Domain Specificity of Teachers' Epistemological Beliefs About Academic Knowledge

Gina Lafrazza
THE FLORIDA STATE UNIVERSITY

COLLEGE OF EDUCATION

DOMAIN SPECIFICITY OF TEACHERS' EPISTEMOLOGICAL BELIEFS ABOUT ACADEMIC KNOWLEDGE

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GINA LaFRAZZA

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The members of the Committee approve the thesis of Gina LaFrazza defended on 30 March 2005.

______________________
Alysia Roehrig
Professor Directing Thesis

______________________
Sherry Southerland
Outside Committee Member

______________________
Marcy Driscoll
Committee Member

Approved:

Frances Prevatt, Chair, Department of Educational Psychology and Learning Systems

The Office of Graduate Studies has verified and approved the above named committee members.
To Justin for his patience, love, mentoring, support and belief in all I do.
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# TABLE OF CONTENTS

| LIST OF TABLES | Page vii |
| ABSTRACT | Page viii |

1. INTRODUCTION ................................................................. Page 1  
   Problem Statement ........................................................ Page 1  
   Purpose of Study .......................................................... Page 2  
   Research Questions ...................................................... Page 3  
   Significance of Study ................................................... Page 4  

2. REVIEW OF LITERATURE ................................................... Page 6  
   Developmental Models .................................................... Page 6  
   The Perry Scheme ....................................................... Page 6  
   Women’s Ways of Knowing .......................................... Page 8  
   Epistemological Reflection Model ................................ Page 11 
   Reflective Judgment Model ........................................... Page 15 
   Epistemic Doubt Theory ................................................ Page 20 
   Multi-Dimensional Theories .......................................... Page 21 
   Schommer’s Theory ..................................................... Page 21 
   Kuhn’s Argumentative Reasoning Model ....................... Page 22 
   Academic Domain Specificity ...................................... Page 23 

3. METHODOLOGY ............................................................... Page 29  
   Participants ............................................................... Page 29  
   Instruments ............................................................... Page 30  
   Procedure ................................................................. Page 32  
   Hypotheses ............................................................... Page 33  
   Research Analyses ..................................................... Page 34  

4. RESULTS ............................................................................. Page 37  
   Educational Experience Analysis ................................. Page 37  
   Whole Sample Analysis (Question #1) ......................... Page 39  
   Analysis by Grade Level (Question #2) ......................... Page 40  
   Analysis of Secondary Teachers by Subject Taught (Question #3) Page 40  

5. DISCUSSION ........................................................................ Page 42  
   Summary of Findings ................................................... Page 42  
   Limitations ................................................................. Page 44  
   Suggestions for Future Research ................................. Page 45
APPENDICES ........................................................................................................... Page 47

A. Domain Specificity Belief Questionnaire ................................................... Page 47
B. Educational Experience Questionnaire ..................................................... Page 51
C. Letters Requesting Participation ................................................................. Page 54

REFERENCES ....................................................................................................... Page 59

BIOGRAPHICAL SKETCH ............................................................................. Page 63
LIST OF TABLES

Table 3.1: DSBQ Statement Item Pairings .......................................................... Page 31
Table 4.1: Summary of Educational Experience Questionnaire……………….     Page 38
Table 4.2: Mean Composite Scores by Sub-Group for Each Item Type………. Page 40
ABSTRACT

Epistemological beliefs are defined as beliefs about the nature of knowledge. This includes dimensions such as certainty of knowledge, what knowledge encompasses, how knowledge is transferred, and who holds knowledge. To date, most of the research on epistemological beliefs has been on students, primarily undergraduates of various majors (e.g., Buehl & Alexander, 2001, 2004; Buehl, Alexander & Murphy, 2002; Fives & Buehl, 2004). There is a distinct void in this literature with respect to the epistemological beliefs of post college adults, specifically teachers (Fives & Buehl, 2004). This investigation used a sample of 22 elementary general education teachers, 32 secondary level science teachers and 19 secondary level social studies teachers. Specifically, the study addressed the following: (1) Are teachers’ beliefs about academic knowledge general across academic domains or specific with regard to academic domain? (2) Is the grade level (elementary versus secondary) that a teacher teaches correlated with the level of sophistication of beliefs and degree of domain specificity about academic knowledge? (3) Are beliefs held by science teachers about science different (more or less sophisticated) than those of social studies teachers? Conversely, are beliefs held by science teachers about social studies different (more or less sophisticated) than those of social studies teachers? Results indicate that similar to undergraduate populations, teachers hold general knowledge beliefs that form the basis for domain specific beliefs that become salient during certain contexts. Additionally, secondary teachers in this sample held more sophisticated epistemological views than did the elementary teachers and discussion provides suggestions for further research to investigate possible reasons for this difference. Lastly, the results from this sample suggest that a secondary teacher’s beliefs about his/her own field will be more sophisticated than his/her beliefs about other fields.
CHAPTER 1
INTRODUCTION

Problem Statement

Epistemology is defined as a theory of knowledge. A long-time interest of philosophers, epistemological development has recently become a topic of interest for educational psychologists (Hofer, 2001). As interest in the topic has grown, two main questions have surfaced. What is epistemological development and why is it important? First, what exactly do we mean by epistemological development? Terminology used in this area of research has been ambiguous and varies with the theoretical framework of the researcher. The following terms have all been used to describe or define beliefs about knowing and knowledge as a construct: epistemological beliefs, reflective judgment, “ways of knowing,” epistemological reflection, epistemological theories and epistemological resources. Despite having no unified vernacular, research in this area can be broadly said to address peoples’ thinking and beliefs about knowledge and knowing and typically includes some or all of the following elements: beliefs about the definition of knowledge, how knowledge is constructed, how knowledge is evaluated, where knowledge exists and how knowing occurs, the self and the learning process, and metacognition (Bendixen & Rule, 2004; Hofer, 2001). Kuhn and Weinstock (2001) suggest that it is critical to this body of research that it be “anchored” in the broader context of development with attention given to what else develops during the same time frame as epistemology. Within this research, there has been recent attention given to academic domain specificity as a metric of these beliefs (Buehl & Alexander, 2001, 2004; Buehl, Alexander & Murphy, 2002; Fives & Buehl, 2004). In other words, it has been asked if individuals’ beliefs about knowledge differ as the frame of reference, specifically academic discipline, changes.

The second, and perhaps more important, question that is addressed in epistemological development research is- why does it matter? What are the implications for other areas of development, student achievement and learner motivation? Additionally, if epistemological beliefs and development vary across content domains, what are the implications for instruction of different disciplines? Are student beliefs a result of the instruction they are exposed to, do student beliefs determine how instruction is received, or is there a symbiotic interaction between the two? Is epistemological development socially situated (that is does it vary across social contexts?)? The research dealing with the importance of personal epistemological development
has seen a dramatic increase in attention within the last decade. Epistemological perspectives play a salient role in experiences in which students encounter new knowledge. Additionally, they are critical to lifelong formal and informal learning experiences (Hofer, 2001).

Individuals’ epistemological beliefs often influence one’s thinking, motivation and behavior. Thus, the literature is rich with studies that investigate epistemological beliefs in relation to various facets of student learning. For example, Paulsen and Feldman (1999) found that there is a relationship between an individual’s epistemological beliefs and their choice of cognitive and meta-cognitive strategies. Specifically, as beliefs became more sophisticated, strategies used by students became more sophisticated. Other research (e.g., Qian & Alvermann, 1995; Qian & Burrus, 1996) found a predictive relationship between the simplicity, certainty and speed of knowledge acquisition, dimensions of knowledge beliefs and students’ conceptual learning and the application of knowledge (Buehl & Alexander, 2004). Furthermore and perhaps most salient, a relationship was found between students’ epistemological beliefs and their cumulative grade point average and performance in some studies (e.g., Hofer, 2000; Rukavina & Daneman, 1996; Schommer, 1993; Schraw, Bendixen, & Dunkle, 2002) (Buehl & Alexander, 2004). Despite the value of these findings, most of these studies have only investigated general epistemological beliefs and learning outcomes. There is a need to examine these relations using domain-specific epistemological beliefs and learning within specific domains (Buehl & Alexander, 2004).

Purpose of Study

To date, most of the work on epistemological beliefs has been on students, primarily undergraduates of various majors (e.g., Buehl & Alexander, 2001, 2004; Buehl, et al., 2002; Fives & Buehl, 2004). There is a distinct void in this literature with respect to the epistemological beliefs of post college adults, specifically teachers (Fives & Buehl, 2004). We do know that teachers use a variety of methods to teach different academic disciplines (Buehl et al., 2002) and we also know that instructional approaches are broadly affected by teacher beliefs (Kang & Wallace, 2004; Richardson, 2003). What is unclear is if and to what degree these diverse instructional methods are due to disparate epistemological beliefs about the disciplines themselves. Instructional choice by teachers may be influenced by many factors, including but not limited to, teacher efficacy, beliefs about students and school environment. Additionally, it is unclear whether certain effective instructional practices are linked to certain types of knowledge
beliefs and conversely, whether certain ineffective practices are linked to certain beliefs. Furthermore, this literature void is problematic because basic epistemological questions provide a foundation for controversial issues (e.g., evolution vs. creationism, politics) that are prevalent in education (Southerland, Sinatra & Matthews, 2001). Certainly, teacher beliefs will play a role in how these topics are approached instructionally.

Buehl et al. (2001) point out that there is a distinct gap in the research with regard to how epistemological beliefs initially take shape in children. One obvious thought is through instruction. Since we know beliefs held by teachers impact their instruction (Kang & Wallace, 2004) and teachers often have varying methods of instruction for different content areas, one must ask if and how teachers’ academic beliefs vary across academic subject domains. If these beliefs are domain specific, further research into how beliefs impact instructional choice and how instruction impacts the development of student beliefs is necessary. If these beliefs are domain general, we can investigate alternative factors that affect instructional choice. The purpose of this study will be to explore the nature of teachers’ epistemological beliefs, specifically the degree of domain specificity seen in these beliefs.

**Research Questions**

This research study built on the work of Buehl, et al. (2002) and Buehl and Alexander (2004) by revisiting the domain specificity question with a narrower, specific sample. Specifically, the study addresses the following:

1. Are teachers’ beliefs about academic knowledge general across academic domains or specific with regard to academic domain?

2. Is the grade level assignment (elementary versus secondary) of a teacher (independent variable) correlated with the level of sophistication of beliefs and degree of domain specificity about academic knowledge (dependent variable)? This aspect of the study is a direct response to the lack of generalizability of Buehl et al.’s 2002 study. Buehl et al. (2002) specifically point out that the degree to which academic beliefs are domain specific may vary due to the amount and nature of educational experiences. Grade level taught may be one indicator of the degree and type of educational experiences teachers have had.

3. Are beliefs held by science teachers about science different (more or less sophisticated) than those of social studies teachers? Conversely, are beliefs held by
science teachers about social studies different (more or less sophisticated) than those of social studies teachers? In other words, are a secondary teacher’s beliefs about his/her own field more sophisticated than his/her beliefs about other fields?

Significance of Study

There is a great deal of evidence that indicates teacher beliefs can strongly affect how they approach teaching and instruction in the classroom (Richardson, 2003). Specifically, research shows that naïve epistemological beliefs are clearly reflected in teaching practice (Kang & Wallace, 2004). For example, instructional goals set by teachers seem to stem from their views on the certainty of knowledge, which is a dimension of one’s general epistemology. Specifically, when a teacher applies these beliefs to an academic subject area such as science and knowledge is seen as a collection of fixed facts that are unchanging, the involvement of student cognition is often minimized. Conversely, when knowledge in science is viewed as uncertain and continually evolving by the teacher, their instructional focus tends to be more on problem solving and reasoning, rather than imparting facts to the students (Kang & Wallace, 2004).

The relational dimension of teachers’ epistemological beliefs also seems to determine instructional practice. For example, teachers that perceive students as being separate from the knowledge, tend to think of them as passive learners, while teachers that connect students to the knowledge take a more constructivist-based instructional approach, where students are encouraged to build their own meaning of classroom experiences (Kang & Wallace, 2004). These results indicate that ontological and relational aspects of epistemological beliefs are distinct explanatory factors of teaching practice. For this reason it is important to investigate what influences the ontological and relational aspects of a teacher’s epistemological beliefs and if these aspects are academic domain specific. This may provide insight into why teachers choose the instructional methods they do for various subjects.

Teacher beliefs have also been directly related to personal teaching efficacy (Anderson, Greene & Loewen, 1988; Payne, 1991), and in turn higher degrees of teaching efficacy have been correlated to increased willingness to attempt varied and innovative instruction (Fives & Alexander, 2004). Again, if teachers’ beliefs are highly domain specific, levels of efficacy for teaching various subjects may vary. This may be a critical issue to investigate in terms of training programs and professional development for elementary teachers that are charged with teaching all subject areas. In addition, professional development stemming from recent science
education reform efforts are thought to have been unsuccessful due to failing to take teachers’ beliefs into account (van Driel, Beijaard and Verloop, 2001). Clearly, research on epistemological beliefs of teachers is a worthy avenue of study. Although research provides evidence for domain specificity of academic beliefs of students (Buehl et al., 2002; Buehl et al., 2001; Stodolsky et al., 1991), it is unclear whether individuals with expertise in certain areas of study (e.g., teachers) view the academic domains in the same way. Therefore, this research would benefit from focusing on individuals (teachers) immersed in a particular area of study (Buehl & Alexander, 2004). An extension of Buehl & Alexander’s work on domain specificity (2004) that will focus on teachers is a natural starting point for filling this literature gap.
CHAPTER 2
REVIEW OF LITERATURE
Developmental Models

Currently, there is no unified theory of epistemology nor is there a single theory that fully captures the relationship between personal epistemology and how epistemological beliefs develop (Bendixen & Rule, 2004). However, many models exist that form the theoretical basis for current epistemological research. These models all suggest a patterned sequence of development that individuals move through with regard to beliefs about knowledge and knowing. These ideas have been organized into five seminal models: 1) the Perry Scheme, 2) Women’s Ways of Knowing, 3) the Epistemological Reflection Model, 4) Reflective Judgment and 5) Kuhn’s Argumentative Reasoning model (Hofer & Pintrich, 2002). All of these models have roots in traditional cognitive development and in varying degrees rely upon Piaget’s work and qualitative stage development theory (Hofer, 2001). This resemblance to Piagetian thought is evidenced by the shared view in each of the five models that individuals move through some specified sequence of steps in their beliefs about knowledge and knowing as their cognitive skills (ability to make meaning) develops. An elaboration on each of the five historical models follows, as they provide the groundwork for the more recent additions and refinements to this body of research, which are also discussed.

The Perry Scheme

The Perry Scheme is a theory of intellectual development during the college years which evolved based upon the research conducted by William Perry and his research team in the late 1950s and early 1960s at Harvard University. Perry investigated the inconsistency and variability in college students’ responses to instruction. Initially, Perry and his colleagues believed these differences to be due to stable personality differences among the students. A clear developmental pattern in beliefs however, was found when they conducted a longitudinal interview study with students. Perry classified students into one of nine fixed positions that are further grouped into four categories. This category system is defined in terms of beliefs about the nature of knowledge and does not specify particular dimensions (e.g., certainty of knowledge) or a contextual basis (Moore, 2002).

The first category includes individuals that hold a dualistic perspective of knowledge. This is characterized by an absolutist view, the idea that truth can be known and the belief that it
is the task of the teacher to impart knowledge to the students. Positions 1 and 2 are included in the dualism category. Individuals in position 1 have the perspective that truth and authority figures are absolute and unquestioned. Alternative viewpoints are not tolerated. Actual individuals in this position were rarely seen in Perry’s samples of Harvard undergraduates. In position 2, individuals acknowledge other points of view but see them simply as wrong (Moore, 2002).

Perry’s second category is the multiplism perspective. In this stage, students begin to recognize and accept the existence of diverse points of view and the possibility of uncertainty. Within this category are positions 3 and 4. In position 3, individuals begin to acknowledge that there is knowledge that is not yet known, but have the belief that it will be known at some point in the future. Individuals in position 4 make the departure from looking for certainty in the future to accepting that some things will never be known and what is important is one’s own opinion. The beginnings of idea and knowledge ownership are seen in this position (Moore, 2002).

As individuals move from position 4 to 5, they move into the relativism stage, which is arguably the most significant developmental step in this scheme. Relativism is characterized by acknowledging that some viewpoints are more valid than others. Individuals in position 5, in addition, see themselves as makers of knowledge and recognize that in order to know, one must have a point of view.

Perry’s final stage is commitment within relativism, which contains positions 6-9. In this stage individuals can analyze varying points of view and forge a commitment to the most valid. In position 6, knowledge begins to take on an ethical component. Rather than simply considering alternatives and making a choice, this position is marked by commitments made in light of legitimate alternatives and upon personal reflection on one’s self identity. Positions 7 through 9 are characterized by making multiple commitments and the development of personal values and identity (Moore, 2002).

The most notable finding of Perry’s research is the idea that the most effective learning occurs with significant qualitative changes in the way learners approach the process of learning and knowledge (Moore, 2002). However, it should be noted that in Perry’s work, all students did not begin college in the dualistic stage nor did all students reach the commitment within the relativism stage before graduation (Moore, 2002). This demonstrates a need for broader sampling in future epistemological development research. For example, longitudinal observations prior to
and beyond the college years would give greater insight into how epistemology unfolds and how it is affected by instruction throughout the lifetime. Additionally, sampling those other than the college bound or enrolled would be beneficial. Specifically, including female subjects and students from diverse institutions would improve this work.

Perry and his colleagues created the Checklist of Educational Views (CLEV) which was intended to identify students on a continuum as dualistic or relativistic thinkers. The CLEV was administered to a random sample of 313 freshmen in 1954 and again to these same students a year and a half later. Based on these scores, invitations to take part in an interview about the college experience were sent out. Interviews were open-ended and nondirective. Perry’s initial study resulted in 98 interviews. Of these, seventeen were interviewed yearly over their four years at Harvard. The results of these interviews led Perry and his colleagues to extend their study by obtaining a larger sample of student reports over their four years of college, explaining the findings in a well articulated developmental scheme and submitting the scheme to validity measures. Subsequently, Perry and his colleagues conducted 366 interviews which included 67 four-year recordings. Perry provided evidence for inter-rater reliability of the interviews as well as validity of the CLEV to assess students’ beliefs about knowledge (Perry, 1968/1999).

Criticisms of Perry’s work include that he worked with a male sample of students and his sample was limited to an elite, private institution. Variability in school setting and subject gender would help to determine the degree to which instruction drives or hinders epistemological development. Women’s Ways of Knowing

Due to the lack of women in Perry’s sample, Belenky, Clinchy, Goldberber and Tarule (1986/1997) built upon his work to take into account the female perspective as well as students from more diverse backgrounds. Belenky and her colleagues interviewed 135 women representing nine different schools as well as women not involved in college. The scheme that developed from this work focuses on the role of the self as the knower and how a woman’s self-concept is intertwined with her way of knowing (Belenky et al., 1986/1997). In the book, Women’s Ways of Knowing, Belenky et al. assert that women’s epistemological assumptions are integral to how they perceive themselves and the world around them (Hofer & Pintrich, 2002).

The scheme outlines the modes of knowing into five stages. Belenky et al., are careful however to point out that in their opinions, the stages are not necessarily experienced in a fixed sequence nor limited to women (Duell & Schommer-Aikins, 2001). The five stages are silence,
received knowing, subjective knowledge, procedural knowledge and constructed knowledge. The silence stage is characterized by a feeling of mindlessness, absence of a point of view and subject to external authority (Belenky et al., 1986/1997). In this stage women do not see themselves as capable of understanding and remembering knowledge that is conveyed to them (Clinchy, 2002). Women in this stage are problematic to study since they have difficulties articulating their thoughts and beliefs. For this reason, all of the knowledge gained about women in this stage was from women that had passed through it and were able to articulate the characteristics of the stage based upon past experience. Interestingly, some educated women reported that they at times find themselves in situations where they exhibit characteristics of the silence stage (Clinchy, 2002).

The received knowledge stage is marked by women seeing themselves as capable of receiving and reproducing knowledge from absolute external authorities. Women do not see themselves as capable of creating knowledge on their own in this stage (Belenky et al., 1986/1997). This stage is synonymous with Perry’s dualism and is marked by the belief that truth is absolute and unequivocal. Individuals in this stage believe that there is one correct answer for every question (Clinchy, 2002).

Clinchy (2002) says:

These are the students who sit, pencils poised, prepared to record the truths I dispense, the ones who ask exactly how long the paper should be, and exactly which topics will appear on the exam. These students are willing to regurgitate the information they have stored in their heads on a test, but they don’t like being asked to apply it. (p. 67)

Both the received knower and silent women recognize authorities as those that should be listened to; however, the distinct difference is that received knowers perceive authorities as sources of knowledge that can be made use of. Goldberger (1996) points out that the analysis of observations of the women in this stage is most likely culturally dependent in that Western culture often labels yielding to authority as passive or dependent, putting greater value on autonomy and independent thinking. This therefore leads to the inference that the received knower is a more ‘developed’ stage than the silent.

Women in the subjective knowledge stage adopt a perspective that views truth and knowledge as personal, private and subjectively known. This falls in line with Perry’s multiplism. Individuals in this stage “believe that all opinions are equally valid and everyone’s opinions are right for them…A person’s experience can’t be wrong” (Clinchy, 2002, p. 69-70).
Opposite from received knowers, individuals in the subjective knowledge stage are suspicious of authority and tend to question information from them (Clinchy, 2002).

As women move into the procedural knowledge stage they become invested in learning and apply objective procedures for gaining and transferring knowledge. In the procedural knowledge stage, women see all knowledge as contextual, can see themselves as creators of knowledge and see value in diverse strategies for knowing (Belenky et al., 1986/1997). Procedural knowers no longer see knowledge as something that can be acquired through immediate apprehension or experience (Clinchy, 2002).

Two distinct orientations were identified within procedural knowledge: connected knowing which encompasses an empathetic and caring aspect to knowing and separate knowing, which is a detached and impersonal approach to knowing (Belenky et al., 1986/1997). Separate knowing is the approach commonly seen in the hard sciences, which places emphasis on issues of validity, methodology and “proof.” The connected knowing approach, is more prevalent in the humanities. Here individuals strive to understand and to be understood. As these two approaches become integrated, the individual moves into the constructed knowing stage. Galotti, Clinchy, Ainsworth, Lavin and Mansfield (1999) take the position that aspects of separate knowing and connected knowing are evident in all individuals.

Constructed knowing is analogous with Perry’s contextual relativism, which is hallmarked by individuals seeing themselves as active in the knowledge acquisition process as makers of meaning. In this stage, individuals hold the belief that all knowledge is constructed and the knower plays a very active role in this process. Constructivists have a very high tolerance for contradiction and uncertainty within themselves. When contradiction arises, rather than trying to reach consensus, constructivists engage in internal dialogue to reach the best possible point of view (Clinchy, 2002).

Belenky et al. (1986/1997) included the following caveats in their stage theory: 1) the stages are not fixed, exhaustive or universal. 2) The stages are abstract in that they cannot adequately describe the intricacy and uniqueness of an individual woman’s thought. 3) Similar stages are appropriate for describing how men think. 4) Finally, this scheme was developed from the analysis of observations. Other researchers may have different interpretations. Specifically, number two and three are problematic for this theory. Caveat two foreshadows the need to look
at epistemological beliefs on a dimensional basis and caveat three is not supported by any aspect of the study.

Belenky et al. utilized the phenomenological approach with long, open-ended interviews that allowed the interviewer and participant to openly reflect upon their beliefs. This qualitative approach differed greatly from Perry’s in that the technique developed into the theory, rather than the hypothesis driving the methodological approach. Interviews were conducted of 135 women from nine institutions ranging from coed adult education programs to private liberal arts colleges. Interviews were 2-5 hours in length and all were recorded and transcribed into a 5000 page report. The interviews took the form of a case study that allowed the subjects to “tell their whole story” without the researcher imposing any preconceived hypothesis onto the subject. Interview questions were broad in nature and open-ended, and subjects were encouraged to respond based upon their own points of view. Specific questions to assess Perry’s nine positions also were embedded into the interviews.

Results from the interviews were coded by blind reviewers who attempted to classify the data into Perry’s nine positions. It was found that this data, from women and more specifically women from diverse backgrounds, did not fit neatly into the Perry Scheme (Duell & Schommer-Aikins, 2001). This led to the Women’s Ways of Knowing model put forth by Belenky et al. The methods employed provide great insight into an individual’s beliefs about knowledge and the social construct of those beliefs. However, conducting this type of interview is a long and arduous process that requires a skilled interviewer and ample time. Belenky et al. do not report evidence for reliability and validity of the interview as a research instrument for assessing epistemological development (Duell & Schommer-Aikins, 2001).

Epistemological Reflection Model

Magolda (1992, 2002) also accounted for the female perspective in her work leading to the development of the Epistemological Reflection Model. This model is similar to the Perry Scheme in that it targets epistemic beliefs that affect how educational experiences (i.e. instruction) are interpreted. Magolda conducted the first epistemological study to include an equal number of males and females (Hofer, 2001). Magolda concluded that although developmental trends were similar for men and women, males interestingly adopted more impersonal and individualist ways of knowing, while women adopted more personal and inter-individualist ways of knowing (Hofer, 2001).
Magolda’s research on epistemological development is grounded in a constructivist framework. This cognitive development tradition relies on the belief that individuals actively construct knowledge by interpreting the world around them. Cognitive development occurs when initial beliefs, which constructivists refer to as cognitive structures, are challenged by some new experience. The individual either adds the new experience to their existing structure, which is referred to as assimilation or they alter the structure, called accommodation, in order to account for the new experience (Driscoll, 2000). Conceptual change occurs as learners have experiences that challenge and change their thinking (Colburn, 2003).

Based on this constructivist foundation, Magolda makes two assumptions that guide her theory. First, beliefs about the nature, limits and certainty of knowledge, which are types of cognitive structures or pre-existing schema, are socially constructed. Meaning is made from experiences, which depend on these existing structures, the nature and extent of the dissonance caused by the new experience and the context in which the new experience takes place. The second assumption is that results from her longitudinal study are context-bound and therefore most likely dynamic, rather than generalizable to a greater audience or diverse situations (Magolda, 2001; Duell & Schommer-Aikins, 2001). The idea of knowledge beliefs as a set of cognitive structures is the first step toward recognizing the multi-dimensionality of individual epistemology. As with other cognitive structures, or schema, it is possible that they develop at different rates. This idea is discussed further later in this paper.

Magolda posited six principles as the backbone of her research: 1) an individual’s epistemological beliefs are created socially, 2) the best way to ascertain an individual’s epistemological beliefs is through natural observation, 3) epistemological beliefs vary with context (i.e., individuals have different beliefs in different situations, 4) epistemological beliefs are not determined by one’s gender, however the two are related, 5) observations made by Magolda that formed the basis of her theory are bound by the context in which they were made and 6) Magolda attempted to generalize to a predominant belief pattern for her subjects while keeping in mind the contextual nature of epistemology (Duell & Schommer-Aikins, 2001).

Magolda’s theory is centered on the epistemological dimension regarding the certainty of knowledge. She identified a sequence of four levels of development, which she refers to as “Ways of Knowing,” borrowed from Belenky et al. (1986): *absolute, transitional, independent* and *contextual*. In the absolute stage, which Magolda found to be most prevalent during the first
two years of college, knowledge is believed to be certain or absolute (Hofer, 2001). Absolute knowers believe that it is the teacher’s responsibility to transmit knowledge to the students and to make sure students understand it, students are responsible for acquiring knowledge from the teacher, peers play a role in the learning process by sharing materials with each other and assessment is a vehicle through which students show the teacher that they have acquired the appropriate knowledge. Within the absolute knowing stage, Magolda found that learning strategies employed differed between men and women. More women than men, listened and recorded information, which Magolda refers to as “receiving.” Conversely, more men than women engaged in active involvement to learn material. Magolda calls this “mastery” (Magolda, 2002).

In the transitional stage, knowledge is only partially certain or absolute. Transitional knowers see knowledge as absolute in fields like math and science, but take on a more uncertain view in the social sciences and humanities. This is the first acknowledgment of domain specificity of epistemological beliefs. This concept will be discussed in depth later in this paper and will become the focus of this research study. In the content areas that are viewed as uncertain, individuals in this stage emphasize understanding over just gaining knowledge, view teachers as responsible for aiding understanding and application of principles, prefer applied-type tests rather than those focused on memorization and view peers as sources of alternative interpretations. The transitional knowing stage is prevalent during the college years. Specifically, according to Magolda’s study, it was seen as follows: in 32% of first-year students, 53% of sophomores, 83% of juniors and 80% of seniors. In this stage Magolda identifies two learning style patterns that were related to gender. The first, the “interpersonal pattern,” is comprised of transitional knowers that enjoy uncertainty and the process of sorting through opinions. Individuals, mostly women, in this pattern value personal judgment to make decisions. In contrast, the “impersonal pattern,” seen predominantly in men, is characterized by a focus on defending one’s own viewpoint and resolving uncertainty (Magolda, 2002).

In the independent stage, knowledge is uncertain and everyone has a truth that is true for them. In this stage, there is a focus on individuals thinking for themselves, an expectation for teachers to promote individual points of view and to not judge students’ personal opinions and a valued exchange of views with peers. The independent stage is predominantly seen quickly after
college as individuals begin work or graduate school. 57% of the participants in the study entered this stage during their first year out of college (Magolda, 2002).

Gender patterns within the independent stage found through Magolda’s longitudinal study provide evidence of developmental implications. Participants that were labeled as receiving and interpersonal pattern knowers (mainly women) typically became interindividual pattern knowers in this stage. This group had difficulties in establishing their own opinions in the light of others’ differing viewpoints. Interindividual pattern knowers were quick to accept another person’s view as being correct and to change their own. In contrast, individuals that utilized mastery and impersonal patterns in earlier stages (mainly men), tended to evolve into individual pattern knowers. This pattern is characterized by difficulty in hearing the views of others and a tighter hold on one’s own opinion (Magolda, 2002).

The post-college world involves substantially different experiences and contexts than students experience in college. This causes dissonance that leads to another epistemic change following graduation (Magolda, 2002). In the contextual stage, knowledge is evaluated based upon evidence in a given context (Duell & Schommer-Aikins, 2001). The ability to integrate and apply knowledge based upon context and to make sound judgments based on evidence is most likely a result of advanced education, professional roles and multifaceted personal relationships that are prevalent after college (Magolda, 2002). Magolda (2002) posits that this ability to make sense of multiple perspectives is the cause of her observation that the earlier gender-related patterns merge in this stage. She believes this to be attributable to individuals learning to make judgments by watching others and learning to supplement the pattern that they use with alternative patterns.

The contextual knowing stage is divided into three sub-phases: 1) external formulae, 2) search for internal authority and 3) establishing an internal foundation for beliefs. In the external formulae phase, individuals take responsibility for their own beliefs, but rely upon external formulae to establish these beliefs. For example, individuals that make life choices based upon what they think is expected of them fall into this phase. From here individuals move into the second phase where they look internally for knowledge to try to replace their reliance on external formulae. This is often a result of unhappiness with life choices. Usually, individuals enter this phase in their mid to late twenties. The third phase, the foundation, is characterized by the establishment of an individual belief system. This phase is predominantly seen among
individuals in their late twenties and early thirties (Magolda, 2002). “…this third phase of contextual knowing integrates the epistemic assumption that knowledge is contextual, the intellectual process of determining what to believe, and the integral roles of the internally defined self in the knowledge construction process” (Magolda, 2002, p. 100).

Magolda developed the Measure of Epistemological Reflection (MER) to conduct her research. This instrument consists of a standardized, open-ended questionnaire interview and a standardized rating protocol. Questions in the instrument focus on beliefs as well as justifications for beliefs, specifically beliefs about the certainty of knowledge as well as the implications these beliefs have for decision making, what the role of the learner should be, what the role of peers should be in the learning process, what the role of instructor should be and what role evaluation plays in the learning process. The drawback to using this instrument is that interpretation is time consuming and requires a knowledgeable rater.

**Reflective Judgment Model**

King and Kitchener (1994) and Kuhn (1991) built on Perry’s work and focused more in depth on how pre-existing epistemic beliefs influence thinking and reasoning. King and Kitchener developed the Reflective Judgment Model based upon cross-sectional and longitudinal research that expanded the previously utilized samples to include high school students through adulthood. Reflective thinking is a construct that was first credited to Dewey (1933) who posited that reflective judgments are used when an individual is faced with controversy about a problem and cannot rely on logic alone to solve it. Rather, the individual must consider one’s own beliefs in addition to available evidence. To date, this type of reasoning is a main focus of higher education (King & Kitchener, 2004).

The Reflective Judgment Model focuses on the cognitive processes that individuals employ when faced with “ill-structured” problems. An ill-structured problem is one in which “reasonable people reasonably disagree.” They require judgments be made based upon the strength of available evidence and the adequacy of argument (King and Kitchener, 2002). Experts do not agree upon one correct solution or answer in these types of problems (Duell & Schommer-Aikins, 2001). Ill-structured problems are characterized by two features: they are not defined by a high degree of completeness and cannot be solved with a high degree of certainty (King & Kitchener, 2004). An example of an ill-structured problem would be assessing whether affirmative action is an effective tool for promoting equality in education.
The Reflective Judgment Model is grounded in the cognitive developmental traditions of Piaget and Kohlberg. Specifically, King and Kitchener (1994, 2004) make the following assumptions: (1) meaning is constructed by individuals, (2) meaning constructions are developmentally ordered, (3) how individuals make meaning of their experiences is important and (4) development occurs as individuals interact with their environments. In contrast, King and Kitchener reject the following assumptions from the previously mentioned traditions. They do not believe that cognitive development is best assessed by deductive reasoning, nor do they assume that it is complete when an individual reaches the formal operations stage. They also reject Kohlberg’s claim that there is cross-cultural universality of cognitive development. Specifically, they posit a much more complex concept of cognitive development (King & Kitchener, 2004).

In the Reflective Judgment Model, King and Kitchener (1994) rely on a three level model of cognitive processing put forth by Kitchener (1983). The first level is called cognition and is characterized by individuals engaging in rudimentary processes such as rote memorization, computing, and reading. The second level is meta-cognition and involves individuals monitoring themselves while engaged in level one tasks. The third level is epistemic cognition where individuals are aware of the limits of knowing, question the certainty of knowledge and think about the criteria for knowing. Again, we begin to see the roots of the movement toward a multidimensional view of epistemology. King and Kitchener (1994) found that achievement of the epistemic cognition stage is fundamentally tied to the ability to understand and construct solutions for ill-structured problems. This is due to the fact that making interpretive judgments about ill-structured problems involves identifying personal beliefs, which also change as the individual develops, and thus requires individuals to address questions about the limits, certainty and criteria for knowing (components of epistemic cognition).

The term “Reflective Judgment” was chosen by King and Kitchener based on Dewey’s (1933, 1938) work that asserted that reflective thinking was required when an individual recognizes that not all problems can be solved with certainty. The Reflective Judgment Model is comprised of seven distinct stages of development categorized into three periods: the pre-reflective period (includes stages 1-3), the quasi-reflective period (stages 4 and 5) and the reflective period (stages 6 and 7) (King & Kitchener, 2002). The seven stages represent qualitatively different sets of assumptions and are associated with distinctly different ways of
justifying beliefs. However, Reflective Judgment interviews provide evidence that individuals may rely heavily on one stage, but also make statements that are consistent with the stages immediately before and after their dominant stage. This is a variation from traditional stage theories (King & Kitchener, 2004). Kitchener (2002) and King and Kitchener (2004) look to Fischer’s Skill Theory and Rest’s notion of the “complex stage” model to support this variation. Fischer makes the salient assumption that individuals’ variability across tasks is grounded in context and the degree of environmental support at the time of the assessment (King and Kitchener, 2004). King and Kitchener posit that development in reasoning about ill-structured problems is characterized by stage-like properties, but evolvement through these stages does not happen in lock-step fashion. Therefore, the term “stage” is qualified when used in the Reflective Judgment Model (King & Kitchner, 2004).

The first period, pre-reflective thinking, is characterized by the belief that knowledge is transferred verbally from an authority figure or through first-hand observation. Individuals in this period believe that what is known is absolutely correct and known with complete certainty. All problems are treated as well-structured and resolved with complete certainty by individuals in this period. This period is broken down into stages 1-3. Each stage differs in how knowledge is viewed. In stage 1, individuals believe knowledge to be absolute, concrete and obtained only through direct observation. In stage 2, individuals still believe knowledge to be absolute and certain, but recognize that it is not always readily available. Additionally, individuals in stage 2 think that knowledge can be obtained through observation as well as from authority figures. Stage 3 differs further in that individuals see knowledge as absolute or temporarily uncertain. In cases of temporary uncertainty, personal beliefs are relevant until more absolute knowledge is obtained. Additionally, absolute knowledge is acquired from authority figures (King & Kitchener, 2002).

When an individual moves into the quasi-reflective period, he or she begins to realize that knowledge contains elements of uncertainty which they attribute to missing information or to faulty methods employed to obtain the information. Individuals in this period use evidence in problem solving but do not understand how evidence entails a conclusion, specifically in the light of uncertainty. This period is comprised of stages 4 and 5. In stage 4, knowledge is seen as uncertain and always involving an element of ambiguity, but attributed to misinformation or lost data. Individuals in this stage attempt to use evidence, but do so in a manner that fits pre-existing
schemas. In stage 5, individuals believe that knowledge varies depending on context and is dependent on individual interpretations of available evidence or observations. Students see others’ points of view as valid as their own, but due to being based upon different sources of evidence (King & Kitchener, 2002).

Finally, an individual moves into the reflective period. This is characterized by accepting that knowledge claims cannot be made with certainty and the ability to make judgments that are most reasonable and about which they are *most* certain, based on the evidence available. Perhaps most importantly, individuals in this period are willing to reevaluate their judgments as new information, evidence or methodologies become available. Dewey (1933) refers to this as critical thinking and sees it as crucial for evaluating and making judgments about ill-structured problems. The reflective period is broken into stages 6 and 7. In stage 6, knowledge is constructed by the individual based on evidence from many sources. This includes evaluation of others’ opinions and information spanning contexts. Individuals in this stage accept varying degrees of certainty of knowledge and identify a point where they are certain enough to develop a personal point of view on an ill-structured issue. Stage 7 is analogous to the constructed knower stage put forth by Belenky et al. Knowledge is believed to be an outcome of the inquiry process as one addresses ill-structured problems and issues. The knower constructs knowledge from experiences, others’ perspectives and available evidence (King & Kitchener, 2002).

King developed the Reflective Judgment interview to assess student beliefs about what can and cannot be known, how people come to know something and the certainty of knowledge. Specifically, the interview identifies into which of the seven previously discussed stages an individual falls. The interview is comprised of four ill-structured problems in the areas of physical science, social science, history and biology that illustrate alternative or opposing conceptions of the dilemma. Each problem is based on an area of current interest with which the sample is likely to be familiar. For each problem, the subjects are asked probing questions that elicit an explanation and defense of their judgment about the issue. They also are asked to explain in what way they know their opinion is true. Subjects are encouraged to expand fully on their responses (Duell & Schommer-Aikins, 2001).

Trained and certified raters score responses by assigning three stage numbers to each. The first number indicates which stage in the Reflective Judgment Model is dominant in the response. The second number indicates the secondarily dominant stage. The third number is only
given if there is evidence of a third dominant stage. In the absence of this evidence, the third number repeats the first. In most instances, interviews of this type have been scored by two certified raters. Individual scores are determined by averaging the three numbers given by both raters on all four dilemmas (Duell & Schommer-Aikins, 2001; King & Kitchener, 2004). Interrater reliability of this instrument ranges from moderate to high and is also ensured by training and certification of the interviewers and scorers. The interview also has fared well on validity measures. However, King and Kitchener caution that since no contextual support (e.g., scaffolding) is offered to the participants during the interview, it may be actually measuring the individual’s functional level, defined by Fisher and Pipp (1984) as a person’s cognitive capacity when there is no available support, and thus may underestimate his or her ability to think reflectively. When contextual support is provided, individuals are able to perform closer to their upper limit, which is referred to as their optimal level. Fischer and Pipp (1984) refer to the space between the functional level and the optimal level as the developmental range (King & Kitchener, 2004).

To address this limitation, Kitchener, Lynch, Fischer and Wood (1993) created the prototypic reflective judgment interview (PRJI) in order to assess reflective thinking under conditions of support. Using the PRJI in conjunction with the original Reflective Judgment interview, Kitchener et al. (1993) conducted a study to determine whether scores differed between the two measures. Results were consistently higher scores on the PRJI than the original interview. This provides evidence for the idea that individuals utilize more than one stage and contextual support seems to increase individuals’ access to higher stage functioning. This study also provided evidence for a performance ceiling that is correlated with the age of the participant. This trend was consistent with patterns observed using the original interview (King & Kitchener, 2004).

Due to limitations of the Reflective Judgment interview, Kitchener, Wood, & Jensen (1999) developed a paper-and-pencil measure for the Reflective Judgment Model. This measure is comprised of two components. The first focuses on the student’s ability to differentiate between more or less sophisticated approaches to a dilemma. The second aspect addresses the level of sophistication of approaches that individuals see as similar to their own. At present, reliability and validity measures appear to be similar to those of the Reflective Judgment interview (Duell & Schommer-Aikins, 2001).
Epistemic Doubt Theory

Boyes and Chandler (1992) put forth the Epistemic Doubt Theory, which focuses on how epistemological beliefs develop from the pre-school years to adolescence. Piaget’s theory of cognitive development provides the theoretical framework from which they have drawn assumptions for their work. They hypothesize that epistemological development of an individual has salient implications for identity and cognitive development. They do not make the assumption that epistemic development determines identity or cognitive growth, but can limit these if a sophisticated enough way of thinking is not available. Boyes and Chandler outline four levels of epistemological development (Duell & Schommer-Aikins, 2001).

Level 0 is the Naively Realistic stage, which is seen during the pre-school years. In this stage, children believe that knowledge is based on direct observation. Conflict arises in this stage since different people observe different things and therefore have differing points of view. From here individuals move into Level 1 which is called the Defended Realism stage. This stage coincides with Piaget’s concrete operational stage of cognitive development, as children begin to accept subjectivity, bias and differing points of view. Level 2 is the Dogmatism-Skepticism Axis stage, which corresponds with Piaget’s formal operations stage of cognitive development. Here individuals begin to see knowledge as uncertain and a product that is constructed rather than observed. Children respond to this uncertainty in one of two ways: 1) dogmatic thinking characterized by “clinging onto knowledge” acquired from an authority figure (Duell & Schommer-Aikins, 2001, p. 432), or 2) skeptical thinking where children abandon all hope for consensus and accept any knowledge. Level 3 is the final stage and is referred to as the Post-skeptical Rational Stage. While well into the formal operational stage of cognitive development, individuals reach level 3. This is characterized by the belief that rational decisions can be made with only partial certainty of knowledge. Individuals can make evaluative judgments about the value of knowledge and alternative decisions (Duell & Schommer-Aikins, 2001).

Boyes and Chandler developed the Epistemic Doubt interview to measure epistemic development. The interview is comprised of two vignettes presenting controversial views. Subjects are asked to present arguments for both sides of each issue and to reach a conclusion. General probes are then provided by the interviewer to engage the participant in further articulation of their arguments and description of what the two vignettes have in common. Responses to each vignette are coded separately and assigned a score: (0) naive realism, (1)
defended realism, (2) dogmatism, (3) skepticism or (4) rational. The subjects are assigned the higher of the two scores. Limitations of this instrument include the ambiguous and time-consuming nature of scoring it as well as the possibility that participants may not have the appropriate frame of reference for the chosen vignettes (Duell & Schommer-Aikins, 2001).

**Multi-dimensional Theories**

**Schommer’s Theory**

Schommer (1990) put forth the first truly multidimensional theory of epistemology. Up to this point, epistemology researchers all held a unidimensional view or conceptualization of epistemological beliefs. The main difference between multidimensional models and unidimensional models has to do with the relationship among the dimensions of the model. For example, epistemological development theories may include beliefs about the certainty of knowledge, the structure of knowledge and the sources of knowledge. A unidimensional theory assumes that all of these dimensions evolve concurrently. A multidimensional model considers the possibility of each dimension developing at a different rate from the rest (Duell & Schommer-Aikins, 2001). Schommer (1990) proposed the concept of personal epistemology as a “system of more-or-less independent beliefs” (Duell & Schommer-Aikins, 2001, p. 440). The term “system” implies that epistemological beliefs are multi-dimensional. The level of sophistication of beliefs may or may not vary within an individual. For example, a student may have very sophisticated beliefs for certain dimensions of knowledge beliefs, but be relatively naïve on other dimensions (Buehl & Alexander, 2004). Schommer identified five salient beliefs that comprise personal epistemology based upon the works of previous researchers: 1) the structural aspect of knowledge (isolated facts vs. integrated concepts), 2) the certainty of knowledge (absolute vs. continually dynamic), 3) the source of knowledge (acquired from authority figures vs. derived from empirical evidence and reason), 4) the duration of learning (quick one time events vs. gradual and continuous) and 5) the capability to learn (fixed at birth vs. improvable with time and practice). Schommer also states that these components may not develop at the same rate, often resulting in disparities among them, particularly during times of epistemological belief change, such as development seen in the college years (Duell & Schommer-Aikins, 2001).

Schommer developed a questionnaire to assess the five belief dimensions discussed in her theory. Subsets of items were created to assess beliefs in multiple ways and were written in a positive and negative valence for the following aspects: the certainty of knowledge, the
relationship between hard work and success, the ability of individuals to learn how to learn, the
innateness of learning ability, the speed in which learning takes place, the importance of effort,
the value of multidisciplinary approaches and the role of authority figures. The instrument is
comprised of 63 items that subjects respond to on a 5-point Likert scale. There is evidence to
support the reliability, content validity and predictive validity of the instrument. Schommer
cautions while this instrument is useful for identifying strengths in an individual’s epistemology,
additional instruments may be needed for a more penetrating view into specific dimensions of
interest to the researcher (Duell & Schommer-Aikins, 2001).

Kuhn’s Argumentative Reasoning Model

Similar to the work done by King and Kitchener on the Reflective Judgment model,
Kuhn’s research focuses on how individuals address ill-structured problems. In her study, Kuhn
sampled individuals from a wide array of age groups ranging from teenagers to adults in their
sixties. Based on this research, Kuhn and her colleagues propose another multidimensional
theory of epistemological beliefs, which specifically focuses on development.

Kuhn hypothesizes four levels of epistemological development: 1) realism, 2) absolutism,
3) multiplism and 4) evaluativism. Kuhn defines these four levels in terms of how an individual
approaches assertions, reality, knowledge and critical thinking. The levels represent qualitatively
distinct understandings of these aspects, which Kuhn believes defines epistemological
development (Kuhn & Weinstock, 2002).

While in the realism level, individuals believe “assertions are copies of reality,” reality is
knowable, knowledge is acquired from external and certain sources and critical thinking is not
necessary. The absolutism level is characterized by the beliefs that assertions are facts that are
either correct or incorrect and critical thinking is utilized to compare assertions to reality to
determine their truth or falsehood. Reality is still knowable and knowledge still comes from
external and certain sources in this level. In the multiplism level, individuals believe that
assertions are opinions, reality is not directly knowable, knowledge is created by individuals and
therefore uncertain and critical thinking is ineffective. Finally, the evaluativist level is
characterized by the beliefs that assertions are judgments that are evaluated and compared
depending on context and available evidence, reality is not directly knowable, knowledge is
generated by individuals and is therefore uncertain and critical thinking is highly valued as a
vehicle through which assertions are made and understanding develops. The evaluativist
integrates an objective view of knowledge with a subjective one by acknowledging that two people can have different yet legitimate positions on a topic, both be right, but one position can be more legitimate based upon the evaluation of available evidence (Kuhn & Weinstock, 2002).

Kuhn’s theory is also multi-dimensional and includes five different judgment domains across which she believes epistemological beliefs develop: 1) personal taste (e.g., music preference), 2) aesthetic judgment (e.g., views on art), 3) value judgment (e.g. whether the death penalty is a just punishment), 4) facts about the social world (e.g., explanations about child development) and 5) facts about the physical world (e.g., the components of a cell). Kuhn integrates these judgment domains within the four developmental levels of understanding. She hypothesizes that people move from the realist level to the evaluativist level at different rates within each judgment domain. For example, development from the absolutist level to the multiplistic level occurs in the following order: personal taste, aesthetic judgment, value judgment, social facts and finally physical world facts. Progression from the multiplism level to the evaluativist level occurs in the reverse order, but does not include personal taste. Kuhn suggests that the personal taste judgment domain should not be classified as evaluativist at all due to its idiosyncratic nature (Duell & Schommer, 2001).

Kuhn and her colleagues created a 15-item questionnaire to evaluate the Argumentative Reasoning Model. While acknowledging the value of qualitatively rich responses from long interviews, they believe this instrument to be practical for assessing epistemology across judgment domains and age groups. At the writing of this review, there is evidence of concurrent validity, but nothing reported on issues of reliability. This instrument is still a work in progress (Duell & Schommer-Aikins, 2001).

**Academic Domain Specificity**

The literature in other areas of educational research, such as student learning and motivational theory, provides evidence for acknowledging the specificity of students’ beliefs. When beliefs are measured at the task level or the domain-specific level, they provide more valuable information for predicting student behavior (Buehl & Alexander, 2004). For example, students’ self-efficacy beliefs have been shown to be predictive of students’ task choice, persistence at a task and performance (Schunk, 1991). More important to the study of epistemological beliefs however, there is evidence that students’ beliefs about the value of
knowledge in a particular academic domain, is related to their decision to pursue courses in that
domain (Buehl & Alexander, 2004; Meece, Wigfield, & Eccles, 1993).

Following the same model as these other areas of educational research and
acknowledging the multiple dimensions of beliefs about knowledge, research on the domain
specificity of epistemological beliefs, as well as the development and implications of those
beliefs, is now at the forefront of the epistemology literature. In other words, current studies
investigate to what degree an individual holds similar beliefs across academic domains. In early
epistemology research, beliefs were studied under the assumption that they were domain general,
most likely a convenient starting point for a newly emerging line of research. Recently, this
assumption has been questioned and has become the focus of new research (Schommer &
Walker, 1995; Schommer-Aikins, Duell & Barker, 2003). This has lead to two opposing
viewpoints. First, recent research on intelligence (e.g., Gardner, 1993) posits the existence of
multiple intelligences that are domain specific. If epistemological beliefs are similar in nature to
intelligence, this would suggest some degree of domain specificity within an individual’s
epistemological beliefs. It also has been hypothesized (e.g., Perkins & Simmons, 1988) that
intra-individual differences across domains are due to domain-independent, higher order
knowledge and content knowledge. Currently, there is growing acceptance for the idea that
domain general and domain specific beliefs co-exist in a complex network of beliefs. In other
words, individuals hold general knowledge beliefs that form a foundation for more specific
beliefs that are salient under particular conditions (Fives & Buehl, 2004).

Schommer and Walker (1995) specifically address this issue by testing the domain
generality of epistemological beliefs across two academic domains – social sciences and
mathematics. An instrument developed in previous research was used (Schommer, 1990) in two
experiments. In experiment one, students were asked to complete a survey about epistemological
beliefs while either thinking about mathematics, such as algebra, geometry and statistics or social
sciences, such as psychology, sociology and history. In the second experiment two design
changes were made. First, the possibility that students had not kept the specific domain in mind
while completing the survey was addressed. Reminders were added to the top and middle of each
page of the questionnaire and additionally, about every third item made specific reference to the
domain. Second, a control group was added to the analysis. Results from these experiments
indicated that students were able to keep a specific domain in mind while completing the
questionnaire. Additionally, results provide support for the assumption that epistemological beliefs are more or less similar across domains. The majority of students involved in the experiment demonstrated a consistent level of epistemological sophistication. However, Schommer and Walker (1995) do suggest that students may have general beliefs about knowledge that are modified when they reflect on a specific domain. For example, a student may believe that knowledge is uncertain in general, but prescribe to the belief that there is more stability in mathematics than in social sciences. Due to the sample used, it is not clear from this research whether experts in a certain discipline have these modifications in their beliefs across domains. Stability and domain specificity of epistemological beliefs among experts remains a void in this body of literature.

Paulsen and Wells (1998) interpreted Schommer and Walker’s data differently by saying that the moderately strong positive correlations that they found were not necessarily indicative of domain generality. Conversely, these correlations could be illustrating the similarity between mathematics and social sciences. Paulsen and Wells (1998) cite the Biglan classification system in which both disciplines are considered “pure” and suggest that a study comparing disciplines that do not share this characteristic would be a stronger test for domain specificity. With this as their basis, Paulsen and Wells compared students majoring in different academic disciplines. There were two major differences between this design and the Schommer and Walker design: 1) this design assesses epistemological beliefs once for academics in general using a between-subject design, rather than the Schommer and Walker within-subject design and 2) Paulsen and Wells use two dimensions of the Biglan classification system- hard vs. soft and pure vs. applied as opposed to Schommer and Walker that compared disciplines that varied on one dimension only- ill structured vs. well structured (Paulsen & Wells, 1998; Schommer-Aikins, Duell & Barker, 2003).

Hard academic disciplines (e.g., engineering, chemistry) are characterized by those within the professions being able to agree on methodology, basic concepts, and questions for research. In contrast, soft academic disciplines (e.g., education, sociology) are characterized by lack of a common paradigm where concepts and methods are debated. The pure vs. applied dimension distinguishes between fields by the degree to which they focus on theory or application. Pure fields include mathematics and sociology. Applied fields include finance and education (Schommer-Aikins et al., 2003). “Biglan found the dimensions of hard vs. soft and
pure vs. applied to be the strongest predictors of structure and output of university departments” (Schommer-Aikins et al., 2003, p. 352).

These dimensions identified by Biglan have several implications for individual epistemology. The main crux of pure fields is theory building, which necessitates change and new ideas. This ongoing pursuit of new knowledge may impact the epistemological thinking of students in these fields (i.e., it may encourage these students to view knowledge as constantly changing and learning as something that occurs gradually over time). Conversely, applied fields emphasize using knowledge. In many of these professions decisions need to be made instantly. This could encourage students of these disciplines to look at knowledge as certain and learned quickly (Paulsen & Wells, 1998).

The dimension of hard vs. soft also has implications for epistemological beliefs. Hard fields involve major concepts and ideas that have evolved over a long period of time. These fields are characterized by agreement on methods and content. Students studying hard fields may tend to believe that knowledge is certain. Whereas soft fields, those that encourage diverse opinions and ambiguity, may attract students that believe knowledge to be complex and uncertain (Paulsen & Wells, 1998). The major criticism of Schommer and Walker’s 1995 study by Paulsen and Wells (1998) is based upon the distinctions between the variables of these two dimensions. Schommer and Walker compared mathematics and social sciences, which fall in proximity along the pure-applied scale (i.e., both are pure). For this reason, epistemological domain independence does not necessarily follow (Paulsen & Wells, 1998). Schommer-Aikins et al. (2003) responded to these criticisms with a follow-up study while agreeing that some evidence of domain specificity of beliefs exists, but is due to use of a between-subject design (rather than the within-subject design Schommer and Walker used in the 1995 study), and thus, academic experience. In other words, Paulsen and Wells addressed whether students from different disciplines have different epistemological beliefs, rather than whether students have different beliefs across academic disciplines. Schommer-Aikins et al. (2003) found evidence for moderate domain-generality of beliefs among college undergraduates, which was consistent with Schommer and Walker’s 1995 study. By “moderate domain-generality,” Schommer-Aikins et al. (2003) refer to an “individual who tends to believe in simple, certain knowledge in one domain will tend to have similar beliefs in other domains. Yet, the epistemological beliefs will not be exactly the same” (p. 362). Despite the confirmation of the Schommer and Walker study (1995),
Schommer-Aikins et al. (2004) suggest that domain-specificity/generality may vary over time and with experience and suggest that future research focus on “the breadth of applicability of epistemological beliefs” (p. 363).

Buehl, Alexander and Murphy (2002) added to the domain specificity literature with a study building on Schommer’s work that resulted in development of an instrument (the Domain Specificity Belief Questionnaire, “DSBQ”) that is specifically focused on the degree to which beliefs about academic knowledge vary across domains. The instrument was then used to further investigate whether these beliefs are domain-specific, as Buehl and Alexander contended previously (2001), or are more domain-general as assumed in previous literature (King & Kitchener, 1994; Perry, 1970). Buehl et al. (2002) point out that previous studies that found student epistemological beliefs to be domain-general (Hofer, 2000; Schommer & Walker, 1995) used survey items that did not explicitly state the academic discipline that was of interest. Rather, “science” or “psychology” was printed across the top of each page. Additionally, Buehl et al. (2002) question the analysis done by Hofer (2000) and Schommer and Walker (1995).

Buehl et al. (2002) conducted their study with a sample of 633 undergraduate students from several courses throughout the university over a full academic year. The students in the sample represented a variety of majors. The DSBQ was administered in two forms to each student. Results of the study support the idea of domain specificity of academic beliefs. The major limitation in this work however, is the lack of control for major (i.e. academic experiences). It seems natural that one’s beliefs about a discipline will vary based upon experience with it, specifically when one takes a multidimensional stance on epistemological beliefs, as discussed previously. Buehl et al. (2002) do acknowledge this limitation as an issue of generalizability and suggest controlling for academic histories in future studies.

Buehl and Alexander (2004) contend that although differing domain specific beliefs co-exist within an individual, they most likely develop separately. They attribute individual variations to different experiences with knowledge in the respective domains. This recent study provided evidence for the existence of underlying knowledge beliefs that encompass multiple domains (domain-generality), but also found that individuals possess specific beliefs that become instantiated when certain domains or contexts are considered (domain-specificity). Buehl and Alexander (2004) recognize the need for future research to consider expertise within specific
domains while analyzing knowledge beliefs in order to gain a better understanding of how epistemologies develop.
CHAPTER 3
METHODOLOGY

This study furthered the domain specificity research conducted by Buehl, et al. (2002) and Buehl and Alexander (2004) by extending the investigation to include teachers. This research operationalized and measured the degree of domain specificity of teachers’ academic beliefs and correlated the sophistication level of these beliefs to the grade level assignment and the subject area taught by the teachers. The Domain Specific Belief Questionnaire (DSBQ) (Buehl, 2002) was used to measure teachers’ beliefs about science and social studies. Statistical analysis was employed to determine if significant differences between these two types of beliefs were present. Teachers’ beliefs were then analyzed by comparing elementary teachers to secondary teachers as well as comparing secondary science teachers to secondary social studies teachers. Specifically, this study investigated the following:

1. Are teachers’ beliefs about academic knowledge general across academic domains or specific with regard to academic domain?
2. Is the grade level assignment (elementary versus secondary) of a teacher (independent variable) correlated with the level of sophistication of beliefs and degree of domain specificity about academic knowledge (dependent variable)?
3. Are beliefs held by science teachers about science different (more or less sophisticated) than those of social studies teachers? Conversely, are beliefs held by science teachers about social studies different (more or less sophisticated) than those of social studies teachers? In other words, are a secondary teacher’s beliefs about his/her own field more sophisticated than his/her beliefs about other fields?

Participants

This study utilized a sample of 51 elementary teachers and 132 secondary teachers. The secondary teachers were comprised of 66 history/social studies teachers and 66 science teachers. This was a convenience sample, as a pre-existing database from the researcher’s office was used to recruit study participants. The database includes elementary and secondary science teachers from six states that have regularly participated in science professional development with the researcher. All would be considered “science leaders” in their schools. The professional development included participation in programs such as one-day, hands-on workshops on sophisticated science topics such as superconductivity, week-long summer institutes that provide...
a survey of content representative of research conducted at the National High Magnetic Field Laboratory (NHMFL) and a six-week residential Research Experiences for Teachers program that matches teachers from across the United States with mentor scientists to conduct real scientific research. All programs provided teachers will direct contact with NHMFL scientists and portrayed science as a dynamic, inquiry-based human endeavor. In all cases, there was an emphasis on hands-on activities and exposure to rich science content.

The researcher requested that the secondary science teachers in the sample group identify history/social studies teachers at their school to participate in the study. The academic beliefs of the three subgroups of teachers (elementary general educators, secondary science educators and secondary social studies educators) were compared because of their presumed diverse educational backgrounds. The sample was based upon the assumption that it will be representative of diverse educational experiences. Specifically, elementary teachers often experience a survey of content and general education courses, whereas secondary teachers often experience a large amount of content courses, specifically for the subject that they will teach. The limitations of this assumption are explored in the discussion chapter, however, it was understood at the onset of the study that the experiences with professional development held by the teachers in this sample may have limited the diversity of the subgroups. Additionally, confounding variables such as gender and years of teaching experience were acknowledged.

The Educational Experience Questionnaire was used to better understand the backgrounds of the subgroups and as a means of analyzing specific variables, such as highest degree obtained. Previous research has used education level and courses taken as a means of gauging teacher knowledge (Benz, Bradley, Alderman & Flowers, 1992; Hoy & Woolfolk, 1993; Enochs, Scharmann & Riggs, 1995). This study used the Educational Experience Questionnaire to explore the subjects’ education background and professional experiences. Information from this instrument was used to draw conclusions about the quantitative results of the study.

**Instruments**

The DSBQ is comprised of 22 statement items with which subjects indicate their level of agreement on a scale of 0 (strongly disagree) to 9 (strongly agree). The 22 items are comprised of 11 pairs containing one science statement and one social studies statement. In five of these pairings, the science statement is worded identically to the social studies statement except for the reference to the academic discipline. In the other six pairings, the science statement is the inverse
of the social studies statement. For example, identical pairs have statements that might read, “Students who are good at social studies have to work hard” and “Students who are good at science have to work hard.” Inverse pairs have statements that might read, “A social studies question can be approached in several different ways” and “There is only one way to approach a science problem.” The eleven pairs of statements on the DSBQ are outlined in the table below.

Table 3.1: DSBQ Statement Item Pairings

<table>
<thead>
<tr>
<th>Science Statement Item</th>
<th>Social Studies Statement Item</th>
<th>Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>1</td>
<td>Same</td>
</tr>
<tr>
<td>19</td>
<td>2</td>
<td>Inverse</td>
</tr>
<tr>
<td>15</td>
<td>3</td>
<td>Inverse</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>Same</td>
</tr>
<tr>
<td>5</td>
<td>14</td>
<td>Inverse</td>
</tr>
<tr>
<td>16</td>
<td>6</td>
<td>Same</td>
</tr>
<tr>
<td>21</td>
<td>7</td>
<td>Inverse</td>
</tr>
<tr>
<td>8</td>
<td>18</td>
<td>Same</td>
</tr>
<tr>
<td>9</td>
<td>22</td>
<td>Inverse</td>
</tr>
<tr>
<td>20</td>
<td>11</td>
<td>Same</td>
</tr>
<tr>
<td>17</td>
<td>13</td>
<td>Inverse</td>
</tr>
</tbody>
</table>

Seventy-four study participants completed and returned the DSBQ developed by Buehl and Alexander (2001). The reliability for the instrument was reported as Cronbach’s α reliability coefficient = 0.89 for Form A and 0.88 for Form B. For split form reliability α coefficients are 0.84 for mathematics and 0.88 for history. This instrument was chosen because it was specifically designed to unearth domain-specific academic beliefs (Buehl et al., 2002) and was adapted by replacing references to “math” with references to “science” in order to address science beliefs in contrast to history beliefs. Reliability of the instrument was confirmed using this study’s sample and resulted in a Cronbach’s α of 0.73 for the whole form (Form A). The weaker reliability as compared to Buehl’s findings was most likely due to the smaller sample size employed in this study.
Procedure

Participation in the study was voluntary. The researcher solicited elementary and secondary (science and social studies) teacher volunteers through direct mailing to teachers at their home schools using a database of elementary and secondary science teachers who have participated in educational programs sponsored by the National High Magnetic Field Laboratory’s (NHMFL) Center for Integrating Research and Learning (CIRL). The researcher maintains this database through her employment as Assistant Director of the Center for Integrating Research and Learning at the National High Magnetic Field Laboratory. The Director of CIRL and the Director of the NHMFL have given their permission to the researcher to use the database for this research project.

At the time of the mailing, the database included 117 teachers from six states (Florida, Georgia, Mississippi, Kentucky, Maryland and Ohio). Of the 117 teachers, 103 teach in Florida. Of the 103 Florida teachers, 92 teach in Leon and surrounding counties in Northwest Florida. Teacher participants were asked to complete the Domain-Specific Beliefs Questionnaire (DSBQ) (Appendix A) and the Educational Experience Questionnaire (Appendix B). The DSBQ, developed by Buehl and Alexander (2001), is a 22-item Likert scale instrument that assesses the degree of academic discipline specificity associated with individuals’ beliefs about knowledge. The educational background survey was developed by the researcher.

Surveys and return envelopes with postage were mailed directly to 117 teachers. This group was comprised of 51 elementary and 66 secondary science teachers. Each science teacher was asked to select a social studies teacher from their school to complete the survey. In this manner, 66 social studies teachers were indirectly mailed the survey materials. The mailing included instructions to complete and return the survey by February 10, 2005. The cover letters that included the survey instructions can be found in Appendix C. Return of the survey to the researcher was considered consent to participate in the study. Packets mailed to the secondary science teachers included two surveys, two sets of survey instructions and two return envelopes with postage, with a request to have a social studies teacher from their school complete the survey as well. Instructions provided to each teacher indicated that the survey should be returned directly to the researcher. All surveys were assigned identification numbers prior to dissemination to the teachers so that the researcher was able to determine which teachers had not returned the survey. Survey recipients that did not respond by February 10, 2005 received
follow-up phone calls and/or email (in cases where appropriate contact information was available) to remind them to complete and return the survey. It was estimated that the survey took no more than 30 minutes to complete.

All participants received a thank you letter (letters to the social studies teachers were mailed care of the paired science teacher as no personal identification was available to the researcher) and were entered into a drawing to win a $25 gift certificate to Barnes & Noble Booksellers. Three teachers (one elementary and one secondary pair) were randomly chosen for the prize. Again, the social studies teachers were contacted through the science teachers.

Hypotheses

With regard to research question #1, it was hypothesized that teacher beliefs would follow the same pattern of domain-specificity as that of students, which has been demonstrated in previous research. There is increasing acceptance for the idea that students possess general knowledge beliefs that shape more specific knowledge beliefs that become salient during certain tasks or conditions (i.e. different domains) (Fives & Buehl, 2004). For example, students tend to believe that knowledge in fields such as history or social studies are significantly less certain and come from an authority significantly less often than knowledge in fields like math or science (Buehl & Alexander, 2004).

In reference to research question #2, it was expected that the level of content specificity of educational experience (operationalized by grade level taught) held by the teacher will be positively correlated to the sophistication of epistemological beliefs. Moreover, it was anticipated that epistemological beliefs of elementary teachers will be less sophisticated, whereas secondary teachers would exhibit more sophisticated and domain specific beliefs. The reason for this hypothesis was because elementary teacher training programs often include fewer content specific classes than do secondary teacher training programs. It was thought that the focus on pedagogy and subject method courses in elementary education programs may not affect epistemological beliefs (general and about specific disciplines) of teachers to the same degree that content-rich courses in secondary education programs might. It was hypothesized that greater exposure to a subject area will most likely result in more sophisticated knowledge beliefs. Specifically, it was predicted that a teacher will have the most sophisticated beliefs about knowledge regarding the subject with which they are most familiar.
With regard to research question #3, it was anticipated that among the group of secondary teachers, the science teachers would have a more sophisticated view on science than would social studies teachers. This was expected because it is often the case that individuals with limited science knowledge view the discipline as a certain, unchanging collection of facts. It was assumed that the science teachers possessed more science knowledge than did the social studies teachers. Additionally, it was expected that the social studies teachers will have more sophisticated beliefs about social studies than will science teachers. It was assumed that the social studies teachers possessed more social studies knowledge than did the science teachers. This hypothesis is supported by Buehl & Alexander (2004) who offer different experiences with knowledge in respective domains as a possible explanation for the domain specificity of beliefs of the students in their general sample.

Research Analyses

This correlational study’s analysis included a general interpretation of the DSBQ for all teachers sampled to address question #1, a comparison between the elementary teachers and secondary teachers to address question #2, and a comparison between secondary science and social studies teachers to address #3. The DSBQ was analyzed by computing two composite scores (one for science items and one for social studies items) for all participants. Composite scores were generated by summing the science items and the social studies items independently. Composite score analysis was used by Buehl, et al. in the 2002 study. Analysis of the Educational Experience Questionnaire was conducted to confirm the assumptions that secondary teachers have more experience with specific content knowledge in their area of study and elementary teachers have general experience with broader content, which informed the interpretation of the quantitative results.

Before analysis of the DSBQ was conducted, missing data were dealt with. Each of the 73 respondents completed all 22 items on the DSBQ except for three instances where an item was left blank by three individuals for unknown reasons. In an effort to preserve as much data as possible, series (survey item) means were inserted for the three missing values. In other words, if an item was left blank by a participant, the mean of responses given for that item for the sample was inserted in place of the missing value. It was necessary to replace missing data, since composite scores were calculated for each participant.
The DSBQ was interpreted by first recoding the inverse statements so that all items could be analyzed simultaneously. Next, composite scores for both the eleven science items and the eleven social studies items were generated for each respondent. Composite scores were calculated by summing the eleven items in each category. A higher score was indicative of more sophisticated beliefs. To test Hypothesis 1, a paired-sample T-test was used to analyze the difference between mean of the science item composite scores and the mean of the social studies item composite scores for all respondents. This statistic was chosen since a within subject comparison was conducted. A Pearson’s correlation was also conducted to ascertain how the scores on the science items varied with the scores on the social studies items for the sample as a whole.

The means of composite scores on both the science items and the social studies items were calculated separately for each subgroup (secondary science teachers, secondary social studies teachers and elementary teachers). Pearson’s correlations were run within each subgroup to determine the relationship between scores on science items and scores on social studies items for each of the three groups.

To test Hypothesis 2, one sample T-test analysis was conducted. The first compared the mean composite score on science items by the elementary teachers (n=22) with the mean composite score on science items by secondary teachers (n=51). The second T-test compared the mean composite score on social studies items by the elementary teachers (n=22) with that of the secondary teachers (n=51). This analysis was conducted to determine if elementary and secondary teachers had significantly different scores on science and/or social studies items. Differences would indicate a difference in the level of sophistication of beliefs among the groups.

To test Hypothesis 3, a one sample T-test was used to compare the mean composite score on science items by science teachers (n=32) with the mean composite score on science items by social studies teachers (n=19). A one sample T-test also was used to compare the mean composite score on social studies items by science teachers (n=32) with that of the social studies teachers (n=19). Differences in composite scores for the science and social studies items would indicate differences in the beliefs about the two academic domains between the two types of teachers. The qualitative information compiled on each participant was used to offer suggestions as to why differences may exist among the subgroups. Pearson’s correlations were also run to
determine the relationship between scores on science items and scores on social studies items within each subgroup in an effort to identify any trends that might be different from the group as a whole.
CHAPTER 4
RESULTS

Seventy-four teachers (40% of the teachers solicited) completed and returned surveys. Of these, 55 were elementary or secondary science teachers that were directly mailed the survey materials. Nineteen were secondary social studies teachers that received the survey materials from a science teacher at their school. See Table 4.1 for a summary of the Educational Experience Questionnaire.

Educational Experience Analysis

Thirty-two science teachers returned surveys. Of these, nineteen held undergraduate degrees in various science fields such as chemistry, physics, biology, meteorology and engineering physics. Nine science teacher respondents held undergraduate degrees in science education. Three held undergraduate degrees in fields unrelated to science and one did not report his/her undergraduate degree. Of the three who held undergraduate degrees in other fields, two of them reported having a graduate degree in science education and a substantial amount of science professional development. For this reason, their experiences with science content were considered similar enough to those teachers with degrees in science or science education to keep them in the analysis. Of all science teacher respondents, fifteen held graduate degrees in a science field or science education. The average years teaching for this group was 16.95. Twelve respondents were male and twenty were female.

Nineteen social studies teachers completed and returned surveys. Of these, thirteen held degrees in fields such as English, political science, history and business. Since all of these are soft fields according to the Biglan classification system (Paulsen & Wells, 1998), they all remained in the analysis since experiences with soft fields provided a sufficient contrast to experiences with a hard field such as science. Five held undergraduate degrees in history/social studies education. One held an undergraduate degree in elementary education. Fourteen teachers in the group held graduate degrees in either a social studies or education field. The average years teaching for this group was 15.03. Eight respondents were male and eleven were female.

Twenty-three elementary teachers completed and returned surveys. Of these, thirteen held undergraduate degrees in elementary or early childhood education, four held undergraduate degrees in special/gifted education or disabled populations, four reported having degrees in art,
biology, English and journalism and two did not report their undergraduate degree. Five reported having graduate degrees in elementary education, three in reading and one in science education. The average years teaching for this group was 20.26. One respondent was male and twenty-two were female.

Table 4.1: Summary of Educational Experience Questionnaire

<table>
<thead>
<tr>
<th></th>
<th>Elementary Teachers</th>
<th>Secondary Science Teachers</th>
<th>Secondary Social Studies Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>23</td>
<td>32</td>
<td>19</td>
</tr>
<tr>
<td>Gender</td>
<td>1 male, 22 female</td>
<td>12 male, 20 female</td>
<td>8 male, 11 female</td>
</tr>
<tr>
<td>Undergraduate degrees held</td>
<td>13 elementary or early childhood education</td>
<td>19 scientific field</td>
<td>13 soft field</td>
</tr>
<tr>
<td></td>
<td>4 special/gifted education</td>
<td>9 science education</td>
<td>5 history/social studies education</td>
</tr>
<tr>
<td></td>
<td>4 various subjects</td>
<td>3 unrelated to science</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 unreported</td>
<td>1 unreported</td>
<td></td>
</tr>
<tr>
<td>Graduate degrees held</td>
<td>5 elementary education</td>
<td>15 science or science education</td>
<td>14 social studies or education</td>
</tr>
<tr>
<td></td>
<td>3 reading</td>
<td>1 science education</td>
<td></td>
</tr>
<tr>
<td>Average years teaching</td>
<td>20.26</td>
<td>16.95</td>
<td>15.03</td>
</tr>
</tbody>
</table>

The Educational Experience Questionnaire included two five-point Likert scale items to provide some quantification of the amount of content knowledge to which the teachers are typically exposed. The two questions were: 1) On a scale from one through five, with five being the most and one being the least, rank the professional development experiences you have had within the last five years with regard to the amount of subject matter content provided and 2) On a scale from one through five, with five being “very often” and one being “infrequently,” indicate how often you expose yourself to materials that provide subject matter content (e.g., non-fiction texts, historical documents, non-trade journals, documentaries, informational videos). One sample T-tests were conducted for each item to compare the mean responses between elementary and secondary teachers. Statistically significant (p=0.001) differences were found between the two groups for each question. For question one, the elementary teachers reported greater subject
matter content in professional development with a mean of 3.91. The mean for secondary teachers was 3.38. For item two, secondary teachers reported greater frequency of exposure to materials providing subject matter content with a mean of 3.91. The mean for elementary teachers was 3.60.

**Whole Sample Analysis (Question #1)**

Composite scores on science and social studies items on the DSBQ were calculated for all respondents. The mean composite score for science items was 7.68 with a 0.64 standard deviation and the mean composite score for social studies items was 7.06 with a 0.85 standard deviation. A paired-sample T-test indicated a significant difference \((p=0.001)\) between means of composite science scores and composite social studies scores. The mean difference in composite scores between science items and social studies items was 0.63, with a 0.70 standard deviation. Composite scores on science items were positively correlated with social studies items for all participants. A significant and strong Pearson’s correlation of 0.59 was found (see Figure 4.1).

![Figure 4.1: Correlation of Science Scores and Social Studies Scores for All Subjects](image)

These data provide evidence for the presence of domain general and domain specific beliefs co-existing in a complex network of beliefs within individuals (Question #1). In other words, the sample seemed to hold general knowledge beliefs that form a foundation for more specific beliefs that are salient in particular contexts. The idea of a general foundation of beliefs is supported by the strong correlations between the level of sophistication of beliefs about
science and those about social studies among all subjects in the sample. This provides evidence
for the idea that an individual’s general epistemological beliefs evolve more or less
simultaneously. Whether an individual’s domain specific beliefs make up his or her general
belief system or whether an individual’s general belief system drives the formation of his or her
domain specific beliefs is unclear, however it appears that a significant relationship exists. The
specificity of beliefs under certain conditions can be seen by the statistically significant
difference in how subjects scored on science items versus social studies items.

Analysis by Grade Level (Question #2)

The mean composite score for both the science items and the social studies items was
calculated separately for each subgroup (secondary science teachers, secondary social studies
teachers and elementary teachers) (Questions #2). The mean composite scores are as follows (see
Table 4.2).

Table 4.2: Mean Composite Scores by Sub-Group for Each Item Type

<table>
<thead>
<tr>
<th></th>
<th>Science Items Composite Score (Mean, Std. Dev.)</th>
<th>Social Studies Item Composite Score (Mean, Std. Dev.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science Teachers (n=32)</td>
<td>7.82, 0.57</td>
<td>7.02, 0.85</td>
</tr>
<tr>
<td>Soc. Studies Teachers (n=19)</td>
<td>7.49, 0.69</td>
<td>7.38, 0.58</td>
</tr>
<tr>
<td>All Sec. Teachers (n=51)</td>
<td>7.70, 0.64</td>
<td>7.16, 0.77</td>
</tr>
<tr>
<td>Elementary Teachers (n=22)</td>
<td>7.64, 0.66</td>
<td>6.81, 0.99</td>
</tr>
</tbody>
</table>

The one sample T-test used to compare the mean composite score on science items by the
elementary teachers (n=22) with that of the secondary teachers (n=51) yielded a significant
result, p=0.001. The one sample T-test conducted to compare the mean composite score on
social studies items by the elementary teachers (n=22) with that of the secondary teachers (n=51)
was also significant, p=0.001. With regard to science and social studies items, secondary
teachers had composite scores indicative of higher levels of epistemological sophistication than
did the elementary teachers as hypothesized. There was greater disparity between the two groups
with regard social studies items than with science items. Possible reasons for this are addressed
in the discussion section.

Analysis of Secondary Teachers by Subject Taught (Question #3)
The one sample T-test run to compare the mean composite score on science items by science teachers (n=32) with that of the social studies teachers (n=19) was significant at a p=0.001 level (see Table 4.1). In addition, the T-test used to compare the mean composite score on social studies items by science teachers (n=32) with that of the social studies teachers (n=19) was also significant at a p=0.001 level (see Table 4.1). As hypothesized, the science teachers had higher composite scores, indicative of a greater level of sophistication of beliefs on science items, than did social studies teachers. Also as hypothesized, the social studies teachers had higher composite scores on social studies items, indicative of a greater level of sophistication of beliefs, than did science teachers. These results indicate that an individual’s domain specific beliefs (those that are part of a general system of beliefs and elicited under certain conditions) are affected by familiarity with a subject domain. This is addressed further in the discussion section.
CHAPTER 5
DISCUSSION

Summary of Findings

With regard to research question #1, the results of this study mirror the findings of previous research conducted on student populations. The data provide further evidence for the idea put forth by Fives and Buehl (2004) that domain general and domain specific beliefs co-exist in a complex network of beliefs. The differences found between mean composite scores on science items and social studies items are similar in statistical significance level to the differences on history and math items found among college students of various majors in the study conducted by Buehl et al. (2002). Similarly to the students studied by Fives and Buehl (2004), the teachers in this study seem to hold general knowledge beliefs that form a foundation for more specific beliefs that become salient when certain academic domains are considered. The idea of a general foundation of beliefs is supported by the strong correlations between the level of sophistication of beliefs about science and those about social studies among all subjects. The specificity of beliefs is supported by the statistically significant difference in how subjects scored on science items versus social studies items. It is important to note that the difference in means between composite scores on science items and composite scores on social studies items, while statistically significant, was only slightly more than half a point (0.63) on the ten-point Likert scale. It would be interesting to investigate whether these teachers approach instruction in these disciplines differently and if their instructional practices correlate with these differing beliefs. This line of investigation for elementary teachers in particular would be revealing since this group often teaches both science and social studies.

With regard to research question #2, statistically significant differences in beliefs in each of the academic domains were found between the secondary and elementary teacher groups. When comparing scores between the secondary and elementary teachers, the secondary teachers had higher scores, indicative of more sophisticated epistemological beliefs, than did the elementary teachers, on both the science and social studies items. Interestingly, the sample of elementary school teachers was almost all female, whereas about 40% of the secondary teachers were male. The differences in scores may also be influenced by this gender difference. Magolda (1992, 2002) contends that although gender does not determine one’s epistemological beliefs, it is related to those beliefs and how they develop.
The elementary teachers scored closer to the secondary teachers on the science items than they did on the social studies items. This could perhaps be a reflection of the sample used. Since all of the elementary teachers and science teachers were considered “science leaders” at their schools and have had exposure to professional development at a national science research facility, they may have exhibited more sophisticated views on science than the typical elementary level teacher. This professional development experience includes participation in programs such as one-day, hands-on workshops, week-long summer institutes and the six-week residential Research Experiences for Teachers program. All programs provided teachers with direct contact with NHMFL scientists and portrayed science as a dynamic, inquiry-based human endeavor.

Additionally, the elementary and secondary science teachers know the researcher as a professional in the field of science. It is possible that subjects’ views of the researcher and the knowledge that she would see their survey responses may have influenced how the science items were answered. It is also not clear from the responses to the Educational Experience Questionnaire whether the elementary teachers in this group had any less content knowledge than their secondary counterparts. In actuality, they reported a higher degree of content in their professional development than did the secondary teachers. While this could be a perceived higher degree of content, it is impossible to unequivocally say that this group of elementary teachers had less content knowledge than did the secondary teachers. Additionally, it was not clear from this survey item what type (subject area) of content knowledge the teachers were referring to. Furthermore, since the average number of years teaching was 20.26 for the elementary teachers, they may be exhibiting more sophisticated general beliefs structures due to greater content knowledge of the subject areas or from professional and life experience. It is not possible to draw any generalizable conclusions based on these results. Again, although the differences in beliefs of elementary and secondary teachers yield statistical significance, they amount to less than half a point on the survey instrument. The next step would be to further investigate the beliefs of the two groups, while also controlling for variables such as years teaching, gender and exposure to real-world science (e.g. professional development at a national science research facility), to determine if each exhibits differences in their beliefs as operationalized by the DSBQ and in other contexts beyond the survey.
With regard to research question #3, statistically significant differences in beliefs in each of the academic domains were seen between the science and social studies teachers. As predicted, the science teachers had a higher mean composite score than did social studies teachers on the science items, whereas the social studies teachers had a higher mean composite score on the social studies items. The findings indicate that perhaps teachers have a better understanding of the epistemological basis of their own subject area than a subject very different in nature from their own. The subjects in these subgroups had similar gender distributions (about 40% male, 60% female) and represented almost all the same schools. Again, the science teachers have had direct contact with the researcher and professional development programs at the NHMFL. This may have had positive effects on the sophistication level of their beliefs about science and may have also resulted in them responding to the survey in a way they believed would please the researcher. The results are significant enough to warrant further investigation of this pattern. It would be interesting to explore the domain specific beliefs of each subgroup beyond this survey.

Limitations

An external validity concern is that most teachers in the sample attended college in the southeastern United States. This may have resulted in the subgroups having more similar beliefs than if the groups were more geographically diverse. The literature previously reviewed in this paper demonstrates that the most dramatic epistemological developments occur during the college years. The culture or environment in which this developmental process takes place could be an influencing factor in how the beliefs take shape. Additionally, the experience with science at a national research facility may make this sample atypical and thus not a good base from which to generalize. Experiences such as these may discredit the tacit assumption that elementary teachers have less content specific knowledge than secondary teachers. Again, the elementary teachers in this sample reported receiving more content in professional development than did the secondary teachers. Although it is known that they have participated in science professional development at the NHMFL, the elementary teachers’ other professional development experiences are unknown and it is not clear what type of content to which the teachers were referring. Furthermore, many characteristics varied from teacher to teacher in the sample. Different school environments, gender, family educational backgrounds and efficacy may all have influenced teacher responses to the DSBQ. Perhaps one or more of these variables
Suggestions for Future Research

Although the results of this study provide a starting point for research on the domain specificity of teachers’ beliefs, suggestions for future research should be considered. These include controlling for more variables than simply grade level taught. Specifically, content knowledge should be operationalized by degree(s) held, if not directly measured, while controlling for teaching experience and professional development experiences. Same gender samples or cohort teacher groups from the same schools would likely yield further insight into which epistemological influencing factors are salient. Additionally, since the sample in this study was rather experienced in the field of teaching, it would be worthwhile to include beliefs of inexperienced teachers in the analysis. Perhaps years teaching or degree held, rather than grade level taught would be a more accurate measure of subject specific knowledge.

One of the next steps for research done on epistemological beliefs of teachers would be to correlate the sophistication level of beliefs with instructional methods employed. Magolda (2002) suggests that direct observation is the best way to investigate a subject’s beliefs. This implies that a teacher’s beliefs may be evident in their teaching. Buehl and Alexander (2004) point out that as student beliefs became more sophisticated, the learning strategies they use also became more sophisticated. It would be interesting to see if teacher beliefs correlate to instructional choice or expectation of student strategies in a similar manner.

In sum, the results of this study should serve as a starting point to inform future research on the domain specificity of teacher beliefs. Since results for the research question #1 are consistent with previous research findings about undergraduate students, it is reasonable to generalize the findings to larger populations (other teachers). It would be interesting to investigate if the same pattern exists among experts in other professions. For research question #3, the results supported the hypothesis that teachers have more sophisticated beliefs about subjects with which they are most familiar. Replication of this finding, as well as investigating teachers of subjects other than only science and social studies is necessary, however, before making any generalized statements about teachers. For research question #2 this analysis has led to more questions such as how to best operationalize and measure content knowledge of teachers, what other factors (e.g., teaching experience, professional development, gender)
influence epistemological beliefs and how epistemological beliefs are related to instructional practices? Due to the aforementioned limitations, the results for research questions #2 should only be generalized to teachers with similar backgrounds to the ones in this study’s sample and should serve to inform future research on teacher beliefs.
APPENDIX A

DOMAIN SPECIFICITY BELIEF QUESTIONNAIRE
Domain-Specific Belief Questionnaire

Directions: Rate the following items by circling the appropriate number. Respond to each item based on what you believe. There are no right or wrong answers.

1. Students who are good at social studies have to work hard.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree  Strongly Agree

2. A social studies question can be approached in several different ways.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree  Strongly Agree

3. How successful students are in social studies is related to how hard they work.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree  Strongly Agree

4. There are links between science and other disciplines.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree  Strongly Agree

5. Information learned in science is useful outside of school.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree  Strongly Agree

6. Even if it takes a long time to learn a social studies concept, it is best to keep trying.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree  Strongly Agree

7. Social studies relates to day to day life.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree  Strongly Agree

8. Reviewing the material discussed in class would help a student learn science.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree  Strongly Agree

9. There is a relationship between the number of hours students study and how well they do in science.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree  Strongly Agree
10. There are links between social studies and other disciplines.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree Strongly Agree

11. It is important for students to integrate new ideas in social studies with what they already know.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree Strongly Agree

12. Students who are good at science have to work hard.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree Strongly Agree

13. It is a good use of time to work on social studies questions that have no precise answers.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree Strongly Agree

14. The information learned in social studies is useless outside of school.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree Strongly Agree

15. How successful students are in science has no relationship to how hard they work.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree Strongly Agree

16. Even if it takes a long time to learn a science concept, it is best to keep trying.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree Strongly Agree

17. It is a waste of time to work on science problems that have no precise answers.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree Strongly Agree

18. Reviewing the material discussed in class would help a student learn social studies.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree Strongly Agree

19. There is only one way to approach a science problem.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree Strongly Agree

20. It is important for students to integrate new ideas in science with what they already know.
   0 1 2 3 4 5 6 7 8 9
   Strongly Disagree Strongly Agree
21. Science is unrelated to day to day life.

0 1 2 3 4 5 6 7 8 9
Strongly Disagree  Strongly Agree

22. The number of hours students study is unrelated to how well they do in social studies.

0 1 2 3 4 5 6 7 8 9
Strongly Disagree  Strongly Agree
Educational Experience Questionnaire

Gender: M or F

Race (circle one):
American Indian or Alaskan Native
Asian
African American
Native Hawaiian or Pacific Islander
Hispanic
White

School currently teaching at: _______________________________

Grade level taught (currently): __________________

Year of teaching:
(For each grade level you have taught, how many years experience do you have as the teacher of record? Please DO NOT include this current year in your totals)

________________________________________

Highest degree obtained:
BA BS MA MS Ph.D.

Undergraduate major: ________________________________

Advanced degree major (if applicable): __________________________

School(s) attended: ______________________________ Year(s) obtained: ________

Courses taught (indicate past and present):

________________________________________________________________________

Textbook used (in this year’s course(s): _________________

How long have you used this text? ________________

Other job experience (non-teaching):

________________________________________________________________________

Hours of professional development experience each year: ________________
On a scale from one (1) through five (5), with 5 being the most and 1 being the least, rank the professional development experiences you have had within the last five years with regard to the amount of subject matter content provided.

1  2  3  4  5

On a scale from one (1) through five (5), with 5 being “very often” and 1 being “infrequently,” indicate how often you expose yourself to materials that provide subject matter content (e.g., non-fiction texts, historical documents, non-trade journals, documentaries, informational videos)

1  2  3  4  5
APPENDIX C

LETTERS REQUESTING PARTICIPATION
Dear Educator,

I am writing to solicit your help with my Master’s degree thesis research project. For my project I am investigating teacher beliefs about academic knowledge. Currently, there is a considerable amount of research on the beliefs about knowledge (put this in lay terms here as well) of college students, but there is a distinct void in literature on teachers. I am hoping to contribute to this body of literature with this research project. Since research tells us that teacher beliefs affect instruction, learning more about what teachers believe may help us better understand how students develop their own beliefs. Furthermore, understanding how beliefs develop will help us to better design instruction.

All participants will be entered into a drawing to win a $25 gift certificate to Barnes & Nobel Booksellers. Two teachers (one elementary and one secondary) will be randomly chosen for the prize.

Your participation in this study is voluntary. Return of the survey will be considered consent to participate. If you choose not to participate or to withdraw from the study at any time, there will be no penalty. It will not affect your standing within your school, district, with Florida State University or NHMFL. The results of the research study may be published, but your name will not be used. Add the stuff about the ID and where you are keeping the key… To maintain your anonymity, your name will not appear on the survey and your responses will not be shared with anyone else. These procedures are meant to protect the confidentiality of your responses. There are no known risks involved with participation.

I am asking that you take some time to complete and return the enclosed survey. It should take no more than 20-30 minutes. I’ve included a stamped, addressed envelope for your use. Please complete and return the survey to me by February 10, 2005. The surveys will be kept in a secure location in my office at the Magnet Lab. I will be the only one with access to them. Please do not hesitate to contact me at lafrazza@magnet.fsu.edu or 850-645-0033 if you have any questions. You may also contact my major professor (Alysia Roehrig, 850-644-9080) or the Chair of...
Human Subjects at 850-644-8633 if you have general questions about the research. Thank you in advance for your help.

Sincerely,

Gina LaFrazza
Dear Educator,

I am writing to solicit your help with my Master’s degree thesis research project. For my project I am investigating teacher beliefs about academic knowledge. Currently, there is a considerable amount of research on the beliefs about knowledge (put this in lay terms here as well) of college students, but there is a distinct void in literature on teachers. I am hoping to contribute to this body of literature with this research project. Since research tells us that teacher beliefs affect instruction, learning more about what teachers believe may help us better understand how students develop their own beliefs. Furthermore, understanding how beliefs develop will help us to better design instruction.

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I am asking that you take some time to complete and return the enclosed survey that is marked “science teacher” and also ask a social studies teacher from your school to complete and return it in the packet marked “social studies teacher.” Both surveys are identical and should take no more than 20-30 minutes. I’ve included two stamped, addressed envelopes, one for you and one for your colleague. Please complete and return the survey to me by February 10, 2005. The surveys will be kept in a secure location in my office at the Magnet Lab. I will be the only one with access to them. Please do not hesitate to contact me at lafrazza@magnet.fsu.edu or 850-645-0033 if you have any questions. You may also contact my major professor (Alysia Roehrig, 850-
644-9080) or the Chair of Human Subjects at 850-644-8633 if you have general questions about the research. Thank you in advance for your help.

Sincerely,

Gina LaFrazza
REFERENCES


Kuhn, D. & Weinstock, M., (2002). What is epistemological thinking and why does it matter? In B.K. Hofer & P.R. Pintrich (Eds.), *Personal epistemology: The psychology of beliefs about knowledge and knowing* (pp.121-144). Mahwah, NJ: Erlbaum.


BIOGRAPHICAL SKETCH

Gina LaFrazza, currently Assistant Director of the Center for Integrating Research and Learning at the National High Magnetic Field Laboratory came to Florida State University in 1998. She received her Bachelor’s of Science degree on Physical Education in December 2000. Since then, she has worked in the field of informal science education doing curriculum development and creating and facilitating professional development for K-12 teachers. In this capacity, Gina has designed inquiry-based, hands-on curriculum modules, interactive educational technologies, classroom outreaches, research experiences, one-day workshops and summer institutes. Currently she is adapting a curriculum and teacher training session for a one-day workshop in Vienna, Austria, that will take place in conjunction with an international science conference. Through these experiences Gina has developed an interest in Educational Psychology.

In her spare time, Gina enjoys travel, cycling, SCUBA diving and the outdoors. She was born and raised in upstate New York, but now calls Tallahassee home.