a share of the problems stems from system issues in K-12 education. Chief among the concerns in the personal category is the difference in definitions used by educators. Another issue stems from the varying skill levels of the teachers. Other issues affecting HOTS usage include the focus on preparation for standardized testing, the lack of time and materials, and the lack of belief that all students are capable of doing higher-level thinking.

A major problem in the personal category of critical thinking is the definition held by each educator. Each teacher tends to develop a personally relevant concept of HOTS. Higher-order thinking skills differ in goals, terms, and meanings hence, relying upon the educator's underlying view of thinking skills in relation to the subject matter. Critical thinking is an umbrella construct underlying all disciplinary areas, and is used in language arts, mathematics, science, and social studies. Abrami et al. (2008), between the 1960s and 2005, conducted a meta-analysis of 117 studies, measuring interventions to affect critical thinking of elementary through adult subjects. They found the study of critical thinking was difficult due to the lack of a consistent definition of the term, as well as different conceptual views dependent upon the different fields of work/study. There was "little consensus about whether it (critical thinking) is a set of generic skills that apply across subject domains (engineering, rats, science) or whether it depends on the subject domain and context in which it is taught" (Abrami et al., 2008, p. 1105). Although Taba (1971) tried to initiate a discussion in the 1970s to clarify thinking in education, little consensus was achieved. Beyer (2001) stated:

> Little has happened in the last 15 years to remedy what Hilda Taba once referred to as "the haziness about what is meant by thinking. In what they choose to discuss or to teach as thinking skills, educators today continue to exhibit both haziness and great diversity." (p. 35)

Without a definition to provide common terms and theory, the meaning and act of critical thinking may be as varied as the people who teach it. This variation leads to differences in the critical thinking beliefs and skills used in schools.

Differing skill levels are another example of personal issues affecting the teaching of HOTS. For example, effective teachers focused on providing students with basic skills as well as critical thinking skills. Less effective teachers showed less skill in providing those higher-order thinking skills (Stronge et al., 2011). Lack of understanding student needs, as well as the complexity of various learning goals, hinders effective teaching of thinking skills. C. Thompson (2011) concluded that there are "inconsistencies in how learning goals are interpreted" (p. 3), so teachers in the same grade interpret the same goal in different ways, with different results, in teaching for critical thinking. For example, one teacher may think that understanding the plot of a story means being able to delineate the basic beginning, middle and end of a story; whereas another teacher thinks that understanding the plot of a story includes more details and motivations of the characters as they affect the plot. Unclear verbs for learning goals and different grasp of the subject matter lead to differential teaching of the same material.

In addition to different comprehension of learning goals and comfort level with subject matter, teachers have varying comfort levels with thinking skills. Although teachers may be comfortable with the subject matter they teach, that comfort level may not extend to teaching and assessing thinking skills. According to Fisher (2001), most teachers "feel less sure, however, about assessing their students' thinking, because most teachers have received very little explicit

training in the teaching of thinking skills" (p. 541). A lack of a firm foundation in critical thinking has hindered educators in teaching thinking skills. These personal issues with thinking skills are compounded by the systemic problems in teaching and using thinking skills in K-12 schools.

Four central problems exist for teaching and using HOTS in K-12 schools. These problems are systemic to education. Snyder and Snyder (2008) identified three impediments: the focus on testing, lack of opportunity for students to learn and use higher-order thinking skills, and the lack of teacher training in HOTS. The first problem is the focus on testing in today's schools, with many assessments focusing on recall of facts or comprehension of written information. Teachers must teach to the standards and cover much specific information in order to have students prepared for state assessments or pre-college tests such as the ACT/SAT.

> Many teachers feel compelled to implement a coverage style of instruction which leans heavily towards lower level cognition, such as memorization and basic comprehension. Teaching for thinking is thus relegated to the periphery of educational objectives despite the specific recommendations of experts who cite the need for including thinking and reasoning in their designs. (Gruberman, 2005, p 11)

Time limits what else teachers may wish to teach, so easily graded objective tests and lectures are the norm in many classrooms. "If these tests measure thinking, they could support the effort. However, if they do not, then thinking may go by the wayside in many classrooms" (Asp, 2001, p. 497). Also, textbook series and online teaching materials may not have much in the way of critical thinking as publishers publish materials needed to complete assessments. This focus on knowledge-based testing hinders teachers' ability to teach and practice critical thinking in classrooms.

Second, since students are not normally taught to use critical thinking, they may not develop those thinking skills on their own. Then, students are unable to think critically when that type of thinking is needed. Snyder and Snyder (2008) stated, "Critical thinking is not an innate ability…they (students) require training" (p. 92) in order to learn and develop these necessary skills. Without this training, students do not have the necessary background knowledge and practice in using these skills when the situation demands them.

Third, teachers often lack training in using and teaching critical thinking, demonstrating another system concern of teaching and learning thinking skills in K-12 education. A person is unable to teach that which they themselves do not know. Gruberman's (2005) case studies of practicing teachers' perceptions of thinking skills described the classroom of today as a place in which the teacher may not know how to teach thinking skills or is pressured to conform to the same curriculum as the other teachers in a subject or grade level. The lack of thinking skill usage in K-12 classrooms was reiterated by Hess et al. (2009). Their study examined English language arts and mathematics assignments from 205 schools in two states. Over 200,000 student work samples (worksheets, tests, quizzes, and homework) were analyzed to determine the highest level of Bloom's Taxonomy needed to adequately complete the item. Grade 3 language arts work (n=over 12,000 samples) scored at the Understanding level of the Taxonomy, while third grade mathematics (n= over 8,000 samples) scored at the application level. The authors noted that data collection occurred over approximately 5 consecutive days at each site, so longer-term projects were not included. Long-term projects may have included examples of higher level thinking skills. Additionally, although work samples were collected and analyzed for K-12 grades, only third grade was detailed for this article.

A fourth issue facing the use of HOTS in schools is the bias teachers and students may exhibit about their own or others' ability to think critically. Teachers who do not believe their

students are capable of thinking critically tend not to assign critical thinking activities to their students. Torff and others (Torff, 2005; Torff & Sessions, 2006; Warburton & Torff, 2005) described multiple research studies that illustrated that expert teachers considered all students capable of learning and doing higher-order thinking activities. In those findings, less-skilled teachers preferred HOTS activities mainly for students who were seen as more capable, rather than for all students. Teachers who see their students as less capable at learning tend not to use higher level thinking activities with them. This deprives the students of learning opportunities, which affects later learning choices.

With this number of barriers to teaching critical thinking, on top of the problem of having a cohesive conceptualization of the topic, it is not surprising that it is difficult for critical thinking to permeate classroom instruction. However, the same lack of a cohesive conceptualization of critical thinking is not endemic only to the field of education. Various other fields of study also struggle with having a clear and unified concept of critical thinking.

Intersection of Critical Thinking and Teacher Beliefs

Critical thinking and teacher beliefs intersect at teacher usage of critical thinking in relation to classroom instructional practices. The beliefs teachers hold about their practices shape their instruction. This, in turn, affects the thinking-skills education received by their students. Several considerations affect the instructional use of critical thinking in the K-12 classroom, including (a) teacher beliefs about learners in relation to achievement tests, (b) the schema of learning held by teachers, (c) terminology used in reference to thinking skills, and (d) level of expertise attained by teachers. These considerations arise not only from the belief structures of teachers, but also from the workplace systems of teachers (Gruberman, 2005). The instructional practices related to critical thinking arise from both personal beliefs of teachers and

the systemic practices of the K-12 structure. The systemic practices, in turn, shape the belief structures of teachers, affecting their instructional practices and the education of students.

Practicing Teachers and Critical Thinking

Contextual factors of schools and learners impact the decisions teachers make when determining instructional practices for their classrooms. These decisions affect the type and quality of instruction received by students. Ertmer (2005) stated, "Contextual factors interfered with teachers' ability to consistently apply their beliefs in practice" (p. 29). The structure and clientele of schools provides the context in which teachers make these decisions. Practicing teachers indicated 11 topics, affecting their beliefs, as important in decision making regarding students and critical thinking (Torff & Sessions, 2006). These topics included: high-stakes testing, learners' level of motivation, ability levels of the learners, and classroom management. These contextual factors may be systemic or personal, and they may enhance or lessen the impact of thinking-skill activities on students. The influence of those decision-making factors is supported by further research, with student achievement on standardized tests an issue of concern to both the public and educators.

The decisions teachers make concerning instructional practices affect student achievement on high-stakes testing. The disparity in student achievement at different schools can be partially explained through the perspective of teachers' beliefs concerning higher-order thinking skills activities. Teachers tend to cover only the content needed for the tests, emphasizing basic computation and memorization "to the detriment of higher order thinking" (Gruberman, 2005, p. 87). Often, students who struggle in school are seen as needing more intense basic practice, not critical thinking. Struggling students are seen as needing critical-thinking activities of less intensity, exacerbating the achievement gap (Torff, 2006; Torff, 2008; Torff & Warburton, 2005). Wenglinsky's (2004) analysis of National Assessment of

Educational Progress (NAEP) and Trends in International Mathematics and Science Study (TIMSS) data of student achievement scores found teacher usage of HOTS activities in instruction led to greater student achievement in mathematics over teachers who emphasized study of only basic skills. So, teacher decisions about thinking-skills instruction can have negative consequences for struggling students. Although teachers who believe in the incorporation of HOTS evidence greater student achievement, teaching expertise also affects student learning.

Differences, in usage of thinking-skill activities, depend partially upon the teacher's level of expertise as an educator. Experienced teachers tend to have a greater familiarity with a variety of materials and strategies. However, this does not mean that the materials and strategies are used equally with all students. Expert teachers (meaning more than 5 years of teaching experience and determined by principals to be extremely competent in fostering student learning) tended to favor HOTS activities for all student groups (Torff, 2006). However, teachers with multiple years of experience, and not labeled an expert teacher, tended to favor different levels of critical-thinking activities based on perceived learner advantages (ability and socioeconomic status), especially in reference to low-advantage learners. Torff described HOTS activities as being either high in critical thinking (high-CT) or low in critical thinking (low-CT). Torff (2005) stated "teacher's beliefs may contribute to this 'rigor' gap, given the finding that expert teachers were generally more supportive of high-CT activities, less supportive of low-CT ones, and less prone to differentiate instruction according to learner advantages" (pp. 46-47). That is, expert teachers considered all students capable of learning and doing HOTS activities, whereas the nonexpert teachers tended to favor HOTS activities more for the high-advantage learners rather than all students. Beyond teaching expertise, another issue impacting the usage of HOTS activities is the schema of learning held by teachers.

Although teachers may be expected to use HOTS in their classrooms, the schema of learning teachers hold affects their classroom pedagogy. Some teachers believe that directly imparting instruction is most efficient for learners, while other teachers hold that student construction of meaning imparts greater understanding. Their beliefs about the nature of teaching lead to many using direct instruction with the HOTS activities. This negates the purpose of these activities. Zohar & Schwartzer (2005) explained the unconscious strategy teachers use when asked to teach HOTS: "Many teachers adopt a transmission of knowledge approach to the teaching of higher-order thinking. … Since teachers are missing the pedagogical knowledge that is appropriate for teaching thinking, they often compromise the 'thinking' curriculum" (p. 1599). The teachers lack or do not understand the appropriate methodology to use thinking skills with students, so they provide the answers or accept opinion-based responses. This incorrect methodology compromises student opportunities to practice critical thinking even when using materials created for that purpose. A disconnect between teacher training, beliefs, and practice appears when using HOTS, possibly demonstrated through their vocabulary regarding thinking skills.

The terminology teachers use to describe HOTS appears to affect their ability to use HOTS in instruction and testing. One example comes via teacher-made tests. T. Thompson (2008) explained that teacher-made tests may rely upon lower-order thinking skills, although the teachers indicated they were assessing students' ability to use HOTS. Practicing secondary mathematics teachers (n=32) who "defined HOTS as problem solving, discovering patterns, interpreting information, and conceptual understanding were much more likely to write HOTS items (on tests) than teachers who did not use these terms" (T. Thompson, 2008, discussion section, para. 1). Teachers who used dissimilar terms (e.g., difficulty level of problems, algebraic problems, more steps to solve problems) were more likely to write and test items

requiring lower-order thinking nearly every time. Yet, they also tended to identify these items as being higher-order thinking according to T. Thompson's (2008) analysis on teacher-written definitions and skills identified via Bloom's Taxonomy. The way a person defines thinking skills affects his or her ability to use these same thinking skills with the students. However, all of these prior studies focused upon the beliefs of practicing teachers in regards to HOTS, not future teachers' comprehension.

Preservice Teachers and Critical Thinking

Critical thinking has long been endorsed by teacher training institutions as a needed component in the teaching program. Over the past three decades, preservice teaching programs were requested to include strategies for teaching thinking skills. The 1983 *Nation at Risk* report clarified the need for teaching thinking in K-12 classrooms, as policy makers demanded reform in America's schools (Willingham, 2007). Prompted by the Report, the National Council for Accreditation of Teacher Education in 1995 adopted teacher-education standards requiring teacher candidates to complete courses to develop their critical thinking and problem solving instructional strategies. However, "preservice teacher education programs, on the other hand, have been slower to respond to the need for explicit preparation of teachers of thinking" noted Martin and Michelli (2001, p. 111). "It is also clear that the variety of definitions of and approaches to the teaching of thinking are as diverse as the number of institutions" (p. 115). Currently, in 2010, the Council for Chief State School Officers (CCSSO) stated in InTASC, the new professional standards for teachers, that "key cross-disciplinary skills (e.g. critical thinking) would be woven throughout the standards because of their importance for today's learners" (p. 6). The CCSSO restated the importance of teachers learning to use and teach thinking skills in diverse subjects. Preservice teachers were required to develop skills in HOTS for many years, yet research demonstrating their awareness of HOTS is scarce.

Preservice teachers tend to feel confident in their ability to teach HOTS as teachers, yet actual practice contradicts this confidence. In a qualitative study (O'Malley Kelley, 2003), the preservice teachers reported themselves able to teach thinking skills to their students. Over one-half of the preservice teachers (*n*=320) in the study reported positive thoughts about using critical thinking in the practicum classroom. However, this ability was not reflected in actual classroom practice. . The incorporation of HOTS into lesson planning may be more problematic for preservice teachers. The lesson plans of practicum teachers (*n*= 67 practicum teachers over 3 years) were analyzed by Sultana (2001). She discovered that the majority of the teachers' plans emphasized lower-level thinking skills with less than 3% of the intern teachers consciously planning to teach for higher-level thinking. Although preservice teachers may state they are ready to use HOTS, practice is not so easily incorporated. Changes in usage of thinking skills appear with targeted HOTS programs for preservice teachers.

Programs which explicitly include HOTS in instructional activities seem to affect preservice teachers' knowledge and incorporation of HOTS in their later classrooms positively. Preservice teachers who were explicitly instructed in the usage of Bloom's Taxonomy and instructional strategies for HOTS were better able to apply this knowledge in their practicum classrooms. For example, preservice teachers at the beginning of a science-methods course had little knowledge of Bloom's Taxonomy of Cognitive Objectives (Pleyvak, 2007). Over the course term, these preservice teachers became more comfortable in using critical thinking in lesson planning. Gruberman (2005) found:

> An introduction to higher-order thinking in teacher education programs appears to have had a marked effect on teacher conceptualization, … in that these experiences have a direct impact on the level of knowledge or understanding of higher order thinking as understood and implemented in the classroom. (p. 298)

Explicit instruction and practice in using HOTS during preservice courses impacts later classroom usage of thinking skills. Apparently, exposure to techniques and methods in teaching critical thinking increases insights by preservice teachers when later teaching critical-thinking skills.

Education courses provide opportunities for teacher educators to teach and model the usage of higher-level thinking skills. Exposure and practice to thinking skills may increase future usage of these skills when the preservice teachers have their own classrooms. Seven methods and curriculum courses at a major Midwestern university were analyzed for levels of Bloom's Taxonomy (Ball & Garton, 2005). Classroom discourse, instructional objectives, and assessments were examined for each course to determine the alignment between Bloom's Taxonomy objective levels. The study authors determined, through hierarchal cluster analysis, that although the objectives were written at higher levels of thinking, classroom verbal discourse was maintained at the knowledge and comprehension levels (61%). Analysis and application types of thinking were needed 30% of the time, with synthesis and evaluation thinking only asked 9% of the time (Ball & Garton, 2005). Therefore, teacher educators were not modeling higher-level thinking in classroom discussions for the preservice teachers. Without experiencing that modeling, preservice teachers lack "seeing" higher level thinking in action in classroom conversations.

Preservice teachers have been, and should be, receiving training in using HOTS. When queried, they generally feel positive about teaching thinking activities. However, this is not effectively translated into classroom practice. "At the core, it is the knowledge, belief systems, willingness, … that determines whether or not teaching for thinking is to be a primary focus of instruction" (Gruberman, 2005, p. 88). Martin & Michelli (2001) stated,

> For teacher-education programs to effectively prepare teachers to teach thinking, teacher educators must confront what they mean by "teaching thinking." Failing to take a programmatic perspective on teaching for thinking may well lead to candidates' experiencing miscellaneous approaches in a variety of courses without seeing connections or developing a clear viewpoint on teaching for thinking. (p. 115)

Preservice teacher beliefs about critical thinking may be resistant to change. This resistance may be due to the strength of prior-held beliefs, the length of time in which they have been held, and the number of interrelated factors that shape the beliefs. The beliefs preservice teachers hold about HOTS will affect when and how they teach CT to their K-12 students. The discrepancy between training, beliefs, and practice calls for investigation.

Summary

Beliefs appear to shape the practices of teachers in their classrooms. Teaching practices affect the curriculum and instruction of their students. The Common Core Standards expect students to build higher-level thinking skills from their classroom instructional activities. Zohar and Schwartzer (2005) wrote, "Teachers' knowledge and beliefs carry important significance for their practice, and thus influence students' learning" (p. 1596). Yet, lacking knowledge of their beliefs on HOTS interferes with the skill and enthusiasm teachers bring to this more challenging teaching task. Although much study has been conducted on the beliefs of inservice teachers in various areas, the beliefs of preservice teachers is in its infancy, with a definite paucity of research on beliefs and comprehension of thinking skills. Without this awareness of preservice teacher knowledge and beliefs about HOTS, the interaction between teaching practices and beliefs is unclear.

CHAPTER THREE

METHODOLOGY

Introduction

This exploratory study used a mixed method design to explore the research questions as neither method alone could answer all the questions posed by this study:

1. How do preservice teachers describe critical thinking?
2. How do preservice teachers identify the thinking level of instructional activities?

This study was an attempt to uncover the views of higher-level thinking skills held by preservice teachers. Personal interviewing allowed acknowledgement of the participants' thoughts and knowledge about thinking skills as they articulated their beliefs about critical thinking and the possible forces that helped shape these beliefs. The qualitative methods employed in the study investigated the meanings participants shared about phenomena as a means of "understanding the phenomenon of interest from the participants' perspectives, not the researcher's" (Merriam, 1998, p. 6). The quantitative method provided a composite picture of participants' identification of levels of thinking, per Bloom's Taxonomy, enacted through their responses to classroom scenarios.

Participants

The participants in the study were undergraduate preservice teachers (N=155) enrolled in the teacher education program at a large midwestern university. The majority of participants were sophomores, juniors, seniors, or fifth year professional-year students enrolled in the elementary teacher education program (n=143), with one group of secondary level preservice teachers (n=12) also participating. The participants' range of years in school provided a basis to

learn the knowledge of preservice teachers at different levels of their programs. All participants were enrolled in teaching-methods courses or student-teaching experiences required of all preservice teachers. Convenience sampling was used to select the classes of participants, as the instructors were willing to allow me to visit class and had time in their schedules to allow 15-20 minutes for data gathering. To avoid conflict of interest, I excluded the two sections of an elementary methods course I taught.

Participants in elementary education completed courses in the professional education program (see Table 2) before student teaching. The professional year students completed relevant coursework in the same year as student teaching and internship. Table 3 illustrates the coursework taken by secondary level participants in the professional education program. The secondary participants concurrently completed courses in the subject matter of their content area. Courses provided multiple opportunities for instructors to teach participants about Bloom's Taxonomy and higher-order thinking skills; however, a scope and sequence chart of thinking skills did not exist for this particular professional education program at the time of the study.

Instrumentation

The research questions guided the researcher-developed written instruments of the investigation and the interview questions, so that each instrument provided insights into the intersections of the research questions. Two written instruments were utilized for quantitative purposes and the interviews provided qualitative data.

Table 2

Teacher Education Courses Required of Elementary Education Majors

Courses Completed Prior to Student Teaching[a]	Courses Completed While Student Teaching[b]
Multicultural Education	Student Teaching
Education and Society	Governance and Organization of Schools
Curriculum Learner in elementary School	Managing and Motivating Learners in the Pre K-6th Grade Classroom
Children's Literature in the elementary School	Advanced Practices for Children with Disabilities in the Elementary General Education Classroom
Mathematics for Elementary School Teachers l & 2	Internship
Literacy Instruction and Practicum in the Primary Grades and Intermediate Grades	Seminar: Developing the Teaching Portfolio
Instructional Approaches for ESOL Learners in the Elementary/Early childhood classroom	Assessment of Students
Science in the Elementary Classroom	
Social studies in the Elementary Classroom	
Mathematics in the Elementary classroom	
Educational Technology in Elementary-Middle Education	
Instructional Strategies in Physical Education for Elementary Classroom Teachers	
Instructional Strategies in Music or Art for Elementary classroom Teachers or children and drama	
Development and Learning of the Young Child Teaching Exceptional Children in Youth in General Education	

[a] Requires three semesters, beginning in a spring semester
[b] Requires two semesters, beginning in the fall semester of the final year

Table 3

Teacher Education Courses Required of Secondary Education Majors

Courses Completed Prior to Student Teaching[a]	Courses Completed While Student Teaching[b]
Multicultural Education	Advanced Teaching Practicum
Education and Society	Governance and Organization
Educational Technology in Middle / Secondary Education	Advanced Practices for Children with Disabilities in the Middle/Secondary General Education Classroom
Development and Learning of the Adolescent	Student Teaching
Teaching Exceptional Children and Youth in General Education	Seminar: Developing the Teaching Portfolio
Curriculum Learner in the Middle School and High School	Assessment of Students
Managing and Motivating Learners in the Middle and Secondary Classroom	
Instructional Approaches for ESOL Learners in the Middle/Secondary Classroom	
Curriculum & Instruction in (Subject Area) Classrooms	
Teaching(Subject Area)	

[a] Requires three semesters, beginning in a spring semester
[b]Requires two semesters, beginning in the fall semester of the final year

Demographic Survey

The Demographic Survey (Appendix A) was developed to gather pertinent information about the participants: (a) educational backgrounds, (b) gender, (c) age, (d) classroom experiences, (e) planned level of teaching certification, (f) courses which taught about critical thinking, and (g) their definitions of higher-level thinking. The definitions were based on an analysis of current conceptions of higher-level thinking as used in the literature. The survey collected insights into the influences that may have shaped the participants' awareness of

thinking skills. Although dependent upon the honesty of the participants in their responses, this survey instrument allowed the researcher to "describe and explain statistically the variability of certain features in a population" (Marshall & Rossman, 2006, p. 125). The participants' responses provided valuable data for quantitative analysis, leading to generalizability "within the known limit of error" (Marshall & Rossman, 2006, p. 126). However, surveys have a weakness in examining complex interactional patterns of thought and behavior. To study this aspect, the Classroom Thinking Skills Assessment (CTSA) was developed.

The Demographic Survey solicited responses to the following questions (see Table 4), which provided responses pertinent to the research questions.

Table 4

Partial List of Demographic Survey Questions

Please describe any courses that taught you how to use Higher Order Thinking Skills with students. The courses could be in the School of Education or somewhere else.

How comfortable do you feel about your ability to teach HOTS (higher order thinking skills) to students?

Not very comfortable	Somewhat comfortable	Very comfortable

Please circle any phrases that remind you of higher-level thinking skills:

Critical thinking	Deciding rationally what to believe or not to believe
Scientific thinking	Seeking alternative opinions or views or info on a topic
Bloom's Taxonomy	Using strategies to solve problems

The Classroom Thinking Skills Assessment (CTSA)

Background. The researcher-developed instrument (Appendix B) gathered the participants' perceptions into the intersection of thinking skills and classroom instruction through

the use of vignettes. Vignettes are short scenarios in which the participants write or mark their answer to the question about the scenario. "The inclusion of vignettes in large-scale assessment may provide a viable and powerful alternative to or complement Likert-scale background questionnaires or observation in the participants' work environments" (Simon & Tierney, 2011, p. 7). Jeffries and Maeder (2004-05) stated vignettes "are valuable in addressing difficult-to-explore and sensitive topics….they reflect real-life contexts and problems" (p. 17). Additionally, they noted that vignettes have been used "to identify and study attitudes and beliefs" in the education field (Jeffries & Maeder, 2004-05, p. 19). Thus, vignettes are a plausible means to ascertain teacher knowledge of thinking skills via the applied context of instructional activities.

Vignettes must be written in a manner that engages the participants and probes the depth of their comprehension. Simon and Tierney (2011) recommended that vignettes present scenarios typical of the topic and germane to the participants. They also suggested that vignettes be short, between 50-200 words, with scenarios using both the relevant literature and typical experiences. The vignettes should then be vetted by experts or scholars to determine readability, accuracy of the scenario, and design elements. The vignettes written for this study fit these recommended guidelines by being brief, focused, and realistic. They offered the preservice teachers in the study brief glimpses into simulated teaching situations to assess knowledge of thinking skills in a contextual situation.

However, vignettes suffer from several disadvantages, as does any research method. Vignettes, whether open ended or multiple choice, are subject to the participants' interpretation, interest in the topic, and willingness to answer thoughtfully. Vignettes' utility is also dependent on their content and construct validity. Simon and Tierney (2011) advised that vignettes be followed by interviews or observations in order to determine congruence with voiced and enacted thought processes and knowledge. Although vignettes have been more commonly used

in social science and medical fields, increasing use has been made in educational settings.

Description of the CTSA. The Classroom Thinking Skills Assessment developed for the study consisted of 10 classroom instructional vignettes. The instrument was designed to measure the knowledge of higher-level thinking needed in the instructional activities, based on the participants' responses to the scenarios. Respondents were asked to identify the type of thinking needed by K-12 students as they participate in the instructional activity. The participants chose among four types of thinking possibly used in the activity. The word choices to describe the types of thinking were drawn from Bloom's Taxonomy of Thinking Skills (Bloom, 1984). Word choices were selected from both the Original and Revised Bloom's Taxonomy, when the labeling of levels changed. This word choice would allow participants who had been exposed to one version of the taxonomy, but not the other, to apply their knowledge of thinking skills to the vignettes. The respondents were instructed to choose the highest level of thinking needed by the students for the activity. The vignettes were balanced among subjects, with two vignettes drawn from each of the five core academic content areas: (a) mathematics, (b) reading, (c) science, (d) social studies, and (e) language arts. Vignettes were written to be pertinent in either elementary or secondary level classrooms.

The CTSA instrument developed for this study was developed after studying Torff and Warburton's instrument, the Critical Thinking Belief Assessment (Torff & Warburton, 2005). Their instrument used vignettes and a Likert-scale to determine the beliefs teachers hold about student demographics in relation to critical thinking. The instrument developed for this study employed multiple-choice vignettes to assess preservice teachers' determination of thinking skills in relation to instructional activities.

Validity of the CTSA. Huck (2012) recommended a review by experts in the field to ascertain content and construct validity. The instrument was developed and then evaluated for

content and construct validity by six practicing or recently retired elementary teachers. The validity judges ranged in experience from three to 20-plus years of public school teaching in Kansas and other states. All held current teaching licenses and were graduates of teacher education programs. All of the practicing or retired teachers had common training in teaching reading and mathematics content and skills that emphasize thinking skills.

The judges were given common written instructions to review and evaluate the vignettes to minimize variation in understanding the task. They were instructed to:

- Evaluate the items for representing classroom instructional activities (construct and content validity).
- Determine if the language of the vignettes was appropriate for K-12 teachers (content validity).
- Answer each vignette by choosing the highest level of thinking shown from the four answer choices (construct validity).

Reliability of the CTSA. Inter-rater reliability data were gathered from the results of this group of judges. The content validity judges all had common training in reading and mathematics instruction, teaching degrees from various universities, and practical experience as teachers. Their diverse teaching backgrounds and sources of teacher education provided a more heterogeneous perception of the vignettes' content. Reliability was determined via correct answer choices and frequency of incorrect answer choices selected. Answer choices for the vignettes were evaluated for correctness and similarity of incorrect responses. Items with incorrect answer choices were examined for commonality of responses. No items showed commonality of incorrect answer choices by this team of judges. Revisions were made to two items for word choice for better clarification, based upon the judges' comments.

Interviews

Volunteers, from among all study participants, were sought to participate in semi-structured constructivist interviews to gather their impressions of critical thinking. Rubin and Rubin (2005) referred to this learning from others' points of view as "responsive interviewing" (p. vii). Responsive interviewing adapts questions and interaction style to each participant. Starting with a defined list of questions (Appendix C), initially to standardize the interviews, additional question probes were developed during the interviews as a means to further explore participants' beliefs and construction of those beliefs. "Each conversation is unique, as researchers match their questions to what each interviewee knows and is willing to share" (Rubin & Rubin, 2005, p. 4). This allowed the researcher to "uncover the participants' views but otherwise respects how the participant frames and structures the responses" (Marshall & Rossman, 2006, p. 101). The interview was used as a research instrument or, as Talmy (2010) stated, "as a research instrument, interviews are theorized (often tacitly) as a resource for investigating truths, facts, experience, beliefs, attitudes, and/or feelings of respondents" (p. 131). Through the use of constructivist interviews, the researcher hoped to learn how preservice teachers explain thinking skills and their plans to use these thinking skills in their future classrooms. The interviews were a means of "securing participants' voices to generate empirical data" (Talmy, 2010, p. 135).

Overview of Data Collection Procedures

The following sequence summarizes the phases followed in conducting this research:

1. Approval of the research plan was gained from my dissertation committee and the university research review board.
2. Permission was obtained from instructors who taught courses for the current student

teachers. Data collection was attempted through face-to-face classroom introduction of the study with distribution of the research materials and information shared about the online assessment.

3. Due to the low number of participants in the online assessment, the study participants were expanded to include preservice teachers prior to student teaching. Permission from education course instructors was secured and visits were made to their class sessions to introduce the study. Research materials were distributed so that interested participants could complete the permission form (Appendix D) and both quantitative instruments.
4. Preservice teachers who had given their email addresses on the quantitative instruments were contacted about the interview portion of the study. Interviews were conducted with the participants.

Phase 1

After approval of my research proposal by the dissertation committee, permission for the study was secured from the university research review board. Participants were advised of their rights via written form, indicating that participation was strictly voluntary and that their information was confidential. Signed consent forms were maintained in compliance with the research review board. Pseudonyms were employed when reporting interview responses of the study. Each interview participant chose a pseudonym. Information shared by the participants remained confidential. To retain that confidentiality, all quantitative and interview data and transcripts were kept in a locked cabinet in my home office.

Phase 2

First, instructors of courses for student teachers in the undergraduate teacher education program that enrolled likely participant groups were contacted. Arrangements were made to visit

the fall semester classes to describe the study and distribute the permission form and the Demographic Survey. Additionally, in order to maintain confidentiality, a system to code participants and their responses on the various instruments was developed. Students completed the Demographic Survey during my class visit. Initially, the CTSA was placed on an online survey tool, Survey Monkey, (www.surveymonkey.com) to facilitate ease of use by the student teachers in the fall semester. The research was introduced and the Demographic Survey was distributed in a classroom setting. Very few (*n*= 3) completed the CTSA in that manner in the time period allowed.

Phase 3

In the spring semester, due to the low number of participants, the participant pool was broadened to include preservice teachers completing coursework prior to student teaching. Interested instructors were contacted and permission secured to visit their class sessions. However, The administration format was adjusted so the CTSA was administered in the classrooms, along with the Demographic Survey, to another group of student teachers and seven classes of preservice teachers (*N*=155).

Phase 4

During my visit to the courses, I explained the purpose of the study and described the instruments. Willing participants (*N*= 155) completed the Demographic Survey and a thinking-skills assessment, the CTSA. Students were given the option of including their email address on the survey if they were interested in participating in the interview portion of the study. I then contacted all 16 interested participants to determine a convenient time for the interviews. Of those contacted, four responded and expressed interest in the interview. None of these four participants were people known to me.

Each participant and I met in the education building on campus in one-on-one settings. Interviews were begun with conversations about the participant's major, year in school, and such personal information as each interviewee was willing to share. For instance, one of the participants was training to compete in the Olympic track trials in several weeks, so we discussed her hopes and plans. Two of the participants were planning to student teach in the fall, and we chatted about their planned placement and expectations. The elementary level participant had just graduated the prior weekend, so she was in the midst of job hunting. Conversation quite naturally turned to prospects for teaching jobs. I shared my background as a teacher and a few reminiscences of my undergraduate experiences in education with each participant as a means of building "cultural frames of reference" (Corbett, 2003, p. 120) in the world of teaching and college education courses. During the interview, I paid attended to the behaviors of conversation (Corbett, 2003) to meter the ebb and flow of conversation in a natural manner. Interviewing is an interactive instrument; participants who feel more rapport with the interviewer may respond more naturally and freely with their thoughts. Building rapport with the interview participants also served to reduce the implications of a power structure the participants may have felt due to my older age and more years of experience and college coursework (Corbett, 2003; Talmy, 2010).

Interview Questions

Higher order thinking is not a phenomenon that can be directly observed, so it must be inferred from the actions and words of participants. To alleviate this obstacle, I began with a defined set of questions and used follow-up probes as needed (see Table 5). Initial interview questions were adapted from the Teachers' Belief Instrument developed by Luft and Roehrig (Appendix E). However, Luft and Roehrig's questions focused upon beliefs about science teaching so the questions were modified to seek information about HOTS. Additional questions

were added to develop insights pertinent to the research questions.

During the interview, participants were encouraged to share and refine their beliefs about thinking skills. "Interviewing is necessary when we cannot observe behavior, feelings, or how people interpret the world around them…..when we are interested in past events that are impossible to replicate" (Merriam, 1998, p. 72). Since thinking skills do not have a definite meaning common among people, I sought to determine the interpretation these preservice teachers gave to the term. Rubin and Rubin (2005) stated, "...a concept clarification interview is to explore the meaning of these special, shared terms" (p. 6), such as the term higher-order thinking.

To uncover deeper meanings related to higher order thinking, the initial questions were open ended and more general, with follow-up probes to elicit more information. As Emerson, Fretz, and Shaw (1995) stated, "…ask questions that are intentionally open-ended, so as to allow members to use their own language and concepts in responding to them" (p. 114). I encouraged each participant to relate her or his view of critical thinking and the narratives of life that influenced this view. Questions for each interview were modified based on the participant's experiences with teaching and to better fit the flow of the conversation. After each interview, I examined the data and allowed it to inform the questions for the next interview participant. By allowing the participants to share their stories using their own terms and concepts, I gained a better discernment of the conceptual lens of higher order thinking for these participants.

Table 5

Initial Interview Questions

1.	How would you define higher-level thinking skills?
2.	Were you familiar with Bloom's Taxonomy before we did the assessment in your class?
3.	Do you recall learning about higher-level thinking skills or Bloom's Taxonomy in your college courses?
4.	Do you feel you've had any courses here at the university that helped you develop your thinking skills?
5.	Can you think of anything other activities or things that might have helped you learn and use thinking skills?
6.	How do you think you will see higher order thinking skills used in the classroom?*
7.	What kinds of activities will you do with students to build higher order thinking skills?*
8.	How will you know when your students are doing higher-level thinking?*
9.	How will you decide when to teach higher order thinking skills?*
10.	Are there particular topics or subjects that lend themselves to higher order thinking or do you think all subjects in your teaching area will work well?*
11.	Do you think all students are capable of thinking critically?*
12.	How will you assess your students when they do higher-level thinking?*
13.	Do you have any concerns about teaching higher-level thinking skills in your future classrooms? Will there be any barriers to using higher-level thinking in your future classrooms?
14.	Do you feel prepared to use higher order thinking skills with your future students?

*Indicates a question modified from Luft and Roehrig's (2007) Teacher Belief Interview instrument.

Validity of Interviews

I kept a digital recording of each interview, with the participant's permission, and transcribed all interviews. Member checks were attempted, as each interviewee was asked if she

or he wished to review the transcript. The interviewees declined to review the transcripts. Thick description, or using complete quotes and descriptions of the responses, was used to ensure validity, or accuracy, of the data. The use of detailed descriptions provides more likely transfer of knowledge gained in interviews to other settings due to shared qualities (Merriam, 1998).

Data Analysis and Synthesis

To answer the following research questions, the data from the instruments were analyzed in sequence. First, each set of data were cleaned and organized. Next, each instrument's data were analyzed separately. Then, those results were synthesized with results of the other instruments to reveal categories that may begin to tell the story of the participants' description and awareness of HOTS in classrooms. As Creswell (2003) described, "Analysis occurs both *within* the quantitative (descriptive and inferential numeric analysis) approach and the qualitative (description and thematic text or image analysis) approach, and often *between* the two approaches" (p. 220). The CTSA and the Demographic Survey data were analyzed using quantitative methods, while the interview data were organized through the constant comparative method to determine thematic descriptions. Then, results from all three instruments were synthesized to address the research questions.

1. How do preservice teachers describe critical thinking?
2. How do preservice teachers identify the thinking level of instructional activities?

Qualitative Data

For the interview data, the constant comparative method was utilized for analysis. Through this method, I examined the data from each interview in light of the knowledge gained from my study of the prior interview transcript. Transcribed interview data were coded and examined for general categories, significant phrases, and anomalies. Using this method allowed

me to compare the most current transcript to those that came prior to it, comparing and contrasting words, phrases, and possible meanings. New phrases and meanings in the most current transcript indicated a need to return to prior transcripts in search of those same phrases. Emerson et al. (1995) described this method as constructing "members' meanings by looking closely at what members say and do, paying particular attention to the words, phrases, and categories that members use in their everyday interactions" (p. 112).

First, using initial coding, general codes based on common terms in each transcript were determined. Then, through intermediate coding, categories were developed from the coded transcripts with notes taken to clarify my own thinking. As Birks and Mills (2011) explained, "Initial coding is often said to fracture the data, whereas intermediate coding reconnects the data in ways that are conceptually much more abstract" (p. 12). Categories flowed from similar ideas expressed by participants to similar questions or follow-up probes. For the final analysis, I reviewed all interviews with the aim of discerning summary quotations to use in the narrative.

Quantitative Data

Data from each instrument were examined for incomplete answers or unusual responses. Then data from each instrument were analyzed.

Demographic Survey. Written data from the Demographic Survey were numerically coded for ease in analysis and frequency data collected on each question. Data from the Demographic Survey were examined to discover common trends among responses.

CTSA results. Descriptive statistics were used to explore possible patterns in the data. First, data from the CTSA were analyzed using SPSS to calculate the means of the data. Item difficulty was calculated for CTSA items. Patterns of responses to the items were examined for mean scores and distribution of scores. Item difficulty analyses were calculated to determine if

CTSA items were statistically too easy or difficult from a psychometric view. Table 6 illustrates the difficulty of each item.

Table 6

Difficulty Level of Vignette Items

Item #	Difficulty Level (p-value)
1	.25
2	.63
3	.75
4	.50
5	.38
6	.74
7	.57
8	.50
9	.63
10	.63

The difficulty level of the items (Table 6) is as follows. The majority of the vignette items fell near middle values, as the optimal difficulty level would be 0.62 (Instructional Assessment Resources, 2007). Excepting items 1 and 5, the range of p-values for the other items falls between 0.50 and 0.75 level of difficulty, showing that the items were the appropriate level of difficulty for the participants. None of the items were too easy for the participants, as none had p-values greater than 0.90.

Then, due to the number of participants who chose particular, incorrect answer choices, three vignettes were reconsidered in terms of accepted answers. The chosen answer choices

could be considered reasonable choices if the vignettes were viewed from a different perspective. Therefore, two answer choices were deemed acceptable for these three vignettes and mean scores were calculated using the revised scoring key. The CTSA was renamed the CTSA-R due to this change in scoring. New descriptive statistics were run on the revised data set. The analyses used for results were based on the CTSA-R.

Data analysis on both quantitative instruments. Examination of differences between and among responses to the Demographic Survey items and the CTSA were explored using ANOVA with follow-up pertinent post hoc analyses. The responses on the Demographic Survey were the independent variables and the CTSA scores served as dependent variables. Results from the CTSA-R were compared to data from the Demographic Survey to discover patterns of thought among the preservice teachers on their perceptions of instructional activities and thinking skills.

Instructors of undergraduate teacher education students were queried to provide context to the picture emerging from the data analysis. Comments were sought in relation to the uses of Bloom's Taxonomy and thinking skills in their courses. The thick descriptions they provided delineated a background to the experiences of the preservice teachers relevant to this construct under study. Their detailed feedback afforded greater insight into the quantitative results.

Data Synthesis

The results from the two quantitative instruments were merged with the interview analysis in order to determine the meanings that preservice teachers give to higher order thinking and the elements that influenced its development. From the analysis of all the exploratory data and instructor feedback, initial insight was developed. As discussed earlier, no extant theory exists on the knowledge of preservice teachers concerning higher-level thinking skills; however,

more interview data are especially needed to advance this line of research in order to develop deeper knowledge.

Reliability of Instrument Interaction

When multiple instruments are used, reliability must be considered in light of the interaction of the instruments. Reliability of the interaction of the instruments provides reassurance to readers that the results of the study are true to the construct under study and reliable in the information provided. Using Merriam's (1998) definition of reliability, "a researcher wishes outsiders to concur that, given the data collected, the results make sense–they are consistent and dependable" (p. 206). The instruments used in this study were considered reliable, or dependable, by giving consistent results through the comparison of the data analysis from the three instruments. Corroboration for instrument interaction was provided by course instructors and related literature. In order to understand the participants' perceptions of HOTS from the data, researcher subjectivity was used as a source of insights and deeper questions to investigate (Maxwell, 1996). The instruments' analyses were consistent with the researcher's background, or experiential data, which added a layer of reliability to the results. Strauss, as quoted in Maxwell (1996) stated:

> These experiential data should not be ignored because of the usual canons governing research (which regard personal experience and data as likely to bias the research), for these canons lead to the squashing of valuable experiential data. We say, rather, "mine your experience, there is potential gold there!" (p. 28)

Summary

The purpose of this study was to explore the views that preservice teachers hold about thinking skills in instructional activities and the ways in which they may have developed those

beliefs. This study used mixed methods to explore these insights. The qualitative method allowed collection of interview data from a small sample of participants to investigate the meaning they gave to thinking skills and the influences they described which contributed to those meanings. Two quantitative instruments were developed and employed, with results analyzed, in order to gather data from a sample of participants enrolled in the preservice teacher education at the university where the research was conducted. The instruments were designed to investigate participants' experiences and perceptions of thinking skills, in addition to gathering data about their knowledge of thinking levels (based on Bloom's Taxonomy) portrayed in instructional activities. Instructors provided additional information on the use of Bloom's Taxonomies and thinking skills as used in their teacher education courses. The results of the transcribed interviews provided contextual information relevant to the results from the quantitative instruments. Presentation of the results follows in Chapter Four.

CHAPTER FOUR

RESULTS

In Chapter Four, the participants in the study are described, both in terms of the entire group of participants (*N*= 155) who completed the two quantitative instruments and the subsample of four interview participants. Then the results of the quantitative instruments are discussed. These results are then related to the categories developed from the interviews. The categories provide insights into the research questions.

Review of the Conceptual Framework of the Study

The beliefs teachers hold about topics in their profession develop due to many influences on their thinking and practices. The influences on their beliefs can begin in their own K-12 school days (Hollingsworth, 1989; Kagan, 1992; Pajares, 1993; Raths, 2001). The influences modify existing beliefs only when the teacher perceives cognitive dissonance in his or her thinking due to experiences in teacher education and in his or her own classroom (Stuart & Thurlow, 2000). Slight literature is available as to the beliefs of preservice teachers about thinking skills, although the evidence is mounting for practicing teachers on this topic. The research shows that preservice teachers may think positively about teaching thinking skills (O'Malley Kelley, 2003); however, the origins of these beliefs are not known. This study was designed to discover the beliefs preservice teachers hold about higher-order thinking skills, the elements that may have influenced the development of those thinking skills, and how HOTS may be used in their future classrooms. The research questions that are the focus of this study are:

1 How do preservice teachers describe critical thinking?

2. How do preservice teachers identify the thinking level of instructional activities?

Participants

To answer the research questions, preservice teachers (*N*= 155) enrolled in either the elementary or middle/secondary track of the education program at a large midwestern university participated in a multi-faceted study. The participants were enrolled in one of five professional education courses (three sections of one course participated; one section of each of the other courses participated). At the time of the study, the program was transitioning from a five-year to a four-year program. The fifth-year participants (five-year program) were completing their student teaching /internship year and had completed all the other courses sampled in this study (*n*=24). The participants in the five-year program who were completing their student teaching/internship year were considered to be professional year students, as they had already graduated with a bachelor's degree. The participants in the inquiry block, comprised of mathematics, science and social studies courses, were juniors in the four-year program or seniors (before graduation) in the five-year program (*n*=24). The juniors would typically have completed the mathematics concepts course already, while the seniors would also have completed the mathematics concepts course and the classroom management course. The secondary level participants in the reading-in-secondary-school course were juniors, seniors, and a graduate student (*n*=12). The participants in classroom management were all seniors in the five-year program and had completed the inquiry block and mathematics concepts course in prior semesters (*n*=21). Participants in the three sections of the mathematics concepts course (*n*=74) were sophomores, juniors and three seniors, coming from both the four-year and five-year programs. Other than the secondary level participants in the reading in the content area course, the participants were all in elementary education. Of the participants, 11% (*n*=17) were males,

with females comprising the other 89% (*n*=138). All participants were in the 20-30 year old age range.

Data Collection

The study used a mixed methods design, with three instruments that complemented each other in terms of the data gathered. The study was conducted in two phases for data collection. The first phase of the study involved the Demographic Survey, which gathered self-reported data from 155 participants about their educational backgrounds concerning thinking skills and their future plans for teaching certification. The first phase also included an assessment of their identification of Bloom's Taxonomy in relation to instructional activities, the Classroom Thinking Skills Assessment (CTSA).

The second phase of the study entailed constructive interviews with four participants, drawn from the larger group, in a variety of certification areas. The interview questions were based upon Luft and Roehrig's (2007) Teacher's Belief Interview protocol (Appendix E). The researcher, in individual interviews, explored the participants' stated backgrounds in relation to thinking skills and their plans to use thinking skills in their future classrooms.

During the interview phase of the investigation, individual interviews were conducted over a two-week time period with willing participants. The four interview participants included one elementary and three secondary education majors, with the elementary participant having just finished her student teaching. Two of the secondary level interviewees were planning to student teach the following year and the third secondary level participant had another year of classes before being eligible to student teach. The three secondary level participants reported having zero to two practica experiences per participant, either in the classroom as an observer or practice teacher, as part of their teacher education coursework. "Credibility of your findings is

enhanced if you make sure you have interviewed individuals who reflect a variety of perspectives" (Rubin & Rubin, 2005, p. 67). The interviews allowed further descriptions and follow-up of enlightening conversation strands, as well as supplying large amounts of data for analysis.

Table 7

Interview Participants

Participant pseudonym	Background information
Laura	Elementary education just completed student teaching and graduated.
Liam	Junior, secondary education majoring in English education, planning to student teach the following year.
Haley	Junior, secondary education majoring in chemistry, planning to student teach the following spring
Mikey	Junior, secondary education majoring in history/government, planning to student teach the following year.

From these three forms of data, two main categories emerged which described the beliefs preservice teachers hold about thinking skills and the influences on these beliefs. The relevant results of the quantitative instruments, the Demographic Survey and the CTSA, are described first. These data were then merged with the interview data to illustrate the beliefs about HOTS held by these preservice teachers, along with their plans and concerns about using thinking skills in future classrooms.

Results from the Quantitative Instruments

The Demographic Survey and the CTSA were utilized to gather data from the entire group of participants.

Results from the Demographic Survey

Results from each instrument were analyzed for frequencies of responses. The results from the Demographic Survey are given below. The Demographic Survey (Table 8) provided insights into self-reported participant background in teaching and thinking skills, in addition to their written thoughts about HOTS. Specific information from the tables is applied to the categories, which answer the research questions.

Table 8

Basic Demographics of Participants

Total Participants[1]	155
Gender	Female = 138 Male = 17
Year in school [2]	Sophomore= 42 Junior = 47 Senior = 37 Professional Year Students = 27
Planned certification level	Preschool child = 8 Grade K-3 = 20 Grade 4-6 = 8 Grade K-6 = 103 Grade 6-9 = 4 Grade 9-12 = 11
Highest level of education completing now	Bachelor's degree = 110 Certification beyond bachelor's degree = 13 Master's degree = 13 Certification beyond master's degree = 0

Note: All participants were between 20-30 years old; 17 were male, 138 were female.

[1] Participants with incomplete forms were dropped from the pertinent analysis.

[2] Professional year students were in the 5-year education program and included a graduate student, while the seniors were in either the 4-year or 5-year programs; sophomores and juniors were in the 4-year programs.

Table 9 details the total responses students provided to the contextual questions on the Demographic Survey.

Table 9

Self-Reported Results from the Demographic Survey

Question	Responses	Number	Percent
How comfortable do you feel about your ability to teach HOTS to students ?[1]	Not very comfortable	21	14%
	Somewhat comfortable	120	77%
	Very comfortable	12	8%
What other classroom teaching experiences have you had?[2]	Early childhood	16	10%
	Upper elementary grades 4-6	6	4%
	K-6 elementary	66	43%
	grades 6-9 middle school	2	1%
	grades 9-12 high school	1	1%
	community based experiences	12	8%
	college mathematics teaching assistant	1	1%
	school volunteer, high school aide	17	11%
Describe any courses that taught you to use HOTS with students. [3]	College English	1	1%
	College social studies	1	1%
	Other university course	4	3%
	Education courses in general	5	3%
	Teacher education courses	14	9%
	Methods and inquiry block	34	22%
	Curriculum and learner	53	34%
	Multicultural education	2	1%
	Special education courses	4	3%
	psychology course	1	1%
	Professional Development School collaboration	1	1%
Circle any of the phrases here that that remind you of higher-level thinking skills. [4]	Bloom's Taxonomy	125	81%
	Deciding rationally what to believe or not to believe	71	46%
	Seeking alternative opinions or views or info on a topic	89	57%
	Using strategies to solve problems	107	69%

[1] (Numbers are less than 155 due to non-responses)
[2] (The student teachers had those experiences as well as other practicum experiences so most had two responses. Some student did not mark any response for this question as they may not have had any experience teaching students yet.)
[3] (Students could list more than one course; however, for statistical purposes only the first one listed was included here and in the analysis)
[4] (Students could mark more than one phrase, so numbers total more than 155)

Comfort level. Examining the year in school by comfort levels provides some differences (Table 10). For example, the juniors self-reported 19% (*n*=9) being "not very comfortable" in their ability to teach HOTS, with the fifth and professional year students reporting the most as being comfortable teaching HOTS (*n*=7 or 26%). Among all the years in schools, the majority, 78%, (*n*=120) of the students marked "somewhat comfortable."

Table 10

Self-Reported Comfort Level by Year in School

Year in school	1: not very comfortable	2: somewhat comfortable	3: very comfortable	Totals
sophomore	n=7 , 17%	n=33, 79%	n=2, 5%	42
juniors	n=9, 19%	n=37, 79%	n=1, 2%	47
seniors	n=3, 8%	n=32, 87%	n=2, 5%	37
professional year, 5th year seniors, graduate students	n=2, 7%	n=18, 67%	n=7, 26%	27
Total per comfort level	n=21, 14%	n=120, 78%	n=12, 8%	N=153

Analysis of CTSA results. The CTSA instrument (Appendix B) consisted of 10-multiple choice vignette items. Each item was composed of a brief description of an instructional activity that might be used in a K-12 classroom, with four answer choices given. The responses represented different levels of thinking as found on Bloom's Taxonomy. The respondents were instructed, both visually and aloud, to select the highest level of thinking illustrated in the vignette. The highest possible score for a respondent was a 10. The scores were reported as the number correct out of 10 possible correct answers.

Rescored items. Three vignettes, with distractors that attracted many participants, posed difficulties for the participants. Item 1 appeared to be the most difficult item of the ten vignettes (p=.25). Analyzing the pattern of incorrect responses prompted reconsideration of possible correct answer choices. Participants may have chosen the incorrect response due to perceiving the vignette in a different manner than intended, they may not have understood the types of thinking given in the choices, or they may not have recalled which of the given answer choices was the highest level of thinking per Bloom's Taxonomy. After due consideration for possible reasons, three vignettes and answer choices were reconsidered in light of possible interpretations of an alternate thinking skill being perceived by the participants as correct. A second response for these items was scored as correct in addition to the first correct response.

Item analysis revealed that distracters for Vignettes 2, 3 and 9 attracted participants. Vignette #2: *A class is learning to make bar graphs to represent data. The students tell the number of people in their families for a class bar graph*. Although the correct answer was knowing, 45% of the participants chose creating as their answer. The students may have read the first sentence "*A class is learning to make bar graphs to represent data"* without considering the second sentence "*The students tell the number of people in their families for a class bar graph.*" The first sentence could draw the participants to the answer choice creating, if they were not reading carefully. In order to create a graph, the students would need to know the information for the bar graph; creating is a higher skill, which uses the lower thinking skill of knowing. Hence a second answer choice of creating was considered correct in addition to the first choice, knowing.

Item #3 also had a distractor chosen by participants. Vignette activity: *A reading class has been reading a book with animal characters about friendship. In a class discussion, the students describe the characters' actions that show how to be a good friend.* Although the

correct answer was remembering, the thinking skill of evaluating could be considered correct if the students in the vignette are judging what actions show a good friend, rather than only remembering characters' actions from the story. The imaginary students would need to remember the character's actions as well as evaluate their actions against the criteria for being a good friend. So, this vignette also allowed two answer choices as evaluating is a higher thinking skill than remembering.

Item #9: *A social studies class has been learning about Kansas history. Students label the pictures in a booklet of Kansas symbols (the Jayhawk, wheat, flag, etc.).* Due to the ambiguity of the first sentence, which does not tell what the students did to learn about Kansas history, both answer choices remembering and understanding were coded as correct.

Items #1 and #5 also had higher difficulty levels (see Table 6). However, these items were not rescored for the several reasons. The participants appeared to have the most difficulty with item #1 (p-value of .25) on the CTSA. The first answer choice, applying, worked as a distractor, as participants chose applying as the type of thinking, instead of synthesizing as the correct answer. Synthesis is a higher level of thinking in Bloom's Taxonomy. Learners who would complete this activity in their K-12 classroom would need to understand the concepts behind the Civil War and the issue of slavery, as well as knowing that President Lincoln was the nation's leader of that era. Then they would need to determine which information to apply to their own letters, evaluate their information against the points they wish to make, and finally synthesize or create their own letters. This item points to the need for teachers to remember that students must exhibit the skills of remembering, understanding and applying with new material before they are able to use the skills of analysis, evaluation and synthesis with the new material. As Bloom (1984) noted, a "difficulty in classification results from the fact that the more complex behaviors include the simpler behaviors" (p. 16).

Participants also chose distractors in item #5, which had the correct answer of analysis thinking. On this item, 61% of the responses were distributed among the three incorrect distractors (Table 11). No conceptual reason was found to consider an alternate answer as correct, as analyzing is the highest level of thinking used in the instructional activity. The difficulty level of the item (see Table 6) was .38, which indicates the item was relatively difficult.

Table 11

Frequency distribution for Item 5

Answer Choice	Frequency	Percent
1	32	20.3
2	39	24.7
3	23	14.6
4	60	38.0
Total	154	97.5

When this item was given to four experienced elementary teachers and a high school principal to answer and share their reasoning, the teachers all answered it with the correct choice (analyzing), while the high school principal remarked he would not consider it upper level thinking in high school; students should be familiar with nouns and verbs by that point in their education. He would have considered it remembering, although his choice does not fit with the definition for remembering*: Involves the recall of specifics and universals, the recall of methods and processes, or the recall of a pattern, structure, or setting*. To answer this item correctly, students in a classroom would have to remember the definitions for nouns and verbs, but would then need to determine how each word fit against the definitions. This item speaks to Bloom's (1984) statement, "the experiential backgrounds of the students to whom the objective is to apply" (p. 16) may affect the level of objective appropriate for the teacher to use.

CTSA scores. After reconsideration of answer choices, new frequencies were calculated to assess participants' knowledge of Bloom's Taxonomy relative to instructional activities. Both sets of descriptive statistics, original and rescored answer choices, are given in Table 12.

Table 12

Correct Responses on the CTSA

Vignette # Level of thinking [1]	**Content area**	**Number of correct responses (percent of total responses)**	**Rescored number of correct responses (percent of total responses)**
1 synthesize	Social studies	25% (*n*=39)	
2 know or create	Mathematics	17% (*n*=27)	63% (*n*=98)
3 evaluate or remember	Reading	24% (*n*=37)	75% (*n*=117)
4 apply	Mathematics	50% (*n*=78)	
5 analyze	Language arts	38% (*n*=59)	
6 remember	Mathematics	74% (*n*=113)	
7 apply	Reading/language arts	57% (*n*=87)	
8 create	Science/language arts	58% (*n*=88)	
9 understand or remember	Social studies	22% (*n*=34)	63% (*n*=98)
10 analyze	Science	63% (*n*=96)	

[1] according to Bloom's Taxonomy of Cognitive Domain

Table 13 illustrates the levels of thinking used in the content areas and the number of participants who answered each thinking level correctly.

Table 13

Correct Responses Reported by Type of Thinking and Content Area

Content area / **Type of thinking**	**Social Studies**	**Mathematics**	**Reading**	**Language Arts**	**Science**
Synthesize	(*n*=39), 25%				
Create		(*n*=98), 63%		(*n*=88), 58%	(*n*=88), 58%
Evaluate			(*n*=117), 75%		
Analyze				(*n*=59), 38%	(*n*=96), 63%
Apply		(*n*=78), 50%	(*n*=87), 57%	(*n*=87), 57%	
Know		(*n*=27), 17%			
Understand	(*n*=34), 22%				
Remember	(*n*=98) 63%	(*n*=113), 74%	(*n*=37), 24%		

The highest number of correct responses was found in the items using evaluation/remember item #3, with 75% (*n*=117) of the respondents selecting the correct response. Respondents also selected the correct response for item #6 which used remembering type thinking (*n*=113) (see Tables 12 and 13). The preservice teachers chose correct answer choices for both of the vignettes employing application-level thinking, items #4 and 7, (*n*=78, 50% and *n*=87, 57%), and vignettes utilizing remembering/knowing type of thinking, items # 2, 6, and 9, (*n*=113, 74%), (*n*=98, 63%), and (*n*=117, 75%). The participants also chose correct answers for vignettes illustrating analysis-level thinking , item # 10, (*n*=96, 63%), a vignette illustrating understanding type of thinking, item # 9, (*n*=98, 63%) and both vignettes illustrating

creating type of thinking , items # 2 and 8, (*n*=89, 58%) and (*n*=98, 63%). The type of thinking with the least correct answers was the synthesis vignette, item #1, (*n*=39 or 25%).

When examining the vignettes by subject area, patterns appeared by content area. The preservice teachers chose correct answer choices for the type of thinking done in science instructional activities, items # 8 and 10, (*n*=88, 58% correct) and (*n*=96, 63% correct). They also chose correct answer choices for mathematics instructional activities, items # 2, 4, and 6, (*n*=98, 63%), (*n*=78, 50%), and (*n*=113, 74%). They also chose correct answer choices for the reading vignettes, items # 3 and 7, (*n*=117, 75%) and (*n*=87, 57%). One of the social studies vignettes, item #1, (*n*=39, 25%) and one language arts vignette, item # 5, (*n*=59, 38%) had the fewest correct answer choices.

CTSA scores by year in school. Mean differences for CTSA-R scores by year in school were examined with a one-way ANOVA (sophomore, junior, senior and fifth year or beyond). No significant differences were found for participants' scores on the CTSA-R when compared by their year in school, F (3, 142) =1.98, p=.12 (see Table 14 for means). Examination of the vignette scores by year in school shows similarities across grade levels in scores. The total mean score for all participants was 5.68 with a standard deviation of 1.80.

Table 14

Vignette Total Scores by Year in School

Year in school	N	Mean	Std. Deviation
sophomore	42	5.26	1.64
junior	45	5.96	1.89
senior	34	5.68	1.85
5th year seniors, professional year students and graduate students	25	5.88	1.76
Total	146	5.68	1.80

CTSA scores and comfort level. Examining the data from both the CTSA-R scores and the Demographic Survey question about comfort level provided a significant difference between those students with a self-reported comfort level of 1 and those who reported a comfort level of 2 or 3 when analyzed through ANOVA, F (2, 141) = 4.74, p=.01 (see Table 15). Post hoc Tukey HSD showed significance at the .01 level between comfort level 1 as compared to comfort level 2 and comfort level 3 (see Table 16 for means). The effect size for this difference shows a medium effect (cohen's d of .45) for comfort level 3 as compared to comfort level 1. The effect size when comparing comfort level 1 to comfort level 2 is small with a cohen's d of .27. The effect size for comparison of comfort level 2 to comfort level 3 is small with a cohen's d of .23. The post hoc analysis showed that participants who indicated lower level of comfort with HOT did not score as highly on the CTSA as those participants who self-assessed higher comfort in teaching using HOTS. However, participants who self-assessed having high comfort in using HOTS did not score significantly better on the CTSA than did those participants who indicated "somewhat" comfortable regarding teaching HOTS.

Table 15

ANOVA of CTSA-R Scores by Comfort Level

	Sum of Squares	*df*	Mean Square	*F*	Sig.
Between Groups	26.59	2	13.30	4.74	.01
Within Groups	395.63	141	2.80		
Total	422.22	143			

Table 16

CTSA-R Scores by Comfort Level

Comfort level	Mean	*N*	Std. Deviation
1	5.70	20	1.84
2	6.68	112	1.63
3	7.50	12	1.78
Total	6.61	144	1.72

Categories Relating to the Research Questions

From the interview data and the quantitative data, the following three major categories were discovered in relation to the first research question (see Table 17). First, the definitions of higher order thinking skills vary dependent upon several variables. Second, these definitions were determined from the interaction of several sources. Finally, background experiences affect the definition of HOTS for these participants. Each category was developed more fully using data from the interviews, the CTSA and the Demographic Survey.

Table 17

Categories Relating to the Three Instruments

Categories answering Research Question 1: How do preservice teachers describe critical thinking?	
Category 1: Definitions of HOTS vary.	
Category 2: Definitional development.	Topic 1: Instructor teaching style and course focus.
	Topic 2: Other life experiences.
Category 3: Background Experiences.	Topic 1: Teacher education coursework.
	Topic 2: Time and experiences in actual K-12 classrooms.
Categories answering Research Question 2*:* How do preservice teachers identify the thinking level of instructional activities?	
Category 1: Content areas affect expectations.	Topic 1: Teaching ideas vary with the content areas.
	Topic 2: Observations of higher order thinking skills
	Topic 3: Instructional activities to develop higher order thinking skills.
Category 2: Challenges of teaching higher order thinking skills.	Topic 1: Student reluctance.
	Topic 2: Faculty or administration concerns.
	Topic 3: Availability of materials.

Results for Research Question 1. How do preservice teachers describe critical thinking?

Category 1: Definitions of HOTS vary. The Demographic Survey of all 155 participants asked the respondents to indicate which of several stated phrases reminded them of

higher-level thinking skills. Participants could mark more than one response. According to these results, the majority (95%) of the participants chose critical thinking and 81% (*n*=125) chose Bloom's Taxonomy. Sixty-nine percent (*n*=107) also chose "using strategies to solve problems." To gain a more contextualized view of their definitions, personal interviews were conducted with four volunteers from the larger group of preservice teachers. The four volunteers held varying backgrounds in the content fields and varied teaching experiences.

The four participants represented three different middle/secondary content areas and one elementary education major. Names given are pseudonyms chosen by the participants. Laura had just finished her student teaching in a fourth-grade classroom in a rural/suburban school which had a new focus on Bloom's Taxonomy as the faculty adjusted to the Common Core curriculum. She described many experiences as an elementary preservice teacher in an elementary classroom as part of her coursework. Mikey was a middle/secondary education major in history and government and planning to student teach the following year. Mikey stated that she had done some practice teaching with a middle school classroom and in a ninth grade. Liam was a middle/secondary English major and would also student teach the following year. He noted that he had observed high school students but was "going in less prepared than I would like to." He also worked at the campus writing center so he had gained experience teaching writing in that context. Haley was a middle/secondary education major in chemistry and would be ready to student teach the following spring semester. She commented that she had previously taught a couple of science lessons to high school students, a couple of lessons in a sixth grade, and a few lessons with a fourth grade combined mathematics and science class.

Three of the four participants seemed very eager in their behavior and voice to talk about higher-level thinking skills. I met individually with each participant in an open workspace in the education building on campus. Haley appeared more shy and reticent in discussing her thoughts.

Laura was very enthusiastic and excited to talk about her student teaching experiences. Mikey relaxed and expanded upon her answers as the interview progressed. Liam was very comfortable talking about HOTS and his thoughts on the questions. His interview lasted almost two hours, whereas the other interviews ranged from 40-70 minutes. As Corbett (2003) explained, qualitative interviews that are perceived as being conversations may elicit more open responses from participants.

Before going deeper into the discussion, each participant explained his or her definition of HOTS. All four described HOTS as thinking beyond the textbook and using the information in some way. After that, their definitions appeared to diverge into their content areas. Mikey and Laura both used the terms "going deeper into the text or topic." Mikey, from history/government courses, spoke about "going into the perspectives of different people in history… putting context and purpose to the instruction." Haley, with the chemistry perspective, talked about "using material in higher level ways–synthesizing, real life applications, designing new experiments off something we've already done." Liam, the English major, articulated that critical thinking meant 'being able to apply logic to a great number of sources, knowing that one should do that, that one should seek out as many sources as one can… ways of looking at multiple sources… the process of thinking with the knowledge that you are always going to have to assimilate something more than you anticipated." Laura, having just completed the semester-long teaching internship, also added that higher order thinking was about "building meaning with the text, and problem-solving in mathematics, and building on what the students' know to go deeper into the topic." All of the participants indicated they believed higher-order thinking is based on applying content as Snyder & Snyder (2008) suggested.

None of the participants spontaneously referred to Bloom's Taxonomy in their descriptions of higher-level thinking, although all mentioned they had heard of it in their classes.

When asked, Mikey noted, "It was mentioned, cursory but that's what we've been taught." Liam also said, "We covered it in class. I haven't gotten it internalized in my bones." Haley, however, remarked that "I heard it in one of my courses a lot, we used it for forming questions for objectives, the hierarchy, um what words are used to describe each level. I'm fairly familiar with it." Haley also used the term "synthesizing" in her definition of HOTS. Liam also intimated the use of the term "synthesizing" as he discussed "you are always going to have to assimilate something more." Laura believed her familiarity was enhanced by her experiences in student teaching. She was the only participant who could recall the levels of Bloom's Taxonomy spontaneously. She disclosed that "I have more of the end goals in mind now for objectives. I'm more intentional now to fit them [objectives] into higher levels of Bloom's." None of the participants used the other terms for thinking skills from the Demographic Survey, with the exception of Laura who mentioned problem solving. Also, Liam alluded to the need to seek out multiple sources of information. So, it seems that although the preservice teachers have heard of Bloom's Taxonomy, it does not necessarily come to mind when discussing higher order thinking, until they are prompted.

Category 2: Definitional development. A question on the Demographic Survey asked participants to write in any college courses that taught them to use HOTS with students. Answers varied considerably. This question elicited comments as well as the requested information, and was the only question to which the participants added unsolicited comments. Comments from secondary-level majors included, "They all kind of talk about it without actually talking about how to do it." Another participant noted, for a curriculum course, "We focused on the use of meaningful assessments and lessons and looked at in-depth questioning strategies and discussion." Another participant wrote "very few" in terms of courses that taught about using HOTS with students. Some described particular methods courses, such as "Teaching Social

Studies and Teaching Kansas Government required me to use higher order thinking skills in our discussion and projects." Another preservice teacher described a curriculum course and the classroom instruction course: "Both talked and discussed with us the importance of using HOTS."

The question from the Demographic Survey relating to "phrases that remind you of higher-level thinking skills" corroborates the sources of background information on HOTS. For instance, 81% (*n*=125) of the participants noted that Bloom's Taxonomy reminded them of HOTS. Participants noted they had learned about Bloom's Taxonomy in their education coursework. However, 95% (*n*=147) of the participants chose critical thinking as a term reminding them of HOTS, indicating they have learned this term in relation to higher order thinking skills somewhere. Elementary education participants have completed several courses in teaching mathematics in classrooms; according to the literature, "using strategies to solve problems" is a term for HOTS used in mathematics. Sixty-nine percent (*n*=107) of the participants chose this option. However, only 34% (*n*=52) of the participants chose "scientific thinking" as a term reminding them of HOTS, indicating perhaps other terms are used in science courses. Coursework may influence the terminology participants use when referring to higher order thinking skills.

The interview participants provided confirmation of Kagan's (1992) findings that K-12 experiences as students influence preservice teachers' awareness of instruction and content when they begin teaching. For example, two of the participants described high-school courses that helped them develop their thinking skills and that influenced their perceptions of ways to teach thinking skills. Mikey experienced a team-teaching course that encouraged students to use critical thinking. "My high school honors history teacher collaborated with my English teacher. The English teacher was also the drama teacher. We had not just papers but learned how does

history go with performance. We had to really think about it through different dimensions. Think that activated lot of different skills." They "always asked that you go deeper than text, focus on more than the dates in text, go into perspectives of different people in history." She also commented that in middle school, her classes were "project based." Haley shared, "I had one really good social studies teacher. His tests were built so they had short-answer and some essay. In my education classes I learned about some of the tools my best teachers used....Now I understand why my high school chemistry teacher did stuff."

Topic 1: Instructor teaching style and course focus. A question on the Demographic Survey asked students to describe courses that taught them to use HOTS with students. At least 22% of the participants noted the methods courses or the inquiry block taught them to use HOTS with students, while 34% of the participants noted the same for the Student and Curriculum course. The methods courses for future elementary teachers are grouped so that participants complete math, science, literacy and social studies teaching pedagogy courses in the same semester, labeled an inquiry block. The Student and Curriculum course focuses upon the interaction of the student, teacher, and curriculum and the factors that influence curricular decision-making. No other courses within the field of education or in the general university generated more than 10% of the responses for this question.

However, students may have noted individual courses that helped them understand higher order thinking skills. One participant wrote that the children's literature course helped build these skills, as did the non-School of Education course Logic & Critical Thinking. "We learned about valid and invalid reasoning." Another student described the English courses at the University: "All English courses with synthesis of information." As they engage in classroom teaching, the way their personal knowledge of HOTS will translate to teaching students remains to be seen.

Among the four interview participants, their perspectives of the influences on their definition were as varied as those of the other participants. All four participants indicated they believed their college courses helped them develop their skills and knowledge of thinking. While Laura, who had finished her progression through the education courses, noted, "I think that a lot of my classes gave me great ideas that have HOTS in them." She explained how the Student and Curriculum course introduced her to Bloom's Taxonomy and different teaching strategies. The methods courses each provided a different focus using thinking skills, such as the 5e model in science, the concept attainment method in social studies, helping students understand abstract concepts in mathematics methods, and how to demonstrate metacognition through think-alouds in reading methods. Liam, however, discussed education courses as being more practical application and more historical in their mindset: "This thing led to this thing led to this, good at looking at the real world" and his English courses emphasized more of "what does abstraction mean?" Haley also commented that the education courses were "more like here, do this" in contrast with her chemistry courses in which she has to "draw conclusions for myself and …step outside of my comfort zone." Mikey, however, didn't offer any specifics on her college courses teaching her to use thinking skills other than, "I've been really fortunate to have really good teachers." Their interpretations of thinking skills appear to flow from different college courses, not only those taken in the teacher education program. These preservice teachers appeared to gain knowledge of thinking skills from their courses. Coursework may develop thinking skills, depending upon the course focus and teaching style of the instructor.

Topic 2: Other life experiences. According to these four participants' narratives, other influences also contributed to their awareness of thinking skills. For example, moving as a military family (Drummet, Coleman, & Cable, 2003), studying the Bible in depth (Solvang, 2004), and following online message boards (Sahu, 2008) enlarged thinking skills for these

participants. Mikey explained that she was from a military family who moved a lot. She found that coming to Kansas, with its home-town feel,-which has many people who see others they know and who return to their hometowns, "see things differently" than she does. "I don't have a home to go to; coming here was the longest time I've lived not on a base…I see things differently." She added, "History is full of people who had to move… people were moved forcefully. Kids, who haven't had to move, don't understand that. I have to teach to different life experiences of children." She also commented that she was resident assistant in a dorm for two years. "That took a lot of problem solving and critical thinking." Mikey's life experiences broadened her perspectives relative to new situations.

Laura discussed her experience of teaching a Bible studies discussion group. She noted that she had to think critically as she had "taken a text and diving deeper into it, how do things fit together, asking questions about it, reading and writing about it, abstract thinking, compare and contrast." Leading a discussion group helped her to become more of a critical thinker. Liam also had the experience of teaching others, which helped his ability to think logically. "The writing center is great cause you're constantly being exposed to thinking, constantly reading, constantly helping people with their thoughts, and finding the best way to help a person structure their thoughts." Teaching others in a tutoring situation seems to have provided a basis for Liam to grow in his thinking skills.

Liam also discussed the ways that Internet message boards have helped develop his views of critical thinking. On Internet message boards, "people just talk about politics and their day so a bunch of people doing activity, that increases critical thinking ability, and they're all just arguing about stuff, leads to pretty competent community for argument. Reading that is pretty good for my ability to understand arguments." Sahu (2008) noted that online discussion boards can be a way to build students' thinking skills. Liam seems to have found this true. The

experiences of these four participants holds true in light of research conducted by Terenzini et al. (1995), which found increasing evidence that interactions with college peers, faculty, and outside of class experiences contribute to gains in cognitive abilities. Other factors in a person's life can influence perception of thinking skills.

Category 3: Background experiences. Another question on the Demographic Survey asked the participants to determine if they felt very comfortable, somewhat comfortable, or not very comfortable with the thought of teaching HOTS in the future. The respondents chose somewhat comfortable (77%, *n*=120), with more participants choosing not very comfortable (14%, *n*=21) than very comfortable (8%, *n*=12).

Topic 1: Teacher education coursework. The elementary education students (34%, *n*=53) reported generally learning about HOTS in their Student and Curriculum course, as well as in their methods courses (22%, *n*=34). During their methods courses, the elementary education majors wrote objectives and lesson plans in addition to learning the specifics of teaching a particular content area and assisting in elementary classrooms. Among the participants from the inquiry block methods course, one person wrote, "Curriculum classes that taught about Bloom's Taxonomy and how to include them in objectives." Another participant from this course noted, "I have had methods courses where we learned how to write objectives and assess higher order skills." Another participant reiterated this comment, "I learned about it in inquiry (methods) classes. Used some of that knowledge when creating lesson plans." One participant described a particular assignment used in different methods courses which required the use of higher order thinking skills: "Doing interviews and assignments that require students to analyze pictures" (History Through a Child's Eye project in inquiry block methods courses, interviewing students for several courses). Several participants explained that any course with a practicum helped teach them how to use HOTS with students. Another student wrote, "All

school education courses encourage us to teach using HOTS." This was reiterated by comments from other participants similar to this one: "In almost every class we talk about Bloom's Taxonomy." So these participants believe the methods courses were particularly helpful in teaching them about higher-level thinking skills and Bloom's Taxonomy.

Among the four interview participants, Mikey was the only one who said she felt prepared to use HOTS with her classes. "I've been fortunate to have really good teachers." Both Laura and Haley responded that they were not completely ready. As Haley said, "I'm not sure I'm ready now. I like to think I can do higher order thinking, but it's been kind of natural for me, not to brag or anything. I'm not really sure how to identify which are higher and which are low, however, so I'm not really comfortable now." Laura commented that "Overall I feel pretty prepared but not completely. When I think of my classes I don't think of HOTS necessarily right away." Liam expressed his pleasure, more than once, in being able to talk about higher order thinking but also expressed concern about his upcoming student teaching experiences and his lack of readiness for it. This finding is supported by O'Malley Kelley's (2003) study of preservice teachers' confidence in teaching thinking skills.

Topic 2: Time and experience in actual K-12 classrooms. The students participating in the elementary education program spend time during their professional education courses in public school classrooms observing, assisting the teacher, and beginning to teach lessons. This is indicated by the data (Table 9) listing the number of students who have had teaching experiences in grades K-6, early childhood and upper elementary (48%, n=57). All elementary majors spend their final year of the program in two classrooms participating in the student teaching experience. The secondary education majors do not necessarily spend that required class time in public school classrooms prior to student teaching in their final year of the program. The amount of time these secondary education preservice teachers spend in the classroom is dependent upon

their content major. Additionally, students may have volunteer experiences teaching or assisting in schools, or they may be employed in childcare centers. The participants working towards preschool/early childhood certification had 17% (*n*=1) feeling very comfortable; however, 17% (*n*=1) also chose not comfortable with teaching HOTS in classrooms. The K-6 certification participants had 10% (*n*=10) feeling very comfortable, but 15% (*n*=15) chose not comfortable with teaching HOTS. This was similar to the secondary education certification participants who had 9% (*n*=1) feeling very comfortable and 18% (*n*=2) not comfortable. The preservice teachers had varying amounts of interaction with actual K-12 classrooms, which may contribute to their comfort level in teaching HOTS.

The experiences of the interview participants in K-12 classrooms may offer explanations related to the time and quality of experiences affecting comfort level. For instance, Mikey mentioned that, in one of her practicum experiences, she had students who

> "tried to go to the next level and were discouraged. They were told they'll get there later, but the rest of the class wasn't there or this students isn't able to do that, so we won't go there, if somebody said something that was critical thinking."

She shared that the teachers gave the impression that if you answer a student who says something involving higher-level thinking, "It was perceived you're teaching to higher kids, so the other kids are not getting what that child said, so you don't address that child's comment. Some kids think critically naturally." Her experiences seemed to provide concern for her future work with students when teaching thinking skills in her future classrooms.

Haley seemed to have differing experiences in her practicum experiences with elementary and secondary students. She explained that, in her experience with fourth grade students doing an inquiry lesson with Kinects cars, the children made realizations about cause-

effect as part of this activity. She also noted that the high school students in her course practicum

> "were against HOTS to an extent, for some of the students. The students are used to the teachers telling them information and I'll get an A even if I just learn this and that's it. Some students when you force them to think outside the box and discover the info for themselves, they're resistant. It's not a skill they've used so it's new to them."

As C. Thompson (2011) noted, "Too often students resist critical thinking exercises or perceive them as being difficult because they had not been socialized to probe, question, and analyze until the intermediate grades" (p. 2). These experiences may have contributed to Haley's stated trepidation about teaching critical thinking in future classrooms.

Laura's experiences were of longer duration, as the school for her 12-week student-teaching experience had a professional learning community, which was trying to incorporate more HOTS into the reading curriculum. She explained the teachers were focusing on higher order questions. The basal reading series had text with pre-made questions and the teachers thought they were pretty good. "But the principal said even other teachers need to use more higher order thinking skills, so those pre-made questions didn't cut it." They had videos of teachers creating questions using Bloom's Taxonomy for training. Then they, the teachers, used strategies to teach their students how to ask questions in reading. "We color coded the questions on a grid for the kids, red were basic level questions green were higher levels. I started creating questions as I taught." The students learned to list questions they should ask themselves at different levels as they read.

> "They started creating their own questions in small groups …actually they got really good with questions coming up with stem words. We have to work towards questions

that are meaningful, that go deeper. It was neat to see the kids on lower levels being able to create questions but it takes them longer but they're able to do it."

She also shared that the students were "really excited about the questions. It was a neat way to motivate them."

Laura seemed enthusiastic about using HOTS with her future elementary classrooms after this experience. This reiterates Hollingsworth's work (1989) that student teachers are influenced by their student-teaching experiences. Laura also seemed to benefit from increased experiences in the elementary teacher education program resulting in her ability to articulate knowledge of thinking skills. This follows the work of Lumpe et al. (2000), who found that more experience increased comfort level in teaching science.

Results for Research Question 2: How do preservice teachers identify the thinking level of instructional activities?

Research Question 2 also yielded interesting findings from the four interview participants. Their descriptions of critical thinking in the classroom developed from several sources, including their content area background. They also stated concerns they felt about future teaching of thinking skills in K-12 classrooms. Each of these categories is described in more detail.

Category 1: Content areas affect expectations. The content areas in which participants will teach in future classrooms appeared to contribute to the expectations they shared about the use of higher order thinking skills.

Topic 1: Teaching ideas vary with the content areas. Although all four interview participants had ideas about ways they would incorporate higher-level thinking skills into their future classrooms, their ideas varied with their content areas. Liam, the future English teacher, described future activities to help his students think at higher levels by

> "doing activities that force them to lay out their thought processes…that way you get to see how they do things. Can you see did the student make the most obvious conclusion? Did they search around, what are their techniques, what are their intuitions, how do they feed into skills we call critical thinking?"

He did not share any specific strategies he would use in his English classrooms, but he has general ideas to lead his way. He noted that he sees the teacher's role as being an "encourager" for his students.

Mikey, the prospective secondary-level history teacher, described that she would have students work with the whole issue and different frames of reference around a topic. Then, she added, "make it like a concrete example, not just throw in what needs to be worked, not just like a critical-thinking worksheet." She used the example of investigating the Civil War from both the North and South side, the Western frontier, and the perspective of women and children, in addition to the soldiers' point of view.

The future chemistry teacher, Haley, discussed lab experiments in which the students "design their own experiments off of something they've already done" and using technology as a means to incorporate HOTS into high school science classes:

> You could use technology to do virtual experiments. I found a virtual gas chamber [online] where you can change virtual pressure, volume, temperature. It's easier to have the students be engaged and draw conclusions from that; it's easier than trying to do an actual lab. It could be really helpful.

Laura, the elementary education major, described ways HOTS could be incorporated into the subject areas that comprise elementary classroom curriculum. She noted that questioning could be done at different levels.

> "In the science classroom, students can come up with questions and hypotheses on their own. On certain subjects they could be guided, they could develop their own tests to try and use info to come up with explanations for whatever they're testing. From that I can come in as teacher and fill in with where there's gaps or where misunderstanding is. You take what they discover and have them expand upon to create new ideas."

Laura's ideas for HOTS in mathematics class related to problem solving.

> "In math I have them in position to solve problems on their own, so they have other ways to solve it, not just the way I did it. Give them strategies so they can work through it in their heads… expand their knowledge with word problems, real life applications."

She noted in reading, "There's such a lot going on, learning to read can be higher order…so much opportunity to expand upon what they know to build connections, in the same way in each subject."

Topic 2: Observations of higher order thinking skills. Another area of research interest was what the participants thought they would see or hear when their students are using HOTS. Both Liam and Mikey indicated they would be able to tell when students are thinking critically by their verbal answers. Mikey felt the clue would be to "listen to the questions they ask, look at how black and white are their answers, do they have the idea," and Liam asserted,

> "I will look for signs of creativity, especially when students deviate from what I expect… critical thinking is more an art of figuring out the space between how you hear and how you intend to hear and how other people hear something."

Class discussion may be important tools in their future classrooms. Haley seemed to be influenced by her practicum experiences as she responded, "They're the students more interested in learning. I guess you would see engagement in the lesson." Class discussion could also be a

useful tool for her in her chemistry classes. Student group work and discussion may be a means to determine if higher order thinking is occurring with students.

Laura found, with her fourth grade students in her student-teaching experience, that all the students, in groups, could come up with questions at different levels.

> "Yeah it took all groups some prompting to move them into that section. The higher groups were able to come up with more questions. Some kids came up with nine different questions. Some kids, even in the high group, came up with not as many, but they were really thinking about what they wrote. The better questions were from higher level group….It was neat to see kids on lower reading levels able to create questions. It took them longer but they're able to do it."

Laura also discovered that she needed to support and model creating questions for her students. It's

> "important for me to model that for students, so they can see how it's done. But it's hard to know how much to do cause you want them to construct knowledge on their own, but I have to equip them with the tools so they can do that on their own. …I'm excited to learn more how to help them do it."

The interview participants held various ideas to determine if their future students will be using higher order thinking skills and the types of support they, as teachers, will need to provide students.

Topic 3: Instructional activities for students. In order to assess their future students' ability to use HOTS, several of the participants felt projects would be a good method. "I'm a big fan of inquiry projects, but they take a lot of time," Haley remarked.

Laura also preferred the idea of projects to assess students' learning, as well as using authentic assessments and essay questions. In addition, she believes in using diagnostic assessment,

> "even at the beginning of the year, cause it will tell me where kids are at, what conceptual knowledge they have, or do I need to spend time building that first, before they can use the concept and use it in different ways to use the concept critically."

Laura defined the need to determine students' prior knowledge before beginning thinking in a topic, as well as methods to assess students' thinking upon completion.

However, Liam reported he would rely more on discussion and signs of creativity in his students.

> "I plan to make discussion a big part of classroom responses from my students, open-ended responses a big part of classroom. That's the stuff that will draw out the critical thinking as much as possible…in classrooms when you see people respond to ideas; it gives an idea of their understanding of complexity of ideas."

Projects and creativity may be methods to develop higher order thinking in students. These preservice teachers stated several pedagogically-similar ideas for student assessment in their courses.

Category 2: Challenges of teaching higher order thinking skills. Although all four of the interviewees planned to use HOTS with their future students, they indicated there may be difficulties in using HOTS in their classrooms. These difficulties were grouped in three main categories: student reluctance, administration or faculty expectations, and resources.

Topic 1: Student reluctance. Based on their experiences as students and in practica, the preservice teachers may hold different views about the ability of all students to think critically. Mikey stated, "All students are capable of thinking critically. I think kids are capable of

memorizing and thinking." However, during the conversation with the participants, all four expressed concerns of one sort or another in regard to their future students and using HOTS. Liam explained,

> "It depends on the individual student. Probably depends on what's holding them back, if it's a general aversion to risk taking, that's understandable….If a student isn't necessarily afraid of thinking critically, but too lazy, it usually means they're intimidated or don't care or have something more important to think about."

Haley had found the elementary students in her fourth-grade practicum were not aware they were thinking at higher levels when they were doing an inquiry activity, but the high school students were going to need more encouragement. She remarked,

> "It's just a personal view I have, the students are used to having the teacher tell them info and I'll get an A even if I just learn this and that's it. Some students, when you force them to think outside the box and discover the info for themselves, they're resistant. It's not a skill they've used so it's new to them."

Haley also recognized the variability of student experiences and background knowledge as a factor in using HOTS. She explained, "At the secondary level we want our students to know the basics of these skills" when the year begins,

> "but that's not always the case and just the fact that students are so much different, ideally you assess each student and group them by achievement levels they're at. Some start at lower level and work up. If you give a struggling student a complex synthesis problem, they'll just go I don't know what to do. But there will be some students who do know what to do and so you have to differentiate instruction for them."

These findings are important in the context of Zohar and Schwartzer's (2005) work in that "Teachers' knowledge and beliefs carry important significance for their practice, and thus

influence students' learning" (p. 1596). These early experiences as preservice teachers may have impacted the new beliefs these future teachers carry about their students' ability to think at higher levels.

Topic 2: Faculty or administration concerns. Liam was concerned that creative projects may not be allowed at his future schools. "You have to justify a case for doing something. Other people might not see your case as being reasonable; you have to work in the system." Laura also noted that that the lack of time and demands to prepare students for testing may limit the opportunity to do projects with students. Faculty or administration expectations may limit the types of thinking and activities that may be allowed in a classroom.

Topic 3: Availability of materials. Laura and Haley both expressed concern that there may be lack of materials for higher-level thinking in the schools, but Laura maintained it was "my responsibility as teacher to meet kids where they are at. I just have to think outside the box, but yeah, materials are there." Haley remarked, "…you have to pull resources together. It's a lot of work to make students use higher order thinking but it's definitely possible." Mikey reported she could find plenty of resources using Google and YouTube and remarked she was "really happy I teach in this time cause it's so easy to find stuff." She also indicated that she planned to use materials in the library, especially perspectives on different historical events. None of these participants noted an issue with lack of planning time interfering with their ability to use HOTS, as Anderson & Krathwohl (2001) discussed as a reason for teachers who did not use HOTS in their classrooms. Materials to teach HOTS are available if teachers search for them, according to these participants.

Summary

The participants, especially the four interviewees, offered relevant insights into the research questions. Although most had heard of Bloom's Taxonomy in at least one course in their teacher education programs, they did not spontaneously equate it as a term for higher order thinking skills. No particular class was cited as a source of their knowledge about Bloom's Taxonomy. A strong student-teaching experience had a major impact on the one participant in terms of her ability to conceptualize and discuss her experiences and ideas related to HOTS. Having experienced higher order thinking skills in K-12 appears to offer them ideas for using HOTS in their future classrooms, in very discipline-specific methods. Prior teachers in their K-12 experience influenced their awareness of ways to teach in their discipline in several cases. College courses also were seen as a means to learn to use critical thinking, as were several other extracurricular activities. They held varying beliefs about students' ability to use HOTS in their future classrooms and saw several obstacles to teaching and using thinking skills. Chapter Five elaborates upon the possible reasons, relationships and implications of these results, in addition to exploring future questions for research.

Chapter Five

Discussion, Conclusions, and Implications

The purpose of this study was to explore the beliefs of preservice teachers about thinking skills in order to uncover their described influences upon those beliefs and to study ways the participants of the study might expect to see thinking skills used in their future classrooms. Because both breadth and depth of participants' knowledge were sought, it was determined that a mixed methods design would provide necessary data. Quantitative methods were employed to gather data from a sample of participants in the preservice teacher education program (N=155) at a midwestern university. Then, constructivist interviewing of a smaller subgroup was used in order to explore, in more depth, the thinking of the subsample about thinking skills. Chapter Four explored the results of the study; this final chapter will discuss the results and then advance conclusions based on these results and the implications for future practice.

Study Background

This study was developed and designed to provide information about the awareness of higher order thinking skills (HOTS) held by preservice teachers. Although much study has been conducted on the beliefs of inservice teachers, study of the beliefs of preservice teachers is an emerging focus of research. Beliefs shape the practices of teachers in their classrooms. Teaching practices affect the curriculum and instruction of their students. The Common Core Standards demand students build higher-level thinking skills. Zohar and Schwartzer (2005) wrote, "Teachers' knowledge and beliefs carry important significance for their practice and, thus, influence students' learning" (p. 1596). Yet, lacking knowledge of beliefs on HOTS interferes with the skill and enthusiasm teachers bring to this more challenging teaching task. Without this

knowledge of preservice teacher beliefs about HOTS, the interaction of these teachers' practices with thinking skills, as they begin their teaching careers, is unclear.

The frame for this study and the chosen research methods were guided by the research questions:

1. How do preservice teachers describe critical thinking?
2. How do preservice teachers identify the thinking level of instructional activities?

Research Instruments and Participants

In order to investigate these questions, several instruments were developed. A Demographic Survey gathered basic data about the participants and included questions concerning their teaching experiences, their comfort level about teaching higher order thinking skills (HOTS), and the courses that taught them about thinking skills. Additionally, the Classroom Thinking Skills Assessment (CTSA) was developed, reviewed by practicing teachers, and administered to the study participants (*N*=155) in order to determine their level of knowledge in identifying the levels of thinking, according to Bloom's Taxonomy, used by students in instructional activities. Finally, a series of interview questions were outlined that allowed for additional question probes to be used in the interviews of four participants.

The participants in the study were undergraduate preservice education teachers enrolled in the teacher education program at a large midwestern university. The participants included sophomores, juniors, fourth- and fifth-year seniors, and participants in their professional year after graduation with a bachelor's degree. All were enrolled in teaching-methods courses or student-teaching practica required of all preservice teachers. Convenience sampling was used to approach the students in classes with interested instructors. Voluntary participants (*N*=155) completed the two quantitative instruments and noted on the forms if they were interested in the

interview portion of the study. Of the participants who expressed interest in the interviews, four were able to find time at the end of the semester for the interviews. The lack of interest among the other elementary level participants was a definite surprise to the researcher. The four participants who participated in the interviews represented three different content areas in secondary education and an elementary education major who had just completed her student-teaching experience. Therefore, they provided a cross-section of backgrounds and pedagogical ideas across future teaching levels and content areas.

Discussion of the CTSA

The CTSA instrument (Appendix B) was developed for this study as a means to investigate the knowledge of preservice teachers on the levels of thinking used in K-12 instructional activities. The CTSA was based upon a set of 10 vignettes with thinking skill levels taken from Bloom's Taxonomy as answer choices. From the four word choices given for each vignette, the participants were to choose the highest level of thinking used by the students in the activities. Vignettes were created around each of the major subjects taught in schools; at least one vignette illustrated each of the six thinking levels from Bloom's Taxonomy. The vignettes were reviewed and evaluated by practicing or recently retired elementary teachers for clarity, construct and content validity. Reliability of the instrument was explored using the correct answer choices and frequency of incorrect answer choices made by this group of teachers. Items with incorrect answer choices were examined for response patterns, with no commonalities found. Revisions were made to wording for two of the vignettes based upon the teacher recommendations.

The instrument was scored as the number correct out of 10 possible correct answers. While the experienced teachers, who served as content validity judges, were better able to discriminate among the answer choices, the preservice teachers had more difficulty with the task.

The difficulty levels of the vignette items, excepting items #1 and #5, ranged between .50 and .75. Several vignettes appeared to challenge the participants' comprehension of thinking skills. Their scores could indicate a struggle to identify different levels of thinking in terms of the instructional activities in the vignettes, a lack of understanding of the operational terms of the thinking skills in the answer choices, nonrecall of the highest levels of thinking skills of the four choices given for each vignette, or a difficulty with the instrument's ability to measure a working knowledge of Bloom's Taxonomy. After review of the descriptive statistics for the items and reviewing the items for level of thinking skills, three items' answer choices were reconsidered so that two answer choices were possible. New descriptive statistics were conducted on the revised scores. Participants responded accurately to items related to science instructional activities, with the most difficult subject area related to thinking skill being social studies. Among the levels of thinking, participants were most often correct on the items using evaluation and remembering. The items incorporating synthesis level of thinking received the fewest correct responses (see Tables 12 and 13).

An ANOVA revealed no significant differences between the CTSA-R scores and years in school. The reasons for that are unclear since one would reason that increasing knowledge of thinking skills due to more education coursework would result in an increase of scores as students progress through the program. The lack of a significant difference could be caused by a lack of continued emphasis on thinking skills in upper levels of education coursework, as instructors perceive Bloom's Taxonomy and thinking skills are taught in prior or other courses. Programmatic changes could have affected outcomes as well.

Instructor Responses

The scores on the CTSA prompted the researcher to contact 19 instructors in the teacher education program at this university to discover how they taught thinking skills and Bloom's

Taxonomy in their courses. Their comments would provide contextualization when interpreting the participants' responses on the Demographic Survey, the scores on the CTSA, and the interviewees' responses. Contacts were made either via email or in person during the data analysis phase of the study. These contacts were made in the year following data collection, so there were some changes in teaching assignments. However, of the nine instructors who responded to the researcher's query, only three instructors were in their first year of teaching at the university. It is likely the students would have had experiences with many of these instructors. Their responses proved very enlightening.

The following questions were answered by nine of the instructors teaching preservice education courses. Additional questions were asked of several of the instructors to solicit more information, dependent upon their initial answers.

- What terminology do you use when teaching the undergraduate education students about higher-level thinking skills?
- Is Bloom's Taxonomy something that is mentioned, taught in more depth, or used when they create lesson plans and activities?
- How do the preservice teachers express their understanding of thinking skills in your course?

The instructors for the inquiry block methods courses (elementary level science, mathematics and social studies) approached Bloom's Taxonomy and higher-level thinking in their courses through various methods. The preservice teachers (juniors and seniors, n=24) enrolled in the inquiry block course were taught by an instructor who had previously taught secondary level history and described herself as emphasizing the use of thinking skills in the methods coursework. These preservice teachers were required to write objectives at the higher levels and watched videos of teachers in action to identify the level of thinking used. This

instructor also noted she discussed Bloom's Taxonomy but used the term 'higher-level thinking skills with the students. Students needed to include both higher and lower level thinking when writing objectives and needed to create activities at both levels (private communication with instructor, January 2013).

The elementary science-methods instructor responded with the information that he shows his students Bloom's Taxonomy. His students have to write objectives, although the use of Bloom's Taxonomy is not required. He noted that, in his course, thinking skills are developed indirectly, mainly through designing science experiences and in ways the preservice teachers were learning to guide their future students in analyzing data. He used the term "science process skills" instead of thinking skills, which includes Bloom's Taxonomy, predicting, hypothesizing, problem-solving, and designing experiments. His elementary education majors analyzed teaching methods in videos of science classrooms, but they did not specifically look at the type of thinking skills demonstrated in the video.

The mathematics methods instructor noted that her course encourages students to conceptualize mathematical knowledge and ways to teach students to use mathematics data. The preservice teachers complete the three inquiry block courses (mathematics, science, and social studies) in the same semester, so they were shown and used thinking skills in different contexts.

This finding is consistent with the question on the Demographic Survey asking study participants to describe courses that taught them to use HOTS with students. At least 22% (n=34) of the participants noted the methods courses and the inquiry block taught them to use HOTS with students, while 34% (n=53) of the participants noted the same for the Student and Curriculum course. No other courses within the field of education or in the general university generated more than 10% of participants' responses for this question.

The secondary level preservice teachers (juniors and seniors, n=12) enrolled in the

Reading in Secondary Schools course may not have taken many formal methods courses at this point in their program. Their focus had been on the content courses for their major teaching area, such as history or English. The instructor noted that she discussed and used Bloom's Taxonomy in multiple ways with the preservice teachers during the course. To use thinking skills in her course, the students develop test questions over the course material and share the question with the class. The other students have to agree or the question writer must defend the question's use. She also discussed the questions in relationship to higher-order thinking questions as a way to review course material with her students. Her varied uses of Bloom's Taxonomy may have contributed to the positive scores of the secondary education participants on the CTSA-R.

The terminology which instructors use in their teacher education courses and the uses of HOTS in the courses may influence the way preservice teachers perceive HOTS. However, as the literature on teacher beliefs demonstrates, teacher education coursework may not influence preservice teachers' beliefs as strongly as other experiences.

Discussion of the Demographic Survey

The Demographic Survey was developed for this study to gather basic demographic data on the participants as well as their responses to questions related to their education program and experiential background in teaching (Appendix A). Several items on the Demographic Survey also posed interesting results (see Table 9) from the participants.

One question asked participants to note any courses they had taken which taught them to use higher order thinking skills. The only clear responses were related to the inquiry block methods courses and the Curriculum and Learner course, required of all elementary level preservice teachers. The methods courses and inquiry block were listed by 22% (*n*=34) of the participants as teaching them about HOTS, while 34% (*n*=53) of the participants noted the

Curriculum and Learner course as teaching them about HOTS. However, participants did not agree on these courses or on the definitiveness of the knowledge gained in these courses. Some seemed to believe they had been well introduced and taught, while others felt less prepared in this respect. A student teacher noted, "I took a course called Curriculum & Instruction where I learned how to plan lessons based on Higher Order Thinking." Another student recalled the methods courses being useful in learning to work with HOTS: "Social Studies, Science, Mathematics in Elementary Classroom practiced teaching based on Bloom's and discovery learning/exploratory." A different student teacher wrote, "Many courses focused on the various levels of Bloom's Taxonomy, either directly or indirectly." However, another student teacher wrote, "I don't think so, possibly our methods courses at SOE." Another student believed that "Almost all school of ed courses discussed this at some point." Another student teacher wrote, "I took one class that explained higher-order thinking, but I feel I never had an opportunity to formulate questions." The student, unfortunately, did not differentiate between questions she/he may have had about HOTS, and questions using HOTS with students. Another student teacher noted, "I have been told/taught what they are, but not at all how to teach them."

Another question evoking interesting differences related to phrases that reminded participants of higher-level thinking skills. The question (see Table 9) asking participants to choose the listed phrases that reminded them of higher-level thinking skills educed differences between the secondary education majors as compared to the responses of the elementary education majors. For instance, 100% (n=12) of the secondary education majors indicated critical thinking as a reminder of HOTS. The elementary level did not choose critical thinking as frequently as the secondary level group of participants. Could this difference in terminology lie in the more extensive content area coursework the secondary level preservice teachers have

experienced as compared to the extent of teacher education coursework experienced by elementary education majors at this point in their programs?

However, those elementary education majors, who were in their methods-course year or in student teaching, chose Bloom's Taxonomy as a phrase reminding them of higher-level thinking skills from 96% to 100% of the time when responses were examined by planned teaching level. Perhaps these responses are reflective of the practical experience the upper level preservice teachers have in actual classrooms, as Bloom's Taxonomy receives increased emphasis in schools with a focus on the Common Core Standards. The State Department of Education in this state provides teachers with several planning guides related to Bloom's Taxonomy. As Abrami et al. (2008) emphasized, "educators must take steps to make CT [critical thinking] objectives explicit" (p. 1121). While this is true for K-12 teachers, the corollary must be that teacher educators must also make objectives, teaching, and practice in using HOTS just as explicit in order that future teachers have a strong foundation in thinking skills.

Another question of interest arose when the self-reported comfort level of participants was compared to their CTSA-R scores. According to a post hoc Tukey HSD analysis, those participants, who chose level 1 for comfort level (not feeling very comfortable about teaching HOTS) had significantly lower scores on the CTSA-R, as compared to those participants who chose comfort levels of 2 (somewhat comfortable) or 3 (very comfortable). Participants who were sophomores and juniors comprised 76% of the participants who chose not very comfortable for their answer. They also would have completed fewer education courses at this point in their programs. This finding seems to imply that those students have an accurate self-perception of their abilities concerning levels of thinking on Bloom's Taxonomy, especially since the participants completed the Demographic Survey, with its question about comfort level, prior to

the CTSA-R. A future study could examine pre-post effects of the CTSA-R and comfort level on participants as they begin education courses and then complete them each semester. Likewise, participants' knowledge as they begin their education coursework, as they begin their student teaching experiences, and then after they return from the year of student teaching should be examined to determine the effects on thinking skills at each level.

Discussion of the Research Questions

Research Question 1: How do preservice teachers describe thinking skills?

In answering this question, three main categories developed from the results: (a) varying definitions of higher order thinking are held by preservice teachers; (b) the definitions developed from multiple sources, including teacher education coursework, prior teachers in their K-12 experiences, and other factors affecting a person's life and free time; and (c) background experiences of preservice teachers affecting the comfort level they hold when considering teaching thinking skills.

Category 1: Definitions of HOTS vary. The Demographic Survey results showed that the preservice teachers equated critical thinking most often with HOTS, with Bloom's Taxonomy also being chosen as a term reminding them of HOTS. Bloom's Taxonomy is not surprising as this term is used in many of their teacher education courses, so the term should be familiar.

The four interview participants added contexts to these findings. They all expressed familiarity with Bloom's Taxonomy; however, only the elementary education major with her fresh student teaching experience could recall the six levels. The three secondary majors mentioned having heard of it in their teacher education courses, but generally expressed less confidence at describing Bloom's Taxonomy. All four used phrases such as "thinking beyond

the textbook" and "using the information in some way" to describe HOTS. The secondary education majors' in-depth definitions related to their subject fields, so the chemistry major discussed synthesizing information in real-life applications. The history/government major used the phrase "going into the perspectives of different people in history" and the English major described using multiple sources of information and knowing that you will "have to assimilate something more than you anticipated." The elementary education major described terms to use HOTS in all the major subject areas taught in K-6 education classrooms, including "building meaning with the text, and problem-solving in math." Snyder and Snyder (2008) described HOTS as applying content, which these four participants reiterated. As Willingham (2007) noted, teachers tend to hold definitions of HOTS determined by subject matter.

Category 2: Definitional development. On the Demographic Survey, Participants were asked to describe courses that taught them about HOTS. The elementary education majors, who were in their student teaching or methods course year, tended to cite methods courses or a Student and Curriculum course required of all teacher education majors. However, the students in the mathematics concepts course preferred the term 'using strategies to solve problems" as a phrase that reminded them of HOTS, perhaps due to the influence of the course.

The four interview participants cited both college courses and K-12 teachers or courses which influenced their perception of thinking skills. Laura, the elementary education major, mentioned her methods courses and the Student and Curriculum course as introducing her to knowledge about Bloom's Taxonomy and helping her develop strategies to teach HOTS. However the three secondary education majors noted other influences, rather than teacher education courses, that shaped their thinking about HOTS. They described the education courses as having more of a practical focus. Liam and Haley referred to subject matter courses in college in their content fields as encouraging them to stretch their thinking. Haley and Mikey both

mentioned high school or middle school teachers and courses that challenged them to use the course information in new ways.

In addition to coursework, the interview participants discussed other influences on their thinking skills. Liam described his reading of Internet message boards and following the arguments of the writers as a way to hone his ability to understand arguments. He also discussed his work at the campus writing center, tutoring other students. Having to read and discuss another person's writing, as well as helping students develop their thinking, built his thinking skills. Mikey had spent her childhood moving from place to place as a child in a military family. She noted that this experience allowed her to "see things in different ways." Additionally, as a history major, these experiences provided insights into the experiences of people who have been forced to relocate due to historical circumstances and helped her understand that future students will have had diverse life experiences. She also served as dormitory resident assistant, which "took a lot of problem solving and critical thinking" in helping the student residents work through issues. Laura had taught a Bible study group, which allowed her to go deeper into a text, finding relationships between events, and asking questions to broaden her group's comprehension. These participants' experiences, with different life events and extracurricular activities in college, lend support to the findings of Terenzini et al. (1995).

Category 3: Background experiences. The teaching experiences in practica appeared to contribute slightly to the level of comfort the preservice teachers expressed about teaching HOTS. Although three-fourths of the participants chose "somewhat comfortable" (77% or n=120) as their self assessed comfort level relative to teaching HOTS, there were no significant total mean score differences between these respondents and the respondents who self-assessed their level of comfort as high (n=12 or 8%) on the CTSA.

Prior to the student teaching semesters, participants in the elementary education teacher education program spend time in actual K-6 classrooms working with students and observing practicing teachers as part of their coursework. Their methods year incorporated multiple weeks of K-6 classroom time. The secondary education majors had varied amounts of actual classroom experience, due to differences in their content major requirements. In addition, preservice teachers may have jobs or volunteer opportunities in child care or after-school programs. This experiential level is reflected in the responses to the comfort level questions, as all certification levels, and year-in-school groups, tended to mark "somewhat comfortable" over "not very comfortable" or "very comfortable." The amount of time in structured classroom situations may increase comfort level when considering teaching thinking skills.

The student teachers were more than twice as likely to mark they felt "very comfortable" with teaching HOTS rather than "not very comfortable." They had spent a semester in K-6 classrooms gaining extensive practical experience as a member of a school faculty. Some schools are using Bloom's Taxonomy as a means to build thinking skills in their students, with faculty participating in workshops to develop their knowledge. Laura, the elementary education major who had just completed her student teacher semester, had that experience. She described the workshops in which the faculty learned to develop questions for their students at different levels of Blooms Taxonomy, as a precursor to teaching the students to write their own questions in reading class. However, she said, "Overall I feel pretty prepared but not completely. When I think of my classes, I don't think of HOTS necessarily right away." Mikey was the only secondary education interview participant who felt prepared to teach HOTS. The other interview participants, with fewer practica experiences, expressed less comfort at the idea of teaching HOTS to their future students.

However, the quality of the time spent in actual classrooms seems to impact the perception preservice teachers hold about teaching thinking skills. Two of the secondary-level interview participants described incidents in which they were discouraged from responding to K-12 students' attempts at critical thinking. Working with students who ask higher level questions "was perceived you're teaching to higher kids, so the other kids are not getting what that child said, so you don't address that child's comment" according to Mikey. Haley had positive experiences working with elementary children on a science and mathematics project, but found that secondary students may be resistant to thinking at higher levels. Both participants expressed concern about teaching thinking skills in the future after describing these incidents.

However, Laura's experiences in the elementary classroom encouraged her to believe that all children can develop higher-level thinking questions. She noted that the teacher has to scaffold learning opportunities for the students. This reiterates Hollingsworth's (1989) work that student teachers are influenced by their student teaching experiences. Laura's more extensive coursework in teacher education also reinforces the findings of Lumpe et al. (2000). Although their study found that more experience teaching science increased comfort level in teaching science, this conclusion may also hold true for teaching thinking skills. As the research on teacher beliefs has shown, early experiences with a subject influences the perception preservice teachers bring to their future classrooms.

Research Question 2: How do preservice teachers identify the thinking level of instructional activities?

Results for this question developed into two main categories. The first category includes: Teaching ideas for thinking skills vary with the content areas being taught; preservice teachers expect to see student interaction and discussion when their students are using HOTS; and

creativity and projects may be methods to develop thinking skills in their future students. The second main category stated that the preservice teachers expect there may be some challenges to teaching thinking skills. The challenges may come from student reluctance, faculty or administration restrictions on the type of activities that may be done, and issues with finding appropriate resources.

The portrayal of thinking skills varying with the content areas echoes the literature describing thinking skills as being domain specific. The instructors who responded to my query about the teaching of thinking skills also noted a difference in the terms they used in their courses. The concept of transfer of skills across subject areas is one that begs more training of teachers so that they can guide future students in using the same skills in different fields. An explicit scope and sequence chart of thinking skills would be beneficial for teacher education programs, which would necessitate the programs' agreement on particular thinking skills as needed for future teachers.

The interviewees also expressed similar responses when asked how they will know when their students are using higher-level thinking skills. All discussed seeing students either interacting and/or involved in discussions. For instance, Laura mentioned "Maybe you can get more projects, where you are integrating things." Haley stated, "As a chemistry teacher, do lab experiments…have them design their own experiments, off of something they've already done." Liam could envision his future students using games and story discussion to develop HOT among his students. "I think games can be used to draw on native processes to make critical thinking explicit, so they [the students] can apply it elsewhere…One thing I plan to do as a teacher, I plan to make discussion a big part of the classroom…open-ended responses are a big part of the classroom." While student interaction and discussion are important means to build knowledge and skills and while peer teaching can be important in student learning, apparently

higher-level thinking is not done quietly or by individuals. As Paul et al. (1997) discussed, "Present instruction is likely to produce teachers who, on the one hand, are confident that they understand critical thinking and know how to teach for it...then many of them no doubt equate critical thinking with active involvement [by students]" (p. 31). The participants seemed to assume that group work and discussion would automatically develop thinking skills in students. As C. Thompson (2011) emphasized, teachers need to use teaching strategies that are both hands-on and minds-on. This finding leads to further research questions. Are the participants' views of HOTS a manifestation of their constructivist training at this particular university, or based on their own personal experiences? What occurs with the thinking skills of a student who is introverted and prefers to work quietly, rather than in a group? However this set of interviewee responses is congruent with their responses to teaching methods they will use to develop HOTS in their students, as they plan to use projects and creativity for building thinking skills.

The challenges the participants mentioned can pose impediments to using and developing thinking skills in students. However, none of the participants discussed (a) having the time to create lessons that incorporate HOTS, (b) the time that may be needed to find or develop materials appropriate for higher-level thinking, or (c) the time needed to assess student work using HOTS. Assessing projects, essays, and productions of students requires more time and effort than marking multiple-choice tests or worksheets, as Snyder and Snyder (2008) clarified.

Limitations

This study was limited because I was the sole researcher, and additional researchers may have provided alternate interpretations of interview data. Limitations also must be inferred from the low number of interview participants. Having more than four interview participants would

have provided a larger picture of preservice teachers' knowledge of thinking-skills usage in the classroom. The study is also limited in scope to those preservice teachers participating in the selected courses in the semester data were collected. The participants of the study were very homogenous in ethnicity, gender, and age. Therefore, results may not be generalizeable to preservice teachers at other institutions or those from other backgrounds. The lack of coherence between the CTSA and the practiced curriculum in the teacher education program may have contributed to the scores. Using actual artifacts produced by the preservice teachers and observing the preservice teachers as they begin teaching in practicum experiences would also provide more data into their actual knowledge of, and their ability to incorporate, higher-level thinking skills into instructional situations.

Implications

This study has several implications for teacher education. The study provided information about the ability of preservice teachers to put their beliefs into action regarding critical thinking. It began determining what they consider critical thinking to be and what they stated influenced those beliefs. An awareness of the influences on beliefs about critical thinking may allow education professors to guide their preservice teachers in building more complete constructs of critical thinking and its relation to teaching K-12 students.

While instructors maintain they are incorporating HOTS and Bloom's Taxonomy into their courses to some extent, the depth of instruction may not be enough to ensure teacher education students are well-grounded in using and teaching thinking skills. As Paul et al. (1997) found in their study of California institutions of higher education, "few faculty members in teacher education have had in-depth exposure to research on the concept [critical thinking]" (p. 31), and they found little evidence of efforts to assess schools of education use of instruction for

critical thinking. Ball and Garton's (2005) study of objectives, instructional techniques, and materials used in teacher education courses at a regionally similar teacher education program discovered that lower-level thinking comprised many class discussions, but that course assessments used higher-level thinking of analysis and evaluation more than synthesis. The explicit teaching of thinking-skill strategies and modeling of methods using HOTS needed by preservice teachers may not be seen frequently enough in teacher education programs.

This lack of teacher training in HOTS carries ramifications for practicing teachers. Sultana (2001); T. Thompson (2008)and Zohar and Schwartzer (2005) all discovered in their studies that practicing teachers or teacher interns did not consistently use HOTS in their objectives or in their actual teaching. Yet, the Common Core Standards expect K-12 students to graduate being able to use higher-level thinking. This lack of congruence between K-12 teacher expectations and the coursework in teacher education, with its lack of continuous emphasis on thinking skills, does not bode well for future teachers. Therefore, teacher education programs must examine their coursework to determine what thinking skills are taught, how they are taught and practiced, and when thinking skills are taught and reinforced to provide seamless continuity across coursework for preservice teachers. In this way, preservice teachers will enter the ranks of teachers with a strong background in thinking skills to benefit their future students.

Future Research Questions

The results of this study provided many lines of research to pursue in the future. Among the questions to investigate is why the elementary-level participants did not have more interest in discussing thinking skills. What is prevailing in their thoughts at this time in their education program? Another area for research lies in the congruence between preservice teachers' stated ideas to teach thinking skills and the ways in which they actually present thinking skills to their

students via lesson plans and observations of teaching experiences. A third area to explore comes from the different content areas of the secondary-level program. What terms do secondary-level preservice teachers use to discuss thinking skills when they major in other content areas? I would also like to better align the CTSA with the uses of thinking skills, stated by the course instructors, to determine if participants' scores change, thus showing better knowledge of Bloom's Taxonomy. Additionally, investigating the long-term changes in comprehension and use of HOTS, if any, in preservice teachers as they progress to student teaching and then become actual practicing teachers could prove very enlightening. Conducting a follow-up study to my (2006) study of practicing teachers to explore their definitions of HOTS and their perceptions of influences on their definitions would be most intriguing. Also, replicating Ball and Garton's (2005) study examining education course artifacts as they align with actual course discussions and assessments to determine the types of thinking used in teacher education coursework would be another starting point in determining the types of thinking skills used and taught in teacher education courses.

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APPENDICES

Appendix A
Demographic Survey

Preservice Teacher Perspectives about Higher Order Thinking Skills

1. What grade level did you have for your student teaching experience?

2. Have you taught in a classroom for other grade levels? yes no
If yes, please briefly describe the experience.

3. Please describe any courses that taught you how to use Higher Order Thinking Skills with students. The courses could be in the School of Education or somewhere else.

4. Circle your age group:
20-30 years 31-40 years 41-50 years 51-60 years 61+ years

5. Circle one: male female

6. Circle your certification area you are completing now:
Preschool child Grade K-3 Grade 4-6 Grade K-6 Grade 6-9

7. Circle the highest level of education you are completing now:
Bachelor's degree Certification beyond Bachelor's degree
Master's degree Certification beyond Master's degree

8. How comfortable do you feel about your ability to teach HOTS (higher order thinking skills) to elementary students?
Not very comfortable Somewhat comfortable Very comfortable

9. What grade level do you hope to teach after receiving teaching licensure?
Preschool Kindergarten Grades 1-3 Grades 4-6 Not planning on teaching

10. Are you interested in participating in a one-on-one interview at a convenient time and location to discuss your views on teaching and higher level thinking skills? If yes, leave your email address for contact information.
Yes No

11. Please circle any phrases that remind you of higher level thinking skills:

Critical thinking	Deciding rationally what to believe or not to believe
Scientific thinking	Seeking alternative opinions or views or info on a topic
Bloom's Taxonomy	Using strategies to solve problems

Appendix B

Classroom Thinking Skills Assessment

Instructions:

We are interested in your thinking about the ways that classroom learning activities encourage Higher Level Thinking Skills (HOTS). Since you have spent time in classrooms, your thoughts and observations are quite pertinent to this research.

Below you will find brief descriptions of learning activities common to many classrooms. For each description, select the ONE option that BEST describes the **highest level of thinking** the activity uses.

1. A social-studies class is studying the Civil War. Imagining that they are living during this time, students write a letter to President Lincoln encouraging him to free the slaves.
a. applying
b. evaluating
c. synthesizing
d. understanding

2. A class is learning to make bar graphs to represent data. The students tell the number of people in their families for a class bar graph.
a. analyzing
b. evaluating
c. creating
d. knowing

3. A reading class has been reading a book with animal characters about friendship. In a class discussion, the students describe the characters' actions that show how to be a good friend.
a. synthesizing
b. evaluating
c. remembering
d. creating

4. A math class is learning to find the area of shapes using flat blocks and various box shapes. The students complete a worksheet about finding area. The worksheet has shapes with squares representing the blocks for counting.
a. applying
b. understanding
c. remembering
d. evaluating

5. A language class has been learning the difference between nouns and verbs. The teacher asks students to separate a group of 10 words into two categories: one of nouns and the other of verbs.
a. evaluating
b. synthesizing
c. remembering
d. analyzing

6. A math class is learning the multiplication tables. The students complete timed tests to demonstrate their memory of the correct facts.
a. understanding
b. creating
c. remembering
d. applying

7. A reading class has been learning to identify the 5 W's and H (who, what, when, where, why and how) in news stories. The teacher asks the students to choose an article from the student newspaper and fill in a graphic organizer with the 5 W's and H for the article.
a. synthesizing
b. remembering
c. applying
d. understanding

8. A science class has been learning about weather in science and myths in reading. The teacher asks the students to create a myth in the form of a cartoon strip that explains the reason we have a particular type of weather, such as lightning or snow.
a. creating
b. evaluating
c. analyzing
d. comprehending

9. A social studies class has been learning about Kansas history. Students label the pictures in a booklet of Kansas symbols (the Jayhawk, wheat, flag, etc.).
a. remembering
b. understanding
c. evaluating
d. applying

10. A science class has been studying the major classes of animals. The students make Venn diagrams to compare and contrast two classes of animals, such as fish and amphibians or reptiles and mammals.
a. analyzing
b. creating
c. evaluating
d. remembering

☐ If you are interested in participating in informal interviews about HOTS in the classroom and the ways teachers form their ideas about higher level thinking skills, please check the box and leave your name, phone number and email for further contact. Thank you!

Appendix C

Interview Protocol

1. How would you define higher level thinking skills?
2. Were you familiar with Bloom's Taxonomy before we did the assessment in your class?
3. Do you recall learning about higher level thinking skills or Bloom's Taxonomy in your college courses?
4. Do you feel you've had any courses here at the university that helped you develop your thinking skills?
5. Can you think of anything other activities or things that might have helped you learn and use thinking skills?
6. How do you think you will see higher order thinking skills used in the classroom?
7. What kinds of activities will you do with students to build higher order thinking skills?
8. How will you know when your students are doing higher level thinking?
9. How will you decide when to teach higher order thinking skills?
10. Are there particular topics or subjects that lend themselves to higher order thinking or do you think all subjects in your teaching area will work well?
11. Do you think all students are capable of thinking critically?
12. How will you assess your students when they do higher level thinking?
13. Do you have any concerns about teaching higher level thinking skills in your future classrooms? Will there be any barriers to using higher level thinking in your future classrooms?
14. Do you feel prepared to use higher order thinking skills with your future students?

Appendix D

Informed Consent

INFORMED CONSENT STATEMENT

Beliefs of Preservice Teachers about Higher Order Thinking Skills

INTRODUCTION

The Department of Curriculum & Teaching at the University of Kansas supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish to participate in the present study. You may refuse to sign this form and not participate in this study. You should be aware that even if you agree to participate, you are free to withdraw at any time. If you do withdraw from this study, it will not affect your relationship with this unit, the services it may provide to you, or the University of Kansas.

PURPOSE OF THE STUDY:

This study explores the beliefs of preservice teachers about higher order thinking skills.

PROCEDURES:

You will be asked to complete:

1. a basic demographic survey

2. a questionnaire in which you evaluate the types of thinking skills used in different 10 classroom activities.

3. a smaller number of the above participants, who are interested in being interviewed, may participate in one-on-one interviews with the primary researcher to discuss their thoughts and understanding of higher order thinking skills in K-12 classrooms. The interviews will be audio recorded with the recordings and notes kept in a locked cabinet in the researcher's home office and accessible only to the primary researcher and the faculty advisor.

RISKS:

The demographic survey and questionnaire will take about 30 minutes of class time. The interview, for those participants, may take up to an hour of time outside the school day.

No risk or pain to the participants is anticipated for either part of the study.

BENEFITS:

Direct benefits to the participants may occur in the form of increased awareness of higher order thinking skills in the classroom setting. Indirect benefits may occur for future preservice teachers and instructors of education courses, in the form of increased knowledge of the beliefs held by preservice teachers concerning higher order thinking skills in the K-12 classroom.

PAYMENT TO PARTICIPANTS:

No payment to participants is anticipated.

PARTICIPANT CONFIDENTIALITY:

Your name will not be associated in any publication or presentation with the information collected about you or with the research findings from this study. Instead, the researcher will use a pseudonym rather than your name. Your identifiable information will not be shared unless required by law or you give written permission. The information will be primarily used for the dissertation of the primary researcher.

Permission granted on this date to use and disclose your information remains in effect indefinitely. By signing this form, you give permission for the use and disclosure of your information for purposes of this study at any time in the future.

INSTITUTIONAL DISCLAIMER STATEMENT:

REFUSAL TO SIGN CONSENT AND AUTHORIZATION:

You are not required to sign this Consent and Authorization form and you may refuse to do so without affecting your right to any services you are receiving or may receive from the University of Kansas or to participate in any programs or events of the University of Kansas. However, if you refuse to sign, you cannot participate in this study.

CANCELLING THIS CONSENT AND AUTHORIZATION:

Data will be collected in the Fall semester of 2011. You may withdraw your consent to participate in this study at any time. You also have the right to cancel your permission to use and disclose further information collected from you, in writing, at any time, by sending your written request to: Diane Coffman dianemc@ku.edu

If you cancel permission to use your information, the researchers will stop collecting additional information from you. However, the researcher may use and disclose information that was gathered before they received your cancellation, as described above.

QUESTIONS ABOUT PARTICIPATION:

Questions about procedures should be directed to the researcher(s) listed below.

Researcher Contact Information

Diane Coffman
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Beliefs of Preservice Teachers about Higher Order Thinking Skills

PARTICIPANT CERTIFICATION:

I have read this Consent and Authorization form. I have had the opportunity to ask, and I have received answers to, any questions I had regarding the study. I understand that if I have any additional questions about my rights as a research participant, I may call (785) 864-7429 or (785) 864-7385, write the Human Subjects Committee Lawrence Campus (HSCL), University of Kansas, 2385 Irving Hill Road, Lawrence, Kansas 66045-7568, or email mdenning@ku.edu.

I agree to take part in this study as a research participant. By my signature I affirm that I have received a copy of this Consent and Authorization form.

_____ _____

Type/Print Participant's Name Date

_____

Participant's Signature

Appendix E

Teacher Beliefs Interview

Questions from Luft and Roehrig's Teacher Beliefs Interview

1. How do you maximize student learning in your classroom? (learning)

2. How do you describe your role as a teacher? (knowledge)

3. How do you know when your students understand? (learning)

4. In the school setting, how do you decide what to teach and what not to teach?

(knowledge)

5. How do you decide when to move on to a new topic in your classroom?

(knowledge)

6. How do your students learn science best? (learning)

7. How do you know when learning is occurring in your classroom? (learning)

Luft, J., & Roehrig, G. (2007). Capturing science teachers' epistemological beliefs: The development of the Teacher Beliefs' Interview. *Electronic Journal of Science Education*, 11, 2, 38-63.