LINKING EPISTEMOLOGICAL BELIEFS TO COGNITIVE DEVELOPMENT AND ACADEMIC PERFORMANCE

A Thesis by

Mary Bird

Bachelor of Science, Kansas Newman College, 1980

Submitted to the College of Education
and the faculty of the Graduate School of
Wichita State University
in partial fulfillment of
the requirements for the degree of
Master of Education in Educational Psychology

December 2005
LINKING EPISTEMOLOGICAL BELIEFS TO COGNITIVE DEVELOPMENT AND ACADEMIC PERFORMANCE

I have examined the final copy of this Thesis for form and content and recommend that it be accepted in partial fulfillment of the requirement for the degree of Master of Education with a major in Educational Psychology.

Dr. Marlene Schommer-Aikins, Committee Chair

Dr. Linda Bakken, Committee Member

Dr. Fran Clark, Committee Member
ACKNOWLEDGMENTS

Words cannot express the gratitude that I owe my thesis chairperson, Dr. Schommer-Aikins. It was truly a pleasure to learn from her brilliance, to receive an endless supply of individual attention, and to experience the enthusiasm and lengths to which she will go to for research. She opened up the world of thinking to me and instilled a passion for epistemological beliefs and their future in education. My deepest appreciation goes out to Dr. Bakken. She was the first professor who showed me that it is possible to be both very intelligent and a deeply caring human being. Her dedication to Piagetian research is an inspiration, along with the generous spirit in which she shares. A special thank you goes out to Dr. Clark who teaches educators that all children are ready to learn and it is perfectly acceptable to do it in the most innovative ways possible. She provided so much to my thesis by the dedication shown to improving all the details, I am truly grateful. Finally, I thank my family and friends who supported all my efforts and gave me encouragement until the very end. My parents and sister were my spiritual pillars; I knew they were always praying for me. Appreciation goes to my family who gave up time with me and home cooked meals so I could get things accomplished. Warmest thanks to my constant cheerleaders and sounding boards, Paula and Rose. You listened to my ramblings and constantly encouraged me to keep going. I am indebted to the wonderful administrators at my school who gave me permission to carry out research that will hopefully benefit the future of education.
ABSTRACT

The purpose of this study was twofold: (a) to determine if there is a relationship between middle school students’ epistemological beliefs and Piagetian stages of cognitive development and (b) if there is a relationship between epistemological beliefs and academic performance. Epistemological beliefs were defined as how individuals come to know and the beliefs they hold about this knowledge. A middle school version of an epistemological beliefs questionnaire was administered in conjunction with a Piagetian assessment of cognitive development to 163 seventh and eighth grade students. Students’ academic performance was measured using the Kansas State Assessment results. Finding showed that there is a relationship between cognitive development and epistemological beliefs. Cognitive development was a predictor in all four domains – math, science, social studies, and reading. Simple knowledge predicted performance in mathematics and social studies, even after accounting for cognitive development. Therefore, epistemological beliefs play a unique role in academic performance.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Problem</td>
<td>1</td>
</tr>
<tr>
<td>Definitions</td>
<td>1</td>
</tr>
<tr>
<td>Epistemology</td>
<td>1</td>
</tr>
<tr>
<td>Epistemological Beliefs</td>
<td>2</td>
</tr>
<tr>
<td>Rationale</td>
<td>2</td>
</tr>
<tr>
<td>Purpose</td>
<td>3</td>
</tr>
<tr>
<td>2. Review of the Literature</td>
<td>4</td>
</tr>
<tr>
<td>Epistemological Beliefs on Academic Performance</td>
<td>10</td>
</tr>
<tr>
<td>Epistemological Beliefs of Middle School Students</td>
<td>11</td>
</tr>
<tr>
<td>Development of Adolescent Epistemological Beliefs</td>
<td>13</td>
</tr>
<tr>
<td>Cognitive Development</td>
<td>15</td>
</tr>
<tr>
<td>Piaget’s Developmental Theory</td>
<td>16</td>
</tr>
<tr>
<td>Influential Factors</td>
<td>20</td>
</tr>
<tr>
<td>Adolescent Thinking</td>
<td>20</td>
</tr>
<tr>
<td>Current Study</td>
<td>21</td>
</tr>
<tr>
<td>3. Procedures</td>
<td>23</td>
</tr>
<tr>
<td>Participants</td>
<td>23</td>
</tr>
<tr>
<td>Instruments</td>
<td>23</td>
</tr>
<tr>
<td>The Booklet</td>
<td>26</td>
</tr>
<tr>
<td>Procedure</td>
<td>27</td>
</tr>
<tr>
<td>4. Results</td>
<td>28</td>
</tr>
<tr>
<td>5. Overview and Discussion</td>
<td>34</td>
</tr>
<tr>
<td>Previous Research</td>
<td>34</td>
</tr>
<tr>
<td>Interpretations of the Findings</td>
<td>35</td>
</tr>
<tr>
<td>Practical Implications</td>
<td>37</td>
</tr>
<tr>
<td>Limitations and Future Research</td>
<td>38</td>
</tr>
<tr>
<td>6. REFERENCES</td>
<td>40</td>
</tr>
<tr>
<td>APPENDICES</td>
<td>45</td>
</tr>
<tr>
<td>A. Epistemological Beliefs Questionnaire</td>
<td>46</td>
</tr>
<tr>
<td>B. Bakken’s Test of Piagetian Stages</td>
<td>49</td>
</tr>
<tr>
<td>C. Mind Break</td>
<td>58</td>
</tr>
<tr>
<td>D. Informed Consent Form</td>
<td>59</td>
</tr>
</tbody>
</table>
Chapter 1: The Problem

Developmentalists have been able to determine that school-age children construct and acquire knowledge in a fairly standard way by going through various stages beginning with concrete thinking and advancing toward abstract thinking. These stages have been conceptualized by Piaget, his theory of cognitive development and are presented in a fairly straightforward manner (Wadsworth, 1989). But questions begin to arise when cognitive development becomes more complex and a person develops a personal set of beliefs about his/her own thinking. These personal beliefs about knowledge and learning, known as epistemological beliefs, affect future knowledge acquisition. It is likely that these beliefs would be acquired in incremental stages, somewhat similar to the development of cognition (Kitchener & King, 1981).

As epistemological beliefs develop, they are likely influenced by the environment, the people in the environment, and general contextual learning itself (Schommer-Aikins, 2004). Once these epistemological beliefs are formed, they then are capable of having effects on the educational process and academic performance. It is within this realm that this study has been conducted, to probe deeper into the relationship between epistemological beliefs, cognitive development, and academic performance.

Definitions

*Epistemology and epistemological beliefs.* Epistemology is a branch of philosophy that is directed toward theories of the sources, nature, and limits of knowledge (Columbia Electronic Encyclopedia, 2005). The field of epistemology is concerned with the foundation and criteria of knowledge, the degree to which the various kinds of knowledge are certain, and the relation between the one who knows and the
object known. The basis of knowledge is generally described as either derived from reason alone or gained by reference to the facts of experience.

The study of epistemological beliefs, or personal epistemology, is a psychological driven concept borrowing from philosophical issues (Schommer, 1994). Hofer and Pintrich (1997) define epistemological beliefs as how the individuals come to know and, the theories and beliefs they hold about knowing. An epistemological belief system (Schommer-Aikins, 2004) encompasses how a person believes he/she learns and knows something, and how these beliefs affect him/her in a variety of ways in the advancement toward knowledge acquisition. The degree to which these beliefs affect a person can be the difference between a simplistic naïve belief about learning at a surface level and a sophistication that involves a deeply divergent thought process that utilizes experience and formal education to a well-developed assimilation of knowledge.

Rationale

This is a study of epistemological beliefs of the nature of learning and how these personal beliefs about knowledge impact students and how they perform academically. In the following literature review, epistemological beliefs will be traced from their beginnings, commencing with Perry and his prominent study of college students that was the antecedent of many theories and ideas about students’ beliefs (Perry, 1968). Since Perry’s time, a number of different researchers have attempted to address the complexity of personal epistemology (Baxter Magolda, 1992; Belenky, Clinchy, Goldberger, & Tarule, 1986; Perry, 1968; & Schommer, 1990).

The first efforts in research attempted to uncover the developmental nature of epistemological beliefs; the younger the student, the less sophisticated the beliefs which
means beliefs that do not support higher ordered thinking (Kitchener & King, 1981). As research continued in this area, questions then moved to what are epistemological beliefs to how do epistemological beliefs affect learning. For example, children who believe that learning is fixed at birth exhibit helpless behaviors when faced with difficult academic tasks (Dweck & Bempechat, 1983). Conversely, children who believe in academic improvement will tackle difficult tasks showing determination and tenacity, knowing they are advancing their education. Hofer (2001) specifically states that this growing research provides evidence that personal epistemology impacts students’ learning. The findings included in this literature review are just the beginnings in the field of personal epistemology that is in its infancy. Whatever research can add to personal epistemological beliefs can only benefit teachers, students, and psychologists in determining how students learn best and how educators can influence students to maximize thought processes.

Purpose

The purpose of the current study is to determine if there is a link between middle school students’ epistemological beliefs and cognitive development. Two questions will be addressed: (a) Is there a relationship between epistemological beliefs and cognitive development as defined in Piagetian stages? (b) Can epistemological beliefs predict academic performance after cognitive development has been accounted for?
Chapter 2: Review of the Literature

In the early 1950’s, at Harvard University, William Perry, Jr., produced some of the earliest results in the study of epistemological beliefs. As a professor and counselor at Harvard, Perry saw similar patterns in his advisees’ thought processes as they began college and how their beliefs toward knowledge followed a progression throughout their college years. This process began with the freshman all-or-nothing thinking to the evolution of seniors exhibiting an integrated relativist viewpoint (Perry, 1968).

In identifying the various developmental stages of students’ thinking, Perry (1968) used A Checklist of Educational Views (CLEV). Once there was a determination of where the student was on the developmental spectrum, specific students were interviewed at a variety of times throughout their college career. Elaborate open-ended interview processes were utilized by researchers eliciting, quite unexpectedly, a definite pattern in epistemological beliefs and the seemingly developmental aspects of specific thought processes.

Perry disseminated the information gathered from the student interviews and derived nine positions of intellectual development, broken down into three subdivisions or conditions. The first epistemic position is one of a dualistic stance: a right-wrong perception of the world. The dualistic thinker gathers knowledge as perfect truth and accepts this truth at face value from an omniscient authority figure, usually a teacher. The second epistemic position in the developmental process is known as multiplicity. This multiplistic view contends that there are conflicting answers; therefore a trust in one’s inner voice develops, along with a right to have one’s own opinions. This is a time of weighing more than one factor, forcing comparisons in thought, and thinking about
thinking. During this stage there are relativistic notions of knowledge in juxtaposition with absolute knowledge. Solutions are supported by reasons and must be viewed in context of relative support. Learning to evaluate solutions and structure context into an overall picture leads to personal growth, emotional maturity, and identity formation. In the third and final epistemic position there is a commitment due to assimilation of experiences, responsibility, knowledge learned from self and others, and reflection. This commitment means that a position is taken after evaluating the support, yet it is open to new information and re-evaluation.

Perry claims that students’ progress along these positions that reflect their attitude toward knowledge and learning. Students may be at different stages at the same time with regard to different subjects. Epistemological development follows in a sequential order, although the rate varies between students. This study articulated some of the newest positions of learning, but also of note was that it demonstrated the feasibility of assessing developments in the epistemological nature of students in late adolescence.

Perry’s pioneer work inspired many researchers to follow up in the investigation of epistemological beliefs. One limitation of Perry’s work was that most interviews were done with Harvard undergraduate men. What remained unanswered is whether women follow along the same epistemological positions as men. Belenky and colleagues investigated this question and published the results in *Women’s Ways of Knowing* (Belenky et al., 1986).

Although Perry had a small sampling of women in his group who were shown to develop along the same developmental continuum as men, the number was extremely small and the study was not designed to measure women’s beliefs. The Belenky et al.
study was similar to Perry’s design in that it used the open-ended interview format.

Belenky et al. identified five distinct ways of knowing, representing the epistemic views of women as knowers. The first position is silence; where a woman exists voiceless and passive, subjected to the notions of some external authority. The second epistemic position is received knowledge that is obtained from outside sources and the woman is capable of relaying this knowledge to others. The third epistemic position is subjective knowledge where knowledge is seen to be acquired intuitively and known subjectively on a personal level. The fourth epistemic position is procedural knowledge in which women reflect upon knowledge using reason, and apply objective procedures for analyzing and relaying this newfound information. The fifth epistemic position is constructed knowledge when women see themselves as creators of knowledge, having an authentic voice, and reconciling knowledge and truth as an integral part of who they are as a person of worth.

Gender differences were also the subject of a study by Baxter Magolda (1992) where she investigated both men and women undergraduates’ cognitive development. Her theory was based on a five-year longitudinal study of 101 undergraduates from Miami University, who were typically white and middle-class. Like Perry, these students were interviewed upon entering college and followed and interviewed throughout their college years. Baxter Magolda’s Model for Epistemological Reflection consists of four main stages: absolute knowing, transitional knowing, independent knowing and contextual knowing. The first stage is absolute knowing where knowledge is viewed as certain. Teachers are considered omniscient authorities and learning involves the acquisition of facts. Women were shown to receive knowledge in more of a private
manner, involving collaborative learning with peers, using a comfortable setting. Men tended to master knowledge in a typically public manner, verbalizing learning by questioning and critiquing instructors.

The second stage is transitional knowing, meaning that knowledge contains some certainty but some uncertainty. At this phase, men use practicality in evaluation and debate to share views, whereas women tend to establish a rapport with instructors and peers through which information is judged.

The third stage, independent knowing, maintains the notion that knowledge is mostly uncertain and everyone holds his or her own beliefs. Two patterns within this stage are interindividual and individual knowing. Interindividual knowing, typically held by women, is accepting one’s own ideas along with others. Used more by men is individual knowing, focusing on one’s own ideas while valuing others thinking at a distance.

The last stage is contextual knowing, demonstrating the integration of relational and impersonal contextual knowledge based on evidence. Baxter Magolda uses this knowledge to offer applications for strengthening student learning, obtaining a positive self-esteem and developing a voice appropriate for instructor and peer relationships.

Where Baxter Magolda focused primarily on thought processes between men and women, Kitchener and King (1981) developed the reflective judgment model (RJM) for clarifying justifications that people use in general when developing reasoning processes. The study by Kitchener and King was conducted with late adolescents through young adults. Reflective judgments were made when people were presented with an ill-structured (controversial) problem that had no clear-cut answer. More explicitly the
problems presented to the students in this study may not have had any clear cut answer whatsoever. The questions lead to ambiguous thought patterns and there were no simple pathways to the answers. For example, the question may have been asked, “What is the answer to poverty?” Obviously this is a question with a broad spectrum of possibilities, yet the answer is not definitive.

There are seven stages to Kitchener and King’s model with each stage having a view of certainty, justification, and validation of knowledge. For most purposes the RJM has been condensed into the three main stages of reflective thinking. They are prerereflective thinking, quasireflective thinking, and reflective thinking. Prerereflective thinking, the first stage, consists of absolute knowledge and it is justified by simply believing what is heard to be true, usually handed down by an authority, with little or no conflict in decisions about the issue. An example is, if it is stated on the news, it has to be true. The second stage, quasireflective thinking, contends that knowledge is uncertain due to situational variables and context specific interpretations. The justification for this stage is that beliefs are evidence-based and there should be comparisons between varying arguments and interpretations. This sometimes leads to a delay in making a decision as there are many factors, usually others’ beliefs, to weigh before coming to some resolution. The last stage is reflective thinking that requires knowledge to be constructed based on information from a variety of sources and opinions that are reputable. Concept justification for this stage is that looking at all of the varying perspectives provides evidence for making the most pragmatic and compelling defense for a satisfactory conclusion. A follow-up study has been done on the original research of the RJM model by asking if reflective judgment stages form a developmental sequence. It was reported
that scores did increase for participants between testing intervals, indicating that the stages of reflective judgment did make a steady, ordered appearance over time (Wood, Kitchener, & Jensen, 2002).

In 1990, Schommer took a different approach than previous stage models and conceptualized an epistemological belief system. This is a system of conscious or unconscious beliefs that people hold about knowledge and learning. Her hypothesized epistemological belief system consisted of five beliefs as follows: the stability of knowledge (tentative to changing), the structure of knowledge (isolated bits to integrated concepts), the source of knowledge (passed on by omniscient authority or reasoned by the individual), the speed of knowledge (quick or not at all), and the control of knowledge acquisition (fixed at birth to evolving over the lifespan). She has proposed that these beliefs are more-or-less independent (Schommer, 1994). This makes it possible for a person to believe that the ability to learn is changeable, yet there is also the belief that knowledge does not change. In practical terms, this would account for the wide variety of thinkers and for the variation in processing knowledge.

Schommer (1990) devised a questionnaire in an attempt to develop these hypothesized epistemological beliefs. In running a factor analysis on this proposal, she found evidence to support all of the five beliefs, with the exception of source of knowledge. The Schommer Epistemological Questionnaire currently consists of 63 items measuring Ability to Learn, Structure of Knowledge, Speed of Learning, and Stability of Knowledge. Modeling from Schommer’s beliefs assessment, Schraw, Bendixen, and Dunkle (2002) constructed an inventory called the Epistemic Beliefs Inventory (EBI).
The EBI shows support for all five of Schommer’s original beliefs making it a prominent tool for current epistemological measurements.

*Epistemological Beliefs on Academic Performance*

Schommer’s 1990 original work was with college students followed by studies with high school students; both generated similar results (Schommer, 1993). She found that high school students possessed at least four epistemological belief factors. Students’ beliefs in quick learning were negatively correlated to student performance whereas there were no relationships among the other epistemological belief dimensions and students’ academic performance. This suggests that students who thought learning was quick or not at all would be the ones that obtained lower grades in school. Schommer-Aikins and colleagues (Schommer-Aikins, Bookhart, Mau, & Hutter, 2000) found that seventh and eighth grader’s epistemological beliefs were characterized by three dimensions (i.e., ability to learn, speed of learning, and stability of knowledge). Of these three, the ability to learn and speed of learning were negatively correlated to student academic performance. This suggests that students who hold the belief that the ability to learn is innate or that learning should occur quickly tended to have lower grades.

Ryan (1984) examined the relationship between text comprehension monitoring and epistemological beliefs. Ryan, using Perry’s paradigm, developed an instrument that classified students as either dualists or relativists. He found that dualists, right or wrong thinkers, tended to use surface knowledge as their standard of comprehension. For example, their criterion for understanding would be in how many details of a story, or what they would consider absolute truths, can be retrieved from memory after reading a text passage. Relativists however conceive of knowledge as the framework within which
particular facts are interpreted. A relativist would assess understanding in terms of the degree to which clear and coherent relationships can be established among the propositions in a text passage.

The nature of monitoring of comprehension standards was found to be related to students’ academic performance. Poorer grades were earned by students reporting only the surface knowledge standards, higher grades were earned by students reporting application/comprehension standards. The number of criteria reported in comprehension monitoring was also found to be important. Better grades were earned by students reporting multiple criteria in monitoring comprehension. In conclusion, Ryan reported that epistemological beliefs were shown to be significant predictors in course grades after the statistical elimination of college experience and academic aptitude. A plausible link between epistemological standards and academic success is that the epistemological beliefs form a psychological context or map from which a student will evaluate and then extract the pertinent information from the text. With high epistemological standards, these students will demand of themselves a greater amount of text retention and text comprehension.

Epistemological Beliefs of Middle School Students

Most of the epistemological studies in this field of research have been conducted with college or high school students. However, there are two studies that have produced results that offer more insight into the middle school realm of epistemological beliefs. The first study by Schommer-Aikins and colleagues (Schommer-Aikins et al., 2000) is one that tested, by a middle-school epistemological questionnaire, the multidimensional aspect of determining epistemological beliefs instead of the unidimensional model. The
analysis resulted in a three-factor model including beliefs about the ability to learn, speed of learning, and stability of knowledge. This is in contrast to the college four-factor model which included beliefs about the speed of learning, the stability of knowledge, the structure of knowledge, and the ability to learn. For the middle school students, the strongest factors were those of speed of learning and the ability to learn. Although the factor of stability of learning was present, it was weak. Schommer et al. concluded that this may indicate that students’ beliefs about the nature of learning develop earlier than a students’ beliefs about the nature of knowledge.

In Schommer-Aikin’s and colleagues (Schommer-Aikins, Duell, & Hutter, 2005) second study, epistemological beliefs in relation to academic performance and other cognitive aspects that created a framework of inquiry were examined. The relationship was examined between general epistemological beliefs of middle school students and domain-specific beliefs about mathematical problem solving. This study proposed that beliefs about problem solving were likely to influence student willingness to perform mathematical problem-solving tasks, as well as the study strategies used by students to carry out the process. In a factor analysis, the two strongest factors were factors entitled quick/fixed learning and studying aimlessly. The first and strongest factor, quick/fixed learning, is a factor where students’ beliefs that learning happens quickly and that the ability to learn is fixed at birth. Furthermore, those people with the innate ability to learn are able to learn quickly. A strong belief in the factor of studying aimlessly indicates that students believe that studying is actually a random unorganized process. Indeed, learning may be more a matter of luck, not because of using particular strategies. A path analysis indicated that the more students believed in quick/fixed learning, the more they also
believed that math is not useful. They performed poorly in mathematical problem-solving and they were more likely to have a lower grade-point average overall. Belief in quick/fixed learning predicted three aspects of learning: belief in math, math problem-solving, and grade point average. This suggests that epistemological beliefs play an important part in middle school learning.

*Development of Adolescent Epistemological Beliefs*

Chandler (1987) studied the development of middle-school students’ epistemic thinking throughout adolescence and high school years. Chandler’s contention was that during the tumultuous adolescent years, young people evolve through a developmental series that takes them through intellectual maturity, although not all commence or arrive at the same time. Of importance is Chandler’s theory known as the “Othello Effect.” He used classical schools of philosophy to account for the process of belief entitlement in adolescents. He then put belief entitlement on a continuum that begins with objectivism, and then proceeds to dogmatism and skepticism, concluding with rationality without reliance upon absolute truth. This time of uncertainty, doubting, and questioning has been described as the Othello Effect because of a Shakespearean play where the character Iago thought of doubts as something to be feared and conquered. Chandler (1987) defined uncertainty as the condition of being uncertain or unsettled in one’s opinion or belief as to the reality or truth of something. He proposed that relativist thinking and doubts are not in themselves problematic, but rather there are degrees of doubt importance ranging from mundane to large scale that appreciably influence personal epistemologies. The smaller case-specific doubts are unsettling but do not impact epistemic development. However, the large scale doubts of the profoundly ethical and philosophical type are
contemplated and resolved affecting the epistemological trustworthiness of knowledge in a way that permanently shapes the belief system.

To make sense in a world of uncertain knowledge, Chandler proposed that young people make use of the following three mechanisms when confronted with ambiguity to their belief system: defended realism, dogmatic-skepticism axis, and post-skeptical rationalism (Chandler, Boyes & Ball, 1990). Defended realism is the ability to conceptually work with “facts” and “opinions.” Interpretation can be clouded by personal biases and prejudices, absolute truths may be pervasive when dealing with facts, but the growth adds to confidence and conviction toward securing beliefs. The dogmatism-skepticism axis is born of the realization by adolescents that ambiguity exists generally within all forms of knowledge. With the realization that no belief stands on its own, adolescents are relegated to use this blind faith versus aimless thinking mentality. Divergent to this conflicted thinking is post-skeptical rationalism which poses that truth can be obtained rationally using criteria, although it need not be present in every situation. Doubt can be presented without distorting the evaluation of truth, conversely supplying discordant views that may actually help build a case in the decision-making process.

When Perry (1970) conducted his study on positions, he determined that most college freshmen began studies with a dualistic ideology, comparable to Chandler’s defended realism that takes place toward the beginning of epistemological development. Interestingly enough, Chandler and colleagues (Chandler et al., 1990) performed additional studies that resulted in over half of the eighth grade students being identified as formal operational thinkers and were categorized as being either dogmatists or skeptics.
This conclusion illustrates that middle school students may develop epistemologically earlier than previously thought, although Chandler’s study also showed that the completion of development does not occur until well into the college years.

Hofer (2004) also contends that epistemic megacognition begins well before late adolescence. She suggests that children are shown to make epistemological judgments, even poorly made, well before the adolescent years. For example, if a child is told by the teacher that dinosaurs became extinct for one reason and parents have provided an opposing view, a child at an early age may form an opinion based on these differing views. Although this is making a decision based on two higher authority figures, it takes reflection and weighing both sides before coming up with a personal decision. Hence, epistemological processes may begin to develop earlier and in a more complex way than most commonly thought.

Cognitive Development

One theory that may help explain epistemological belief development is Piaget’s theory of cognitive development. It would stand to reason that young people’s beliefs about the nature of knowledge and learning reflects the ability to think deeply. Children’s ability to think in general, first about themselves, their own needs and observations about the environment around them would then develop to thinking about learning and knowledge. A plausible hypothesis is that there is a link between Piaget’s cognitive stages of development in general and the evolution of how a child thinks specifically about knowledge and the nature of learning in the acquisition of a personal epistemological belief system.
Piaget’s Developmental Theory

In the 1920’s Piaget became one of the earliest pioneers to develop a major theory of cognitive development. He revised an earlier theory from the late 1800’s based on James Mark Baldwin’s general theory of intellectual development (Case, 1996). Piaget was interested in knowledge and how children come to know about their world and the thought processes involved. Information was gathered by Piaget using a set of questions that were asked to children of all ages. There were no right or wrong answers to these questions, they were asked to prompt the child to share thought processes from which spontaneous comments were used to construct the theory. After listening to children’s comments and observing their behavior, Piaget theorized four stages of development: sensori-motor (0-2 years), preoperational (2-7 years), concrete operational (7-11), and formal operational (11-16). These stages are broad levels that fall within a continuum as development is a continuous process. Each stage subsumes the previous stage and the chronological ages set forth are not fixed, but are typical of the average child. There is a fixed element to Piaget’s theory: every child must pass through the stages of cognitive development in the same order. For example, a child cannot move from the preoperational stage right into the formal operational stage without going through the concrete operational stage. Rates of passing through the stages may vary according to experiential and hereditary factors (Wadsworth, 1989).

A basic summary of these stages of cognitive development follows, although bear in mind there are substages to each one of these broad periods. The first stage of development is the sensori-motor period when learning is primarily motor and sensory in nature. The child is unable to think conceptually, yet cognitively the child begins to form
schemata to base future thoughts. Preoperational stage thinking is characterized by language development and representational development that is fairly rapid. At this stage reasoning is referred to as prelogical or semilogical. The stage of concrete operations is the time when children develop the ability to take concrete problems and apply logical thoughts to form solutions. Formal operations is the stage when the child has the ability to apply logical thought to all sorts of problems, concrete and abstract.

To understand Piaget’s theory, it is necessary to understand a few of the foundational concepts which are used when explaining childhood cognitive development and how it takes place. These concepts are schema, assimilation, accommodation, and equilibration (Wadsworth, 1989). Schemata, the plural form of schema, are the mental structures of the mind by which individuals learn to organize and know the world. These structures exist as processes and are frameworks of the mind where information is gathered, simply at first, and then additions are noted, creating a large web of intricately interwoven knowledge from which sophisticated thought processes evolve. Schemata change and develop from the instinctual schema of a baby to sophisticated rationalization of the adult. These changes are due to the processes of assimilation and accommodation. Assimilation is active organization of fitting new information into existing schemata. No new stimulus or behavior is taken as is because some aspects are transformed by the existing cognitive system. Assimilation is thought to go on continuously; it does not change the schemata but is integral to the growth process for development to occur because it provides meaning due to stability and continuity. Accommodation occurs when a new stimulus is introduced and there is no schemata for which it fits. The child may create a new schema to place this information or there can be modification of an existing...
schema to place the information. So it is either the creation of new schemata or the adjustment of the old. Assimilation and accommodation are how a child responds to stimuli based on prior knowledge. Considering it is a construct of the child, it reflects the child’s current level of understanding and it may not be accurate of reality. In the absence of assimilation and accommodation there would be no allowances or adaptations for stimuli in a child’s schemata. With a lack of assimilation there would be no large schemata and there would be no differences between things in the world. A lack of accommodation would result in a great number of small schemata that would be generalized, but similarities would not be easily differentiated. Obviously it is imperative to have a balance of accommodation and assimilation for development to occur. This balance is referred to by Piaget as equilibrium. The interaction of assimilation and accommodation provide the individual with cognitive balance that is referred to as equilibration. When the sensory stimulus is quickly and properly incorporated into a schemata, the child experiences equilibration, therefore promoting the developmental process (Wadsworth, 1989).

As equilibration is necessary to achieve a cognitive balance in thought processes, disequilibrium is the conflict created when thoughts do not match with experiences and predictions that have been made. The difference between what is expected and what actually occurs puts a child in the state of disequilibrium. One would think that this state of conflict is to be avoided, but it is the actual working through of inconsistencies that produces problem-solving skills and rationalization that enhance cognitive development. The cognitive states that go back and forth between equilibrium and disequilibrium are a
positive cacophony that results in higher level thinking. During this time of progression, a
child may go back and forth between the concrete and formal operational stages.

Formal and concrete stages are similar in that they both make use of logical
thinking. The difference between these stages is the vastness of logic available to the
person who can now use formal thought. The concrete operational learner is content
bound by current experiences. Other limitations are the inability to think into the future,
the exclusivity of using only concrete examples, and lack of freedom because of ties to
past and present perceptions that may be false. At the beginning of the concrete
operational stage, new achievements are observed within a short time. Mental operations
have become a reversible system, constructed of a stable hierarchy of classes and
relations (Cowan, 1978). Children are able to reverse combinations without losing the
concept of the whole for the parts. A property of things (tall, short) is now not seen in a
category by itself, but in relation between all things. As the concrete stage advances,
children may be able to conceptualize that others may view things from a different
perspective, but are unable to take the role of another. As egocentrism diminishes during
the late concrete operational stage, social perspectives and value hierarchies become
more stable. It becomes easier to decide good from bad not just based on consequences,
but because of the reconceptualization of social conventions. The result is a ten year old,
with a newly formed sense of standards, using his or her own personal intellectual powers
and not just information handed down from others.

For the formal operational person there is free thinking that can be of a
hypothetical nature involving past, present, or future occurrences. More importantly it is
at this stage where the person becomes introspective and has the ability to think about his
or her own thoughts. Reflection advances toward scientific reasoning and causation that is highly developed. A problem can be seen objectively and an argument may be developed independent of its content. Logic may be used and favored over factual truth. It is reasoning that goes beyond perception and memory and makes deductions from things that are not necessarily known or have been experienced.

The structural advance of cognition is complete with formal operations. Learning and intellectual development will continue to evolve as long as a person is motivated, but the organization of cognitive equipment is at its highest level at late adolescence (Cowan, 1978). At the beginning of formal operations, adolescents experiment with various strategies in a trial and error sort of way. Late adolescents seem to have a systematic strategy from the start. There seems to be a self-regulating balance between assimilation and accommodation produced during formal operations. There is an ability at this stage that enables adolescents to adopt a hypothetical attitude, to explore all possible combinations, and to formulate and verify hypotheses. This disequilibration seems to stimulate the adolescents’ structural development of cognition.

*Influential factors.* Affecting the various stages, Piaget proposed four broad categories that are factors influencing cognitive development. These important aspects are maturation/heredity, active experience, social interaction, and general progression of equilibrium. He perceived all of these factors to be essential for cognitive growth, but there is not one factor by itself that can ensure adequate development.

*Adolescent thinking.* Often gone unnoticed is Piaget’s explanation of the uniqueness of adolescent thought and behavior. He proposed that adolescents have the mental capability to solve logical problems, so why are they said to “think differently”
than adults (Inhelder & Piaget, 1958)? Piaget’s answer for this is partly the level of cognition and affective development, but mostly by the egocentrism of thought. In each stage of cognitive development there is a variable, yet constant role for egocentrism. At the formal operational stage the adolescent is reveling in his or her brand new command of logic. So it is thought that what is logical to the adolescent must be always be right, and what is illogical is always wrong. The role of egocentrism to the adolescent is the inability to distinguish between the real world and the world of the adolescent.

The four influencing factors for cognitive development, as delineated by Piaget, as well as other factors may be related to epistemological belief development in adolescence. This stage between middle childhood and maturity is a time when adolescents are feeling the strains of social obligations and making decisions about college and career preparation. Boyes and Chandler (1992) have proposed that along the course to cognitive maturity there are more stages than Piaget described. They also suggest that at this typical time for the onset of formal operations, there is a moratorium or suspension on epistemological development, called epistemic doubt, a time at which identity is formed and the teenager is in a state of disequilibrium. When faced with such adolescent pressure, it has been proposed that high school students who have achieved levels of epistemic dogmatism and relativism during junior high are passing through them for a second time due to stressful circumstances. During a lifetime people may drift in and out of this process several times (Boyse & Chandler, 1992; Schommer-Aikins, 2002).

Current Study

Chandler and Boyes (1992) are two researchers that have made some attempt to link Piaget to epistemological beliefs. They limited their study to the adolescents’ beliefs
about the certainty of knowledge. Furthermore, it has been hypothesized (Hofer, 2004) that epistemological development is occurring sooner than high school. The purpose of this proposed study is to look at students before high school and to determine if there is a relationship between cognitive development, as assessed with an instrument that reflects Piagetian theory, and epistemological beliefs, as assessed with an instrument that takes a multidimensional approach. Hence, the study being proposed looks at students’ cognitive development in the earlier years furthermore, for the first time it links Piagetian cognitive development to an epistemological belief system.

This study specifically addressed two questions: Do epistemological beliefs relate to Piagetian stages and can epistemological beliefs predict academic performance after the affect of cognitive development has been accounted for?
Chapter 3: Procedures

Participants

Participants in this study were 163 seventh and eighth grade students from a midwestern parochial school. Participants were randomly chosen to participate in this study. School demographics are an English-speaking middle to upper middle class population that is comprised mainly of Caucasian students. The seventh grade class had a sample size of 80 students, 44 female and 36 male. The average age was 12.9 years old. The ethnic breakdown of the population was 69 Euro-American, 9 Hispanics, 1 African American, and 1 Native American student. No lunch support is received by 89% of the class, 11% received reduced or free lunches. The eighth grade class had a sample size of 83 students, 41 female and 42 male. The average age was 13.8 years old. The ethnic breakdown of the class was 76 Euro-Americans, 5 Hispanic, 1 Asian-American, and 1 Multi/Not Coded. Only 2.5% received reduced lunches; 97.5% of the students receive no lunch support.

Instruments

In this study there were two measurements used for analysis, along with pre-existing scores from standardized Kansas Assessments.

A middle school version of an epistemological beliefs questionnaire (see Appendix A) was used (Schommer-Aikins, et al., 2000). The questionnaire consisted of 30 test items in language that was age appropriate for middle school students. Students responded on a Likert scale from 1 (strongly agree) to 5 (strongly disagree). This scale was administered to determine students’ beliefs about knowledge and learning. The four beliefs specifically measured were simple knowledge, certain knowledge, fixed ability,
and quick learning. For example, “Scientists can find the truth if they just keep searching for it.” About half of the questions were written so that students who were epistemologically sophisticated would agree, and the remainder of students, who are epistemologically naive, should disagree. Items were ordered randomly and approximately half of them were reverse scored. Using this scoring system resulted in the higher the score, the more epistemologically naïve the student (Schommer-Aikins et al., 2005). Cronbachs alphas were used to measure internal consistency that ranged from .63 to .85 for the college version and from .51 to .81 for the high school version (Duell & Schommer-Aikins, 2001). Predictive validity is evidenced in the instruments’ prediction of students’ belief in the usefulness of math would directly effect academic performance and overall grade point averages.

Bakken’s Test of Piagetian Stages (1995) was used to determine the level of cognitive development among the seventh and eighth grade students. The test consisted of 21 multiple choice questions composed of Piagetian tasks (e.g., conservation of numbers, area, liquid, length, weight and volume). Other items included problem-solving items involving classification, right-left relationship, perspective-taking, reasoning, and logic. The items were visually displayed to help in describing the proposed problem. Students silently read the test items and chose from four multiple choices. See the entire instrument in Appendix B. More specifics of this assessment are discussed in Chapter 4 where scoring is more detailed.

Two criterion-related validity studies were conducted with this instrument (Bakken, Thompson, Clark, Johnson & Dwyer, 2001). The first study was a random sample of 40 third-grade students from four elementary classrooms that were tested on
the Piaget concrete tasks. The researchers administered the Piagetian task assessment to students using a clinical interview technique. The researchers then administered the Piagetian multiple-choice paper-pencil test.

The relationship between performance on the clinical interview and paper-pencil test was tested with zero-order correlations. The correlations were significant: concrete operational substage 1, \( r = .75, p < .02 \); concrete operational substage 2, \( r = .69, p < .01 \); and concrete operational substage 3, \( r = .69, p < .01 \). For the second study, validity on this instrument was conducted with a group of approximately 40 fifth grade students from four classrooms. The paper/pencil results were again statistically compared to Piagetian clinical interview results of the participants. There was a significant correlation for all three concrete operations substages, \( r = .69, p < .01 \); both formal operations substages also yielded a significant correlation, \( r = .54, p < .01 \), for the first substage and \( r = .45, p < .05 \), for the second substage.

Test-retest reliability was established with a group of 21 children, ranging in age from 10 to 12 (\( M \) age = 10.4 years) were measured at a three-week interval; results indicated that the reliability coefficient for the concrete substage total was \( r = .70 \) whereas the reliability coefficient for the formal substage total was \( r = .52 \). These reliability coefficients offer some evidence for the developmental theory and suggest that few 10-to-12 year olds are using formal operational reasoning and guess at those questions that address formal logic. The reliability coefficients for each substage of concrete operations and each substage of formal operations yielded similar results: concrete operations substage 1, \( r = .59, p < .01 \); concrete operations substage 2, \( r = .68, p < .01 \); concrete operations substage 3, \( r = .70, p < .01 \); formal operations substage 1,
\[ r = .62, p < .01 \] and formal operations substage 2, \[ r = .49, p < .05 \] (L. Bakken, personal communication, December 1, 2005). Hence, there is evidence to suggest that Bakken’s Test of Piagetian Stages is a valid assessment of students’ cognitive thinking and is advantageous as it can be group administered and does not require the extensive time and professionals needed by the personal interview technique.

Students’ content knowledge was assessed using the Kansas State Assessments. These assessments were administered in the spring and the content-area tested is dependent on the grade level. The seventh graders were assessed on math and science and the eighth graders were assessed on reading and social studies. Scores from these assessments were compared with scores of all seventh and eighth graders in the state of Kansas. The students’ performance level, determined by a percent of items correct, is then identified by a rating system that is aligned with Quality Performance Assessment (QPA) guidelines. The rating system is as follows:

- U=Unsatisfactory
- B=Basic
- P=Proficient
- A=Advanced
- E=Exemplary

**The Booklet**

Booklets were prepared by including the 32-question epistemological beliefs (EB) questionnaire and Bakken’s 21-item Test of Piagetian Stages to determine cognitive development. The epistemological beliefs questionnaire contained 2 items that required the students to leave them blank, this served as a check for student cooperation. There was a one page filler between the two assessments used as a mind break (see Appendix C). It queried demographic information and two filler task items. The materials were counterbalanced so the order of the epistemological beliefs questionnaire and the
Piagetian tasks would be varied. Packets were handed out individually to each student so they would be evenly distributed.

Procedure

In this parochial middle school, seventh and eighth students had the same teachers in their respective disciplines for two years. For example, Dr. Jones teaches math for both seventh and eighth grade, Mrs. Smith teaches English in both seventh and eighth grade. In order to keep data collection as consistent as possible, one teacher was asked to administer all of the assessments during his or her classes throughout one day. This provided the students with the same setting and same teacher.

Students were admitted into this study after consent forms (see Appendix D) were sent home to parents and permission was granted by the Internal Review Board at Wichita State University. A researcher went into each class period on the same day and explained to each of six classes that this was an exercise to collect thoughts and opinions of middle school students. The researcher read directions orally and explained that the activity was to be taken seriously, honest answers were important and confidentiality of the study was reiterated so students would feel free to express true opinions. Booklets were then handed to each student and they were given 45 minutes to complete the questions, with the option of getting more time if needed. All of the students completed the booklet within the allotted time; most of them were finished well before the end of class. Students who finished early had the choice of finishing homework or silently reading a library book as other students finished the questionnaire.
Chapter 4: Results

The purpose of the analyses is to answer two questions. Is there a relationship between epistemological beliefs and cognitive development as defined in Piagetian stages? Can epistemological beliefs predict academic performance after cognitive development has been accounted for?

Because the epistemological beliefs questionnaire had been administered to middle school students in two previous studies (Schommer-Aikins et al., 2000; Schommer-Aikins et al., 2005), scores were calculated following the scoring systems from those reports. About half the items were recoded so that the higher scores reflected more naivete in the learner. The lower scores reflected more epistemological sophistication in the learner. Items were rescored in order for a higher number to consistently reflect a naive perspective.

Students’ cognitive development was assessed with Bakken’s Test of Piaget Tasks (1995). This Piagetian paper-pencil assessment was compiled using 21 items that successively measure the Piagetian stages in order from pre-operational to formal. Each set of questions was designed in ascending order with easier items first, assessing preoperational stages to concrete, and increasing in order of difficulty through formal operational stages concluding with the most difficult question. It was possible to attain one of seven possible stages of Piagetian development, that have been labeled as follows: Preoperational, Concrete Substage 1, Concrete Substage 2, Concrete Substage 3, Formal Substage 1, Formal Substage 2, and Formal Substage 3. Test items were scored as either right or wrong and a level of competency was determined by answering questions
correctly at each operational level. A breakdown of the scoring structure is shown as follows:

- **Preoperations:** failure to correctly answer 4 out of #s 1, 3, 4, 7, 8
- **Concrete operations sub1:** 4 correct answers from #s 1, 3, 4, 7, 8
- **Concrete operations sub2:** above + 4 correct answers from #s: 2, 5, 6, 9, 10
- **Concrete operations sub3:** Above + correct answers for both #s 11, 13
- **Formal operations sub1:** Above + 3 correct answers for #s 12, 14, 15, 17
- **Formal operations sub2:** Above + correct answers for #s 16, 18, 19
- **Formal operations sub3:** Above + correct answers for both #s 20, 21

An item analysis was completed using a check mark for items missed and correct items were left blank. The design of the assessment should have shown students getting the first questions correct and, as questions grew harder, students should have missed them in order of difficulty. This item analysis illustrated 3 items that were missed by over 85% of the students in the beginning formal stages, but students would then get later-stage formal operation items correct that were successively more difficult. Consequently, items 14, 15, and 16 were eliminated because of extreme item difficulty and stage-like order of development that was missing. The remainder of the 21 items were included in analyzing this Piagetian paper-pencil assessment. Items were rescored from the above original system using the following method. The scoring system was revised as follows:

- **Preoperations:** failure to correctly answer 4 items out of 1, 3, 4, 7, 8
- **Concrete operations sub1:** 4 correct items 1, 3, 4, 7, 8
- **Concrete operations sub2:** above + 4 correct items 2, 5, 6, 9, 10
- **Concrete operations sub3:** Above + correct answer for 11
- **Formal operations sub1:** Above + 2 correct answers for 12, 13, 17
- **Formal operations sub2:** Above + correct answers for both items 18, 19
- **Formal operations sub3:** Above + correct answers for both items 20, 21

Before analyses were conducted, the data were examined to determine if there were any students who were not cooperating and data may have been erroneous. For example, there was one eighth grade student who was an honor student, making
exemplary scores on the Kansas State Assessments, yet she scored at the lowest preoperational stage using the Piagetian assessment. An inconsistency such as this would yield unreliable data. There were four students in seventh grade and four students in eighth grade that were classified as having unreliable data, indicating a questionable discrepancy between their academic scores and the Piagetian stage obtained by the paper-pencil assessment. Therefore their data were not included in these analyses due to this inconsistency. One student was not included because the parents declined consent into the study, and three students were eliminated from the study by failing to leave two check items blank on the test.

Descriptive statistics for students’ epistemological beliefs and cognitive development are displayed in Table 1.

Table 1

Descriptive Statistics for Epistemological Beliefs and Cognitive Development

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Observed Min/Max</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive Development</td>
<td>4.59</td>
<td>1.70</td>
<td>1-7</td>
<td>-.30</td>
</tr>
<tr>
<td>Epistemological Beliefs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple</td>
<td>3.00</td>
<td>.41</td>
<td>1.9-4.1</td>
<td>-.02</td>
</tr>
<tr>
<td>Quick</td>
<td>2.30</td>
<td>.53</td>
<td>1-4</td>
<td>.67</td>
</tr>
<tr>
<td>Fixed</td>
<td>2.05</td>
<td>.50</td>
<td>1.1-4.2</td>
<td>.67</td>
</tr>
<tr>
<td>Certain</td>
<td>3.15</td>
<td>.53</td>
<td>1.6-4.6</td>
<td>.03</td>
</tr>
</tbody>
</table>
In order to determine if there was a relationship between cognitive development and epistemological beliefs, zero-order Pearson correlations were conducted. One significant correlation was found between cognitive development and simple knowledge. The higher a student’s cognitive development, the less they believed knowledge was simple. See Table 2 for the correlation matrix.

Table 2

<table>
<thead>
<tr>
<th></th>
<th>Cognitive Development</th>
<th>Simple</th>
<th>Quick</th>
<th>Fixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple</td>
<td>-.205*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quick</td>
<td>.026</td>
<td>.055</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed</td>
<td>-.092</td>
<td>.049</td>
<td>.457**</td>
<td></td>
</tr>
<tr>
<td>Certain</td>
<td>-.030</td>
<td>-.018</td>
<td>-.159</td>
<td>-.135</td>
</tr>
</tbody>
</table>

*p<.05  **p<.01

In order to determine if epistemological beliefs determine academic performance, a series of multiple regression analyses were conducted. Kansas State Assessments of math and science for seventh grade and reading and social studies for eighth grade served as criterion variables in separate regression analyses. Cognitive development, epistemological belief scores, and gender were used as predictor variables. (In order to insure that demographic factors are not accounting for the variance, gender was included in these analyses). Step-wise regression analyses were conducted, indicating predictor variables are competing for entry. The variable that accounts for the most variance is entered in the first step; the variable accounting for the next most variance is entered
next, and so on. This technique was used because of the assumption that cognitive development would enter first, but since this has not been tested, an exploratory approach was taken with variables competing for entry.

Both cognitive development and epistemological beliefs predicted academic performance for seventh grade students. Specifically, the more cognitively developed and belief in simple learning predicted students’ mathematical performance. The higher level of cognitive development achieved and the less students believed in simple knowledge, the better they performed on the mathematical Kansas State Assessment. The statistical details of these regressions, as well as the remaining regressions are shown in Table 3. Cognitive development and belief in fixed learning predicted students’ performance in science. The more cognitively developed and the less they believed in fixed learning, the better they performed in science.

Results for eighth grade were mixed. Only cognitive development predicted eighth grade reading performance. The more cognitively developed students were, the better they performed in reading. On the other hand, cognitive development, gender, and belief in simple knowledge predicted social studies performance. Scores were higher in the social studies assessment for students who were more cognitively developed, believed less in simple knowledge, and were boys.
Table 3

*Piagetian Analyses - Cognitive Development and Epistemological Beliefs Predicted Academic Performance*

<table>
<thead>
<tr>
<th>Academic Performance Predicted</th>
<th>Predictor</th>
<th>b Weight</th>
<th>R² Change</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math 7th</td>
<td>Cognitive Dev.</td>
<td>.32</td>
<td>30</td>
<td>28.12***</td>
</tr>
<tr>
<td></td>
<td>Simple</td>
<td>-1.02</td>
<td>15</td>
<td>17.11***</td>
</tr>
<tr>
<td>Science 7th</td>
<td>Cognitive Dev.</td>
<td>.24</td>
<td>20</td>
<td>16.47***</td>
</tr>
<tr>
<td></td>
<td>Fixed</td>
<td>-.41</td>
<td>5</td>
<td>4.43**</td>
</tr>
<tr>
<td>Reading 8th</td>
<td>Cognitive Dev.</td>
<td>.32</td>
<td>33</td>
<td>32.51***</td>
</tr>
<tr>
<td>Social Studies 8th</td>
<td>Cognitive Dev.</td>
<td>.26</td>
<td>27</td>
<td>24.91***</td>
</tr>
<tr>
<td></td>
<td>Gender</td>
<td>-.72</td>
<td>11</td>
<td>11.47**</td>
</tr>
<tr>
<td></td>
<td>Simple</td>
<td>-.60</td>
<td>6</td>
<td>7.20**</td>
</tr>
</tbody>
</table>

*p < .05. **p < .01. ***p < .001.*
Chapter 5: Overview and Discussion

Previous Research

In the 1950’s, Perry theorized nine positions which college students pass through with respect to intellectual development. A student’s thinking could fall upon a continuum of dualistic, right versus wrong thinking, or could be as complex as relativistic thinking where all sides must be viewed before a commitment to an answer is made (Perry, 1968). Equally important to his actual findings was the paradigm set forth for other researchers to base their epistemological theories. Belenky et al. (1986) then followed up with her study of gender related differences where she found a distinction between separate and connected knowing. Males tended to focus on formal analysis of an object or a person, whereas females focused on personal understanding of the topic or person. Similar results were found in the Reflective Judgment Model (King, Kitchener & Wood, 1985). They found a pattern of development from a belief that knowledge is absolutely certain to a view that knowledge is completely uncertain and finally to a position that accepts some knowledge as more certain or true than other knowledge.

Schommer (1990) conceptualized an epistemological belief system, a system of conscious or unconscious beliefs that people hold about knowledge and learning. She theorized that these epistemological beliefs be conceived as a system of more or less independent beliefs. This system is composed of more than one belief and it does not necessarily have to develop in synchrony. These epistemological beliefs are multidimensional and levels can be varied depending on the domain. The epistemological beliefs of high school and middle school students were determined to relate to the ability to learn, speed of learning, and stability of knowledge. If a student believes in quick
learning, it may affect problem-solving strategies over time (Schommer-Aikins et al., 2005).

This study focused on the relationship between epistemological beliefs and Piagetian stages along with cognitive development. One hundred sixty-three middle school students were administered an epistemological questionnaire and Bakken’s Test of Piagetian Stages. Past scores from the Kansas State Assessments were analyzed as well as results from the two assessments. Results demonstrated that both cognitive development and epistemological beliefs were found to predict academic performance for seventh grade students. Cognitive development and belief in fixed learning predicted students’ performance in science. In eighth grade students, only cognitive development predicted reading performance. Students who were more cognitively developed scored better at reading. But cognitive development, gender, and belief in simple knowledge predicted social studies performance.

*Interpretations of the Findings*

One of the first findings in this study was the relationship between cognitive development and epistemological beliefs. There was one significant finding; the less students believed in simple knowledge, the more cognitively developed they appeared to be. This finding seems to be consistent with prior research; as students approach formal operations, their minds not only can solve complex problems, but their belief systems appeared to have developed an awareness of the complexity of knowledge.

It is important to keep in mind the finding that belief in simple knowledge and cognitive development correlate. This is relevant to the interpretation that follows. There was no correlation between cognitive development and the belief in certainty of
knowledge. This may not have developed yet because students have not encountered college material that inundates them with competing hypotheses (Perry, 1968). Note that the means for both certain knowledge and simple knowledge are high, indicating naivete on these two beliefs. On the other hand, belief in fixed ability and quick learning are low, relatively speaking. Students may be in an academic environment that encourages them to think reflectively and to use study skills.

Regression analyses provide an intriguing pattern. As would be expected, cognitive development predicted in all four domains – math, science, social studies, and reading. Simple knowledge predicted performance in mathematics and social studies. This occurred even after accounting for cognitive development. Therefore, epistemological beliefs appear to play a unique role in academic performance. Be mindful that cognitive development correlates with belief in simple knowledge. Consider the idea that the less you believe that knowledge is simple, then the more you believe knowledge is not just bits and pieces, but it is integrated and complex. The domains of math and social studies both require synthesis of information in creating big pictures, so these beliefs are more complex and useful.

Belief in fixed ability predicted science performance, even after accounting for cognitive development. Belief in fixed ability is often associated with motivational variables. For example, students who believe in fixed intelligence display helpless behaviors in the face of difficult academic tasks. Students who believe in incremental (can improve over time) intelligence out perform students who believe in fixed ability (Dweck & Leggett, 1988).
Only cognitive development predicted reading. Since the reading assessment involves a fictional story, it is more difficult to determine the role of epistemological beliefs with clarity. Epistemological beliefs would not necessarily affect a student’s ability to read fiction. Therefore epistemological beliefs may not play a role in this specific genre. In contrast, past research has found the relationship between epistemological beliefs and academic content area books.

**Practical Implications**

This study has shown that epistemological beliefs can predict students’ performance in several academic domains, even after accounting for cognitive development. Students who scored low on simple knowledge believe that knowledge is complex and consists of more than random bits of information. They perceive knowledge more as a network of interrelated concepts. This could mean that students have taken past learning and experiences, incorporated them with new knowledge, and have come up with a deep meaning of the learned concept. Sophistication of epistemological beliefs and cognitive development indicates that students can be given more challenging and complex assignments. They can be given assignments that are more diverse and enriching than simple isolated facts. It means they are ready for learning and it is the responsibility of the teacher and parents to provide meaningful and stimulating environments that foster deep thinking.

A concentrated understanding of epistemological beliefs could be important because it may reveal that young students are being influenced by unconscious and initial beliefs about the nature of knowledge and learning. Teachers will see students rush through projects, only search for simple answers, seek only certainty, and not understand
students’ resistance to their instruction. It may be that teachers not only need to adjust the content, but the epistemological underpinnings which would have to be approached in an appropriate way.

Pintrich (2002) suggested that epistemology is developmental. Development is the aim of education. Thus part of the goal of education should be to promote epistemological development. Hence, if teachers explicitly guided students in their study of personal epistemology, students could develop on yet another sphere that would promote learning along with self-awareness. Hopefully, once a student was made aware of self-inflicted epistemological roadblocks, effort would increase or change for academic improvement. If epistemological education was made explicit at an early age, many pitfalls could possibly be avoided altogether.

Limitations and Future Research

Like all studies, this study has its limitations. The generalization of the results are limited by the population, a parochial, middle-class, Euro-American students. Future research should be conducted on middle school students from public schools and from different ethnic groups. The variety of teachers could also be a factor in this study because the participants from this study had the same teachers throughout their elementary years and a small change during middle school. These students stay in the same building from kindergarten through eighth grade. This stability could be a factor in why the students tested as well, along with the personal philosophy of the parents and administrators at the school.

An unspoken assumption is that epistemological beliefs are acquired though experience and/or education. The exact details of epistemological beliefs acquisition are
unclear. Do academic epistemological beliefs come mostly from teachers? The teacher is in the formal role as the educator, the omniscient authority. Are children’s epistemological beliefs formed primarily from the person in charge of the classroom? Differences may be accounted for due to teachers’ methodology and their individual beliefs in using open-ended thought processes with the students. Teachers’ roles in students’ acquisition of epistemological beliefs could be studied to determine how strong this factor is and to determine what methods a teacher could use to promote a positive epistemological belief system among students.

In contrast, the development of epistemological beliefs (academic or non-academic) may be due to parental support systems and parents’ own personal epistemological beliefs. This would lead to a number of interesting questions. Do students who have the same personality traits as their parents have the same epistemological beliefs as their parents? Or could epistemological beliefs be accounted for by parental discipline styles or modeling parents’ behavior? For example, if a parent becomes frustrated when encountering a problem and gives up right away, would his or her child form an epistemological belief that if a problem cannot be solved immediately the solution is to give up? The results of this study demonstrate that epistemological beliefs may have an effect on students’ academic performance. Teacher preparation programs should consider epistemological beliefs as an important aspect of all content area knowledge. If teachers explicitly include epistemological instruction throughout the curriculum, students are likely to benefit in their learning.
LIST OF REFERENCES
LIST OF REFERENCES


Perry, W. G. Jr. (1970). *Forms of intellectual and ethical development in the college*


paradigm. *Journal of Educational Research, 94*(2), 120-128.


APPENDICES
APPENDICES
APPENDIX A

ATTITUDES ABOUT EDUCATION

Directions: Using the scale below, rate the degree to which you agree or disagree with the following statements. There are no right or wrong answers for the following questions.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

1. It is hard to learn from a textbook unless you start at the beginning and learn one chapter at a time.

2. If I can't understand something right away, I will keep on trying.

3. The best thing about a science course is that most problems have only one right answer.

4. You will get mixed-up if you try to combine new ideas in a textbook with what you already know.

5. I like it when experts disagree.

6. Some people are just born smart, others are born dumb.

7. Being a good student generally involves memorizing facts.

8. What students learn from a textbook depends on how they study it.

9. You cannot learn anything more from a textbook by reading it twice.

10. Please leave this line blank and go on to number 11.

11. I can depend on the facts written in my school books for the rest of my life.
<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

12. A class in study skills would probably help slow learners.
13. Learning something really well takes a long time.
14. Thinking about what a textbook says is more important than memorizing what a textbook says.
15. Working hard on a difficult problem only pays off for the really smart students.
16. An expert is someone who is really born smart in something.
17. Successful students understand things quickly.
18. I really do not like listening to teachers who cannot seem to make up their minds as to what they really believe.
19. If I cannot understand something quickly, it usually means I will never understand it.
20. Scientists can get to the truth if they just keep searching for it.
21. Most words have one clear meaning.
22. Please leave this line blank and go on to number 23.
23. If I am ever going to be able to understand something, it will make sense to me the first time I hear it.
24. Today's facts may be tomorrow's fiction.
25. To me studying means getting the big ideas from the textbook, rather than the details.
<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

26. The really smart students don't have to work hard to do well in school.

27. The only thing you can be sure of, is that nothing is sure.

28. If I find the time to re-read a textbook chapter, I get a lot more out of it the second time.

29. Students who are "average" in school will remain "average" for the rest of their lives.

30. If scientists try hard enough, they can find the truth to almost everything.

31. Getting ahead takes a lot of work.

32. The knowledge of "how to study" is usually learned as we grow older.
APPENDIX B

FUN AND CHALLENGING PUZZLES

Instructions: The following are puzzles that we would like you to solve. To the best of your ability, try to find the answer to each puzzle; and then draw a circle around the letter that gives you the answer. If a certain puzzle doesn’t make any sense to you, just skip it and go on to the next puzzle.

1. Pretend that these circles are quarters.

Which row has more quarters?

a. The top row
b. The bottom row
c. Both rows have the same number.
d. You can’t tell which row has more.

2. Pretend that these two glasses are 2/3 full of coke.

Now, pretend that you take the glass on the left and pour it into this glass:

So now you have these three glasses, one without coke, and two with coke in them:

Which of the two glasses with coke has more coke in it?

a. The glass on the right has more.
b. You can’t tell which glass has more.
c. The glass on the left has more.
d. They both have the same amount.
3. Look at the following two lines, which are the same length: 

Now, pretend that I move the bottom line so that the two lines look like this:

Which line is longer?

a. Both lines are the same length.
b. The top line is longer.
c. You can't tell which line is longer.
d. The bottom line is longer.

4. Pretend that the following two squares are two fields with a cow in each field. In the corner of each field is grass for the cows to eat.

Now pretend that you take the grass in the field on the right, cut it up, and move it so it's like this:

Now you have two fields with cows and grass that look like this:

In which field does the cow have more grass to eat?

a. You can't tell.
b. They both have the same amount.
c. The field on the right has more.
d. The field on the left has more.
5. Let's pretend that we have this box with twelve plastic beads in it. Some of the beads are black and some of the beads are white.

Are there more black beads or more plastic beads in the box?

a. There are more black beads.
b. There are more plastic beads.
c. There are the same number of black beads and plastic beads.
d. There are actually more white beads.

6. Assume that I have these two balls of clay:

Not only are they the same size, but they also weigh the same amount. Now I'm going to take the ball on the right and roll it into a sausage so that it looks like this:

So now I have two pieces of clay that look like this:

Which of these pieces of clay weighs more?

a. They both weigh the same.
b. The piece on the right weighs more.
c. The piece on the left weighs more.
d. You can't tell which piece weighs more.
7 - 10. Here we have a pencil, a shoe, and a quarter. Now I'd like to ask you some questions about these three items.

7. First, is the pencil on the right or the left of the shoe?
   a. The pencil is on the right of the shoe.
   b. The pencil is on the left of the shoe.

8. Second, is the quarter on the right or the left of the shoe?
   a. The quarter is on the right of the shoe.
   b. The quarter is on the left of the shoe.

9. Third, is the shoe on the right or the left of the pencil?
   a. The shoe is on the right of the pencil.
   b. The shoe is on the left of the pencil.

10. Fourth, is the shoe on the right or the left of the quarter?
    a. The shoe is on the right of the quarter.
    b. The shoe is on the left of the quarter.
11. Let's take those two balls of clay that are the same size and weigh the same one more time. Now let's pretend that I drop each of them in a glass of water. We can see how the water rises to the same level in each glass.

Now I'm going to take them out of the water and roll this ball on the right into a sausage once more.

If I put these two pieces of clay back into the water, which piece of clay will make the water rise more?

- a. The clay on the left
- b. You can't tell which one will make the water rise higher.
- c. The clay on the right
- d. They will both make the water rise the same amount.

12. If A is greater than B, and B is greater than C, then C is ____ A.

- a. greater than
- b. the same as
- c. less than
- d. similar to
13. Pretend that you are sitting at the table below in position "A."

Now you get up from position "A" and move to position "C." Which of the following would be the correct view of the table if you were sitting in position "C"?

a. 

b. 

c. 

d. 

e. None of the above is the correct view.

14. Pretend that you have these three foods: ham, cheese, and bread. How many possible different meals can you make from these three foods?

a. 4  
b. 6  
c. 7  
d. 10  
e. 3
15. Pretend that you just landed on a brand new planet. The life forms that are on this planet are:
   - vertebrate
   - invertebrate
   - terrestrial
   - aquatic

   From these life forms, how many different possibilities of life forms could there be found on this planet?
   a. 4
   b. 15
   c. 18
   d. 8
   e. 7

16. Look at this balance beam with a weight on each side of the beam

   ![Balance Beam Diagram 1](image1)

   Now let's add a weight to the right side so it looks like this:

   ![Balance Beam Diagram 2](image2)

   How can the balance beam be brought back in balance again?
   a. Remove the weight.
   b. Add a weight to the left side.
   c. Move the weight on the left farther from the center.
   d. Both a and b, but not c are correct.
   e. Both a and c, but not b are correct.
   f. A, b, and c are all correct.
17. If dogs are bigger than elephants, and elephants are bigger than mice, then dogs are ___________ mice.
   a. smaller than
   b. the same size as
   c. bigger than
   d. similar to

18 - 19. Susan is trying to learn how to play tennis. So she tried several things to improve her game:

   First, she turned her tennis racket a little to the right;
   and she turned her wrist inward;
   and she used type A tennis balls;
   and she hit a good serve over the net.

   Second, she turned her tennis racket a little to the left;
   and she turned her wrist outward;
   and she used type A tennis balls;
   and she hit a poor serve over the net.

   Third, she tried turning her tennis racket a little to the right;
   and she turned her wrist outward;
   and she used type B tennis balls;
   and she hit a poor serve over the net.

   Fourth, she tried turning her tennis racket a little to the left;
   and she turned her wrist inward;
   and she used type B tennis balls;
   and her serve was a good one.

   Last, she tried turning her tennis racket a little to the left;
   and she turned her wrist inward;
   and she used type A tennis balls;

18. Was her serve a good one or a poor one?
   a. a good serve
   b. a poor serve

19. I decided on the serve because
   a. how she turned her tennis racket was what was important.
   b. how she turned her wrist was what was important.
   c. which type tennis balls she used was important.
   d. all three (turning her tennis racket, her wrist, and the tennis balls) were important.
Imagine that you are running an electric train that is hooked up to three switches in front of you. Two of the three switches determine how fast the train will go. The way these two important switches are set—down and down, up and down, down and up, or up and up—will determine the speed of the train. The various combinations of positions are given below. Your task is to determine which combination of switches is important and how they work.

<table>
<thead>
<tr>
<th>Switch 1</th>
<th>Switch 2</th>
<th>Switch 3</th>
<th>Train Goes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up</td>
<td>Down</td>
<td>Down</td>
<td>Slow</td>
</tr>
<tr>
<td>Up</td>
<td>Up</td>
<td>Up</td>
<td>Not at all</td>
</tr>
<tr>
<td>Down</td>
<td>Down</td>
<td>Down</td>
<td>Fast</td>
</tr>
<tr>
<td>Up</td>
<td>Down</td>
<td>Up</td>
<td>Slow</td>
</tr>
<tr>
<td>Down</td>
<td>Up</td>
<td>Up</td>
<td>Slow</td>
</tr>
<tr>
<td>Down</td>
<td>Down</td>
<td>Up</td>
<td>Fast</td>
</tr>
<tr>
<td>Down</td>
<td>Up</td>
<td>Down</td>
<td>Slow</td>
</tr>
<tr>
<td>Up</td>
<td>Up</td>
<td>Down</td>
<td>Not at all</td>
</tr>
</tbody>
</table>

20. Which two switches are important?
   a. 1 and 2
   b. 2 and 3
   c. 1 and 3

21. The way they work is:
   a. When both switches are up, the train goes fast.
   b. When both switches are down, the train goes fast.
   c. When one switch is up and one switch is down, the train goes fast.
   d. When one switch is up and one switch is down, the train does not go at all.
   e. I don’t know how they work.
APPENDIX C

Mind Break

Name: __________________________

Age: ______

Gender: Male ______  Female ______

How much do you like school? (number only) ______

1=Very much  2=Somewhat  3=Neutral  4=Very little  5=Not at all

Give your opinion about the following story, there is not a right or wrong answer.

HEINZ AND THE DRUG

In Europe a woman was near death from a special kind of cancer. There was one drug that doctors thought might save her. It was a special drug that the druggist in town had recently discovered. The drug was expensive to make, but the druggist was charging ten times what the drug cost to make. He paid $200 for the ingredient to make the drug and charged $2,000 for a small dose of the drug.

The sick woman’s husband, Heinz, went to everyone he knew to borrow the money, but he could only get together about $1,000, which is half of what it cost. He told the druggist that his wife was dying, and asked him to sell it cheaper or let him pay later. But the druggist said, “No, I discovered the drug, and I’m going to make money from it.” So Heinz got desperate and began to think about breaking into the man’s store to steal the drug for his wife.

Should Heinz steal the drug? (Check one)

____ Should steal it   _____ Can’t decide   _____ Should not steal it

In one sentence, tell why you made this decision. (Remember there is not a right or wrong answer.)

______________________________________________________________________________
APPENDIX D

INFORMED CONSENT FORM

Parents,

Your child is invited to participate in a study of student opinions about learning and education. As educators, we are constantly trying to understand student viewpoints to help enhance what is taught and the best way to present the information. In order to conduct the study, students’ responses will be analyzed from existing data from an informal questionnaire.

Information will be randomly selected from St. Francis of Assisi 7th and 8th grade opinions about learning. Data will be strictly confidential and students’ names, along with the school name, will not be cited in any way. Observations will be generalized to middle school students, not to any one student.

Participation in this study is entirely voluntary. The decision to allow the use of your child’s opinions from the existing pool of information will not affect future relations with anyone at St. Francis of Assisi School. If you agree to let your child’s information be included, you are free to withdraw this decision at any time without penalty.

If you have any questions about this research, you can contact Mary Bird at 945-3508 or Dr. Marlene Schommer-Aikins at Wichita State University at 978-3326. If you have questions pertaining to your rights as a research subject, you can contact the Office of Research Administration at Wichita State University, Wichita, Kansas 67260-0007, telephone (316) 978-3285.

You are under no obligation to have your child’s information included in this study. Your signature indicates that you have read the information provided above and have voluntarily decided that your child’s information may be included in the study.

You will be given a copy of this consent form to keep, if you request.

________________________________________  __________________________
Signature of Parent                                      Date

________________________________________  __________________________
Principal Investigator                                  Date