TESTING AN EPISTEMOLOGICAL BELIEF INSTRUMENT THAT REFLECTS A MULTIDIMENSIONAL MODEL

BY

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That Reflects

a Multidimensional Model

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

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DEDICATION

I dedicate this thesis
to Rolly, Mom Miller, Mom Walter, and Ricarda
who have spent many hours taking care of Jack
to make it possible for me to complete this thesis.

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ABSTRACT

Recently Schommer, Mau, and Brookhart (1999) attempted to assess middle school students' epistemological beliefs using a 30-item epistemological beliefs questionnaire that was designed by Schommer specifically for use with middle school students. A three-factor model of epistemological beliefs was found. In contrast, a four-factor epistemological beliefs model has been found with high school students, college students, and older adults using a 63-item version of the epistemological beliefs questionnaire (Schommer, 1990; 1993b; 1998). The purpose of this research was to determine if the three-factor epistemological beliefs model found in the Schommer et al. (1999) study accurately assessed middle school students' epistemological beliefs or if the questionnaire lacks appropriate psychometric properties to detect the fourth factor. Using the 30-item epistemological beliefs questionnaire, a total of 901 students from two Midwestern high schools participated in order to determine whether the 30-item epistemological beliefs questionnaire had similar psychometric qualities compared to the original 63-item epistemological beliefs questionnaire (Schommer, 1990). It was expected that the data from this research would elicit the same four-factor epistemological belief structure found previously among high school students (Schommer, 1993b) and the epistemological belief factors would predict grade point averages (GPA). The data gathered from the high school population using the 30-item Attitudes About Education epistemological beliefs questionnaire elicited a four-factor structure of personal epistemology and three epistemological belief factors were found to predict GPA. Results indicate that the 30-item questionnaire elicits similar results among high school students as the 63-item questionnaire.

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CHAPTER ONE

Introduction

Rationale

Research in personal epistemology, or the study of peoples' beliefs about knowledge, can be divided into two paradigms. One paradigm is that beliefs about knowledge follow along a single continuum. Perry (1970), a founding researcher of personal epistemology, discovered college students changed views about knowledge and the educational process as they progressed through college. Perry organized his findings and created an epistemological belief theory that was unidimensional and highly developmental. Perry organized personal epistemology on a continuum from the belief that knowledge is absolute to the belief that knowledge is tentative. Using Perry's framework, researchers such as Ryan (1984a, 1984b), Baxter Magolda (1992), and Kitchener and King (1981) sought to further explore personal epistemology. As researchers uncovered interesting and helpful information, Perry's theory was called into question. Epistemological beliefs were found not to be as simple as originally conceived. Therefore, the paradigm of personal epistemology as a single continuum began to change. Schommer (1990) expanded the notion of personal epistemology by conceptualizing epistemological beliefs as multidimensional. She incorporated such ideas as the independence of epistemological belief dimensions and extended the study of personal epistemology to include beliefs about learning.

Regardless of which theoretical viewpoint researchers preferred, researchers continued in seeking to pinpoint influences of personal epistemology. Anderson (1984) suggested that childrens' beliefs about

knowledge are most likely to be influenced by their parents. In a study involving adult epistemological beliefs, Schommer (1998) found that upbringing dynamics were correlated with participants' epistemological beliefs. Jehng, Johnson, and Anderson's (1993) research suggested that education may influence personal epistemology. For example, they found that individuals with more education in specialized courses where the content is seemingly more complex, were found to be more likely to believe that knowledge is uncertain.

Researchers expanded into other areas such as reflective judgment. In 1981, Kitchener and King established a model, termed the Reflective Judgment model, that outlines the stages in which people develop in their ability to justify beliefs based on their concept of knowledge and reality. Kardash and Scholes (1996) examined the influences of personal epistemology upon interpretation of controversial material. They proposed that people who believe that knowledge is tentative are better able to understand the inconclusiveness of controversial issues. In 1988, Dweck and Leggett found that students' beliefs about intelligence predict chosen study strategies as well as influence students' persistence in school work. Ryan (1984b) researched how personal epistemology predicts comprehension monitoring standards. For example, he found that students who believed that knowledge is simple chose to memorize facts in order to comprehend material.

Until now, most epistemological belief researchers have focused on high school, college students, and older adults. In studies using the multidimensional model of epistemological belief research, the 63-item epistemological beliefs questionnaire developed by Schommer (1990)

consistently generated a four-factor epistemological belief structure (Bendixen, Dunkle, & Schraw, 1994; Schommer, 1990, 1993b; Schommer, Crouse, & Rhodes, 1992). Each of these studies revealed four-factor epistemological belief structures that were fairly similar. These four belief dimensions include: beliefs about the Structure of Knowledge, the Ability to Learn, the Speed of Learning, and the Stability of Knowledge.

Only recently has a multidimensional epistemological belief model been applied at the middle school level. In 1999, Schommer, Mau, and Brookhart tested a 30-item epistemological beliefs questionnaire entitled Attitudes About Education that was designed by Schommer specifically for use with middle school students. The findings indicate that middle school students have fewer measurable epistemological beliefs than do older students and adults. The middle school research data elicited a three-factor epistemological belief structure. This factor structure included epistemological beliefs about the Speed of Learning, the Stability of Knowledge, and the Ability to Learn. The factor, Structure of Knowledge, was absent. Furthermore, these three factors were found to highly correlate with each other. Although these findings may suggest that middle school students have epistemological beliefs albeit in the early stages of development, these results may in fact only be a consequence of the different instrumentation used in the studies. Because the 30-item epistemological beliefs questionnaire developed for use with middle school students is a new instrument, there are limitations in drawing conclusions from the results. Further examination of the psychometric properties of the questionnaire is essential.

Overview

The main purpose of this study was to examine the psychometric properties of the 30-item epistemological beliefs questionnaire entitled Attitudes about Education. This study was accomplished by surveying students at two Midwestern high schools with the 30-item epistemological beliefs questionnaire to determine if the results were similar to those found in the Schommer (1993b) study in which the original 63-item epistemological beliefs questionnaire was used with high school students. Exploratory factor analyses were conducted to examine the factor outcomes and stepwise regression analyses were carried out to determine if epistemological beliefs predicted grade point averages. Exploratory factor analysis and stepwise regression analysis were carried out in the 1993 study and were replicated in this study for comparison purposes. It was expected that the high school students would have similar factor structures as was elicited in the 1993 study. That is, a four-factor solution would result. Also, it was expected that the epistemological beliefs would predict grade point averages.

Chapter Two reviews the epistemological belief research upon which the epistemological beliefs questionnaire was based. This includes: (a) differing conceptions of personal epistemology; (b) epistemological belief development; and (c) learning correlates of epistemological beliefs. Chapter Three outlines the method of this research beginning with the purposes and hypotheses of this study. Also included is a description of the participants, materials, procedure, and analyses. Chapter Four describes the results found and Chapter Five provides a full discourse of the conclusions and implications drawn from the results. Limitations of the study, future research implications, and practical implications are delineated as well.

CHAPTER TWO

Literature Review

The purpose of the research being reported was to examine the psychometric properties of an epistemological beliefs questionnaire developed for middle school students by Schommer and tested by Schommer et al. (1999). In this chapter, the historical background and theoretical underpinnings of the questionnaire are presented. This includes discussion of the conception of epistemological beliefs, development of epistemological beliefs, and the impact of epistemological beliefs on the learning process.

Epistemological Belief Research

Conception of Personal Epistemology

The study of personal epistemology can be divided into two paradigms. In one paradigm, researchers conceptualize personal epistemology as a single belief or single dimension. In the second paradigm, researchers conceptualize personal epistemology as a broad spectrum of beliefs which includes beliefs about learning. These two paradigms will be discussed in depth in the following two sections.

Personal Epistemology as a Single Belief

William Perry, Jr. (1970) was among the first to research personal epistemology. Through interviews of Harvard and Radcliffe students during the 1950s and 1960s, Perry postulated that college students go through a sequence of nine positions of epistemological beliefs as they mature. These positions of development range from the belief that knowledge is absolute to the belief that knowledge is relativistic. Within the early phases of believing that knowledge is absolute, knowledge is believed to be absolute regardless of the context; knowledge is either right or wrong (dualistic). People in these

early positions also believe that knowledge is handed down from authority figures. On the other hand, within the later phases of believing that knowledge is relativistic, truth is determined by the context. Disruptions in this developmental path can be experienced in several ways. These are Temporizing (pausing while often quite aware of the step that lies ahead), Escape (sticking with the position that allows some detachment and avoidance of responsibility) and Retreat (regressing to the dualistic position).

Throughout the 1970s and 1980s a number of researchers followed in Perry's footsteps. For example, Ryan (1984b) studied the relationship between epistemological beliefs and personal reading comprehension standards. Kitchener and King (1981) developed the Reflective Judgment model that was intimately related to Perry's initial model. Belenky, Clinchy, Goldberger, and Tarule (1986) began to investigate women's ways of knowing using Perry's model as a guideline. Baxter Magolda (1992) began to examine men's and women's epistemological beliefs using Perry's model as the initial foundation for her interviews. These researchers, as well as many others, maintained a commonality. That commonality was to examine epistemological beliefs as if it were a single, although a highly complex, dimension.

Personal Epistemology as a Set of Multiple Beliefs

In 1990 Schommer challenged the notion of a unidimensional conception of epistemological beliefs. She argued that it masked the powerful influence that epistemological beliefs may have. Schommer suggested that epistemological beliefs be reconceptualized as a system of beliefs. By system of beliefs, she meant that there were multiple beliefs to be considered. Furthermore, epistemological beliefs within a system may mature at different

rates. Since the publication of her first article (Schommer, 1990) describing this multiple belief system, many researchers have started to investigate personal epistemology with this new perspective.

Using questionnaires for assessment with high school and undergraduate and graduate students, at least four epistemological beliefs have been identified (Bendixen et al., 1994; Schommer, 1990, 1993b; Schommer et al., 1992). Each of these studies revealed four-factor epistemological belief structures that were fairly consistent. These four belief dimensions include: beliefs about the Structure of Knowledge, the Ability to Learn, the Speed of Learning, and the Stability of Knowledge. Beliefs about the Structure of Knowledge range from the belief that knowledge is simple and organized as isolated bits of information to the belief that knowledge is complex and organized as highly integrated concepts. Beliefs about the Stability of Knowledge range from the belief that knowledge is absolute to the belief that knowledge is tentative. Beliefs about the Ability to Learn range from the belief that the ability to learn is fixed at birth to the belief that the ability to learn can be improved over time. Beliefs about the Speed of Learning range from the belief that knowledge is acquired quickly or not-at-all to the belief that knowledge is acquired gradually.

Recently, Schommer et al. (1999) tested an epistemological beliefs questionnaire that she developed to assess middle school students. In comparison to the four factors of personal epistemology found among older populations, only three factors were found. The Structure of Knowledge factor was absent. It was suggested that this finding was due to a possible developmental issue among middle school students' personal epistemology.

Recent findings also provide some support for the notion that epistemological beliefs are more or less independent (Bendixen et al., 1994; Kardash & Scholes, 1996; Schommer, 1990). By independent it is meant that epistemological beliefs within a system may be at different levels of maturation. For example, an individual might believe that knowledge is unchanging (which is considered less mature), at the same time, the individual may believe that knowledge is highly complex (which is considered more mature). Schommer (1990) found that students showed evidence of believing that knowledge is acquired quickly or not-at-all (which is considered less mature) while at the same time they believed knowledge is uncertain (which is considered more mature), hence, lending support to Schommer's theory that each epistemological belief may develop at a different rate.

Because research utilizing each of these two paradigms of personal epistemology has led to distinct findings, researchers continue along both paths. However, within this study it will be taken into account that the researcher who designed the epistemological beliefs questionnaire in review has chosen the multidimensionality conception of personal epistemology.

What Influences the Development of Epistemological Beliefs

The dimensionality of the model notwithstanding, many have looked at what or who influences epistemological beliefs (Anderson, 1984; Baxter Magolda, 1992; Beers, 1988; Bendixen et al., 1994; Jehng et al., 1993; Perry, 1970; Schommer, 1990, 1993a). In this section of the literature review, parental and educational influences on epistemological beliefs are examined.

Parental Influence

Although most epistemological belief researchers have focused on high school aged youth and older, when epistemological beliefs seem to be forming more concretely, it is postulated that personal epistemology begins to form before a child enters school. Childrens' beliefs about knowledge are most likely to be influenced by their parents (Anderson, 1984). Schommer (1994) hypothesized that children just entering school would have varying degrees of epistemological sophistication due to familial influences. In a study involving adult epistemological beliefs, upbringing dynamics were found to correlate with participants' epistemological beliefs (Schommer, 1993a, 1998). The more the participants were allowed to question their parents, the less likely they were to believe in fixed ability and quick learning. That is, they believed that ability can be improved over time and that knowledge is acquired gradually. The less overbearing the participants perceived their parents to be, the less likely they were to believe in quick learning. Also, the more the participants were allowed to make their own decisions, the less likely they were to believe that knowledge is certain. They believed, accordingly, that knowledge is tentative.

Within the limited scope of adult recollections, Schommer has studied the influences upon childrens' epistemological beliefs. Hypotheses have been made regarding childrens' epistemological beliefs, but not much has been done to assess their beliefs directly.

Educational Influence

Numerous researchers focusing on the learning process have found that the educational environment influences epistemological beliefs (Beers, 1988; Bendixen et al., 1994; Jehng et al., 1993). Specifically, epistemological

beliefs have been linked to levels of education. The more classes that undergraduate and graduate students had in higher education, the more likely they were to believe that knowledge is tentative (Perry, 1970; Schommer, 1994) but the amount of education was not found to predict beliefs about the Ability to Learn or Speed of Learning (Jehng et al., 1993). Individuals with more education in specialized courses where the content is seemingly more complex, were more likely to believe that knowledge is uncertain, learning isn't a totally orderly process, and independent learning is crucial (Jehng et al., 1993).

Jehng et al. (1993) also found a correlation between students' particular chosen field of study and their epistemological beliefs. Those studying in soft fields (e.g., social sciences, arts, and humanities) tended to believe that knowledge is uncertain, that learning depends upon independent reasoning and that learning requires flexibility of thought. Those studying in the hard fields (e.g., engineering, natural sciences) believed that learning follows a prescribed order. It is not known whether epistemological beliefs are changed because of more education or if those who choose higher education have different epistemological beliefs (Schommer, 1994).

In 1998, Schommer examined how age and education have unique effects on adult development of epistemological beliefs. Schommer first used stratified random sampling to ensure varied educational experience. One third of the sample had high school education, another third had some undergraduate experience, and the remainder had postgraduate experience. She then used multiple regression analysis to control for the confound between age and education. She found that as individuals grow older, they

believe that the ability to learn can be improved; whereas, with more education individuals are more likely to believe that knowledge is complex and tentative.

Another approach used to examine the link between epistemological beliefs and education is the study of teachers, themselves. Due to the variety of personal philosophies of education held by teachers, they are likely to teach from different epistemological belief perspectives. For instance, some teachers believe that education involves a simple transmission of knowledge from the teacher and absorption of knowledge by the students (Samuelowicz & Bain, 1992 cited in Watkins, 1998). Others might believe that education is a result of students' challenging themselves in their views about knowledge through debates or through tangible interaction with educational materials.

Beers (1988) conducted a study to examine the extent of college teachers' influence on students' epistemological beliefs. Beers analyzed previous interviews with college teachers that were initially designed to better understand teachers' goals. Few of the teachers were interested in transmitting content, but rather wanted to develop students' attitudes and thinking styles. "A biologist, for example, said that she 'hated facts' and spoke of 'getting students excited about the way the world works.' A sociologist spoke of understanding the 'form of an argument, the way a sociologist thinks'" (p. 87). When these teachers were talking about their educational goals, they were referring instead to a set of epistemological beliefs; what knowledge consists of and ways that people go about obtaining knowledge.

Learning Correlates of Epistemological Beliefs

Although the study of epistemological beliefs may seem like a mere academic exercise, it has important implications for how students go about

learning. In this section of the literature review, the relationship of personal epistemology to the learning process will be presented. This includes how epistemological beliefs predict reflective judgment, interpretation of controversial material, and information processing strategies.

Reflective Judgment

Research supports the idea that epistemological beliefs influence individuals' conceptions of reality thereby affecting reasoning styles (Bendixen et al., 1994; Kitchener & King, 1981). Reasoning includes justifying one's position about an issue. Building on Perry's developmental scheme, Kitchener and King (1981) established a model that outlines the stages in which people develop in their ability to justify beliefs based on their concept of knowledge and reality. This model, termed the Reflective Judgment model, includes a seven-stage sequence. As with Perry's sequence (1970) the Reflective Judgment model places the belief that knowledge is absolute in the beginning stages, and ends with a more relativistic view in which knowledge is understood as the process of critical inquiry. Therefore, individuals who have achieved the highest stage in this model would have the ability to make justifications based on rules of inquiry and to believe that statements are only approximations to the truth and are open to scrutiny.

Bendixen et al. (1994) conducted research with undergraduate and graduate students correlating Schommer's four dimensions of epistemological beliefs with the Reflective Judgment model and found that the Ability to Learn belief was the best discriminator among different levels of reflective judgment. That is, the belief that ability is fixed was found to be positively related to lower levels of reflective judgment.

Interpretation of Controversial Material

Controversial issues such as gun control, or ill-structured problems (problems that don't have an absolutely correct solution) such as school violence, require reasoning abilities to understand the whole issue and to look at it nondiscriminantly from all sides using sophisticated processes of critical inquiry. Kardash and Scholes (1996) specifically focused on how the belief in the certainty of knowledge would predict interpretation of controversial material. In their study, 96 undergraduates completed a partial version of Schommer's epistemological beliefs questionnaire. The students completed another measure that determined their personality disposition and the degree to which they believed that HIV causes AIDS. They then read a text that presented two conflicting views about the relationship between HIV and AIDS and were asked to write a concluding paragraph. The students' conclusions were categorized according to whether they were certain (conclusion sided clearly with one particular viewpoint), tentative (conclusion did not favor one viewpoint over the other), or ambiguous (conclusion addressed the issue that research may never provide clear answers). The less students believed that knowledge is certain, the more they drew conclusions that reflected the inconclusiveness, or tentativeness, of the controversial issue.

How Students Process Information

Epistemological beliefs are related to how students process information. For example, epistemological beliefs predict how students choose to study materials in the classroom (Qian & Alvermann, 1995; Ryan, 1984b). Epistemological beliefs are also related to such things as persistence

and comprehension standards (Dweck & Leggett, 1988; Glenberg & Epstein, 1987; Ryan, 1984b; Schommer, 1990, 1993b; Schommer et al., 1992; Schommer & Dunnell, 1994).

Qian and Alvermann (1995) explored the correlations between epistemological beliefs and conceptual understanding among high school students. When students' conceptual understanding about science, for example, is directly challenged by a teacher, students have to process the change in their hypothetical framework of ideas. Qian and Alvermann found that students who believe that knowledge is simple and certain and who believe that learning is a quick process are less likely to engage in conceptual change learning, that is, students seem to resist changing their preconceived notions.

Schommer et al. (1992) found that among college students, prior knowledge, beliefs about the Structure of Knowledge (whether knowledge is simple or complex) and test preparation predicted test performance. If the students tended toward the belief that knowledge is simple, they prepared for a test by studying a list of facts without making much effort to interrelate them.

Persistence. Among the few researchers to study grade school students and their epistemological beliefs, Dweck and Leggett (1988) researched grade school students' persistence (as it relates to the belief about the Ability to Learn) in the face of a difficult intellectual task. They found that students who believe that intelligence, or ability, is fixed at birth will display helpless behavior in the face of a difficult task. Students who believe that intelligence or ability can be improved persist in difficult tasks. In previous research by Diener and Dweck (1978, 1980 cited in Dweck & Leggett, 1988), students on

either end of the spectrum did well in persistence when doing an easy assignment. On the other hand, when the assignment became difficult, students with beliefs that ability is fixed did not persist. In fact, over 60% of the students who believed that the difficulties they were experiencing would result in failure, were a result of low ability and were unsurmountable, started using ineffective strategies even if they had used the effective strategies successfully in the easy task.

The students who believed that the difficulties they were experiencing were challenges to be mastered (mastery oriented outlook) rather than issues of personal ability had different mind sets, rose to the challenge, and even tried to incorporate different strategies. Students who believed that ability is fixed focused on their adequacy or inadequacy in ability during a task and therefore challenges were a threat to their self esteem. On the other hand, the students with more mastery oriented outlooks about learning focused on strategy and effort during a task and therefore challenges were an opportunity for them to learn something new.

Finally, in addition to looking at epistemological beliefs and information processing strategies directly, Schommer and Dunnell (1994) approached the question of persistence from a different perspective. They compared the epistemological beliefs of gifted and regular high school students. Gifted students were more likely to believe that learning is a gradual process and were less likely to believe that knowledge is simple. The intriguing link is that gifted students are noted for their persistence when faced with difficult tasks and for their eagerness in seeking out complexities during problem resolution. Therefore these results lend support to the

notion that gifted students' openness to complexity and willingness to persist are related to their beliefs about the Ability to Learn and the Structure of Knowledge.

Comprehension. Building upon Perry's developmental model, Ryan (1984b) conducted research on undergraduates' personal epistemology and their information processing strategies. He found the comprehension monitoring standards that students used predicted academic performance. Students who used a dualistic approach to comprehension (retrieving facts from memory) received poorer grades than students who used a more relativistic approach (relating propositions in a passage).

Schommer (1990) asked college students to read a passage in which the final paragraph had been omitted and to write a concluding paragraph. Students with strong beliefs in quick, all-or-none learning tended to oversimplify written conclusions and overconfidently rated how well they thought they comprehended the passage. Also, students who had strong beliefs that knowledge is certain tended to distort tentative information (found in the inconclusive story) as if it were absolute and wrote conclusions accordingly.

The link between epistemological beliefs and more global measures of the learning process have been made. Schommer (1993b) examined the correlations between high school students' epistemological beliefs and their academic success as measured by Grade Point Average (GPA). Although all four factors (Structure of Knowledge, Stability of Knowledge, Ability to Learn, and Speed of Learning) predicted GPA, Speed of Learning was found to be the best predictor. The less students believed in quick learning, the higher GPA they earned.

It appears that epistemological beliefs influence how students process information and how they choose to study, predicting such things as persistence in difficult tasks and comprehension monitoring standards. Overall, it seems that epistemological beliefs have both a direct and indirect effect on students' academic success.

Summary

In review of the literature, the study of personal epistemology is divided into two paradigms. Some researchers, such as Perry (1970) examine personal epistemology as a single belief. Perry (1970) established a developmental scheme in which personal epistemology changes from a dualistic approach (i.e., believing that knowledge is absolute) to a relativistic approach, wherein knowledge is tentative. Others examine personal epistemology as a system of multidimensions and more or less independent beliefs (Bendixen et al., 1994; Kardash & Scholes, 1996; Schommer, 1990).

Within both models, research indicates that epistemological beliefs play an important role in the learning process predicting such things as persistence in difficult tasks, comprehension monitoring standards, reasoning ability, and academic success. However, epistemological belief research has focused mainly on high school students, college students, and older adults. Schommer (1994) and Anderson (1984) hypothesized that personal epistemology begins to form before a child enters school; it is only logical that epistemological beliefs are in the process of developing before high school age. That is, epistemological beliefs don't just appear in high school.

Researchers need to know more about the earlier forms of epistemological beliefs if they are to better understand personal

epistemological development. It is important that educators learn as much as they can about how personal epistemology develops so that they can know how to identify epistemological beliefs as well as encourage more mature epistemological beliefs.

Recently Schommer et al. (1999) attempted to assess middle school students' personal epistemology using a 30-item epistemological beliefs questionnaire that was designed by Schommer specifically for use with middle school students. Of the 30 items that were initially presented to the students, eleven of the items loaded onto three factors: the Ability to Learn, the Speed of Learning, and the Stability of Knowledge. In contrast, a four-factor epistemological beliefs model, including the belief about the Structure of Knowledge has been found with high school students, college students, and older adults (Schommer, 1990, 1993b, 1998). It is important to determine if the three-factor epistemological beliefs model found in the Schommer et al. (1999) study accurately assessed middle school students' epistemological beliefs or if the questionnaire lacks appropriate psychometric properties to detect the fourth factor. Therefore the purpose of this study was to investigate the psychometric properties of the 30-item epistemological beliefs questionnaire with high school students to determine if the results found in the Schommer et al. (1999) study were due to a developmental issue for middle school students or if the quality of the epistemological beliefs questionnaire might be the cause for the difference in findings.

CHAPTER THREE

Method

Purpose of Study

The main purpose of this study was to investigate the psychometric properties of a 30-item epistemological beliefs questionnaire entitled Attitudes About Education designed by Schommer to assess middle school students (Schommer et al., 1999). The 30-item Attitudes about Education questionnaire was shortened and modified from the original 63-item epistemological beliefs questionnaire (Schommer 1990). The 63-item epistemological beliefs questionnaire has been used with high school students, college students, and older adults.

This investigation was accomplished by surveying high school students with the 30-item Attitudes About Education epistemological beliefs questionnaire to determine if the results were similar to those found in a previous study (Schommer, 1993b) in which the 63-item version was used with high school students. The factor structures and predictability of grade point averages were closely examined. Another purpose of this study was to compare the results from the present study to the results from the Schommer et al. (1999) study in which the 30-item Attitudes about Education epistemological beliefs questionnaire was used to assess middle school students. The differences in epistemological belief factor structures found were examined.

Hypotheses

Three hypotheses were tested. First, the four-factor structure found (Schommer, 1993b) with high school students using the 63-item version of the epistemological beliefs questionnaire would be replicated with the use of

the 30-item Attitudes About Education epistemological beliefs questionnaire. Second, the factor structure found with high school students using the 30-item Attitudes About Education epistemological beliefs questionnaire would be different than the three-factor structure found with middle school students. Third, the epistemological belief factors elicited would predict academic success as measured by grade point averages.

Participants

A total of 901 students participated in this study: 770 students from Newton High School (public school) and 131 students from Berean Academy High School (private school). At Newton High School, Gender (55% female and 45% male) was approximately equal in representation and grade (32% freshmen, 24% sophomores, 24% juniors, and 20% seniors) was slightly unequal in representation. At Berean Academy High School, Gender (52% female and 48% male) was approximately equal in representation but grade (19% freshmen, 27% sophomores, 24% juniors, and 30% seniors) was slightly unequal in representation. Students at Newton High School were predominantly White with a large Hispanic American population (79% Euro American, 13% Hispanic American, 2% African American, 1% Asian American, and 3% other). Students at Berean Academy High School were predominantly White (97% Euro American, 1% Hispanic American, and 2% Asian American).

Materials

Assessment Packets

Packets were prepared for group administration. Each packet contained five items (see Appendix A): (a) an informed consent cover sheet; (b) the 30-item Attitudes About Education epistemological beliefs questionnaire; (c) a

demographics sheet; (d) a Views About Mathematics questionnaire (Kloosterman & Stage, 1992); and (e) a filler task (comprehension passages). The filler task was included in order to keep students who finished early occupied. The packet took approximately 25 minutes to complete. All participants received the items in the order listed above. It seemed more logical to progress from an epistemological beliefs questionnaire that was general to a more specific questionnaire that assessed beliefs about mathematics. The packets were coded by copying the filler task onto a distinct color of paper (yellow for Newton High School and purple for Berean Academy High School) so that data from each school could be separated for data analyses as well as for giving schools their own information derived from the questionnaires.

Epistemological Beliefs Questionnaire. The 30-item epistemological beliefs questionnaire used in this study entitled Attitudes About Education was developed by Schommer for use with middle school students (Schommer et al., 1999). In this study, two items were added to assess student cooperation which stated, "Please leave this line blank and go on to number..." (next item). The 30-item Attitudes About Education epistemological beliefs questionnaire was modeled after Schommer's 63-item epistemological beliefs questionnaire (1990) and written to measure these four epistemological belief factors: the Ability to Learn (ranging from the belief that ability is fixed at birth to the belief that ability can be improved over time), the Structure of Knowledge (ranging from the belief that knowledge is simple and organized as isolated bits of information, to the belief that knowledge is complex and organized as highly integrated concepts), the Speed of Learning (ranging from the belief that knowledge is

acquired quickly or not-at-all, to the belief that knowledge is acquired gradually), and the Stability of Knowledge (ranging from the belief that knowledge is absolute to the belief that knowledge is tentative).

The 30-item Attitudes About Education epistemological beliefs questionnaire was used in this research to determine whether it would result in findings consistent with those obtained with Schommer's 63-item epistemological beliefs questionnaire (1990). Schommer (1993b) found that high school students indicate four factors of personal epistemology: the Ability to Learn, the Structure of Knowledge, the Speed of Learning, and the Stability of Knowledge. She also found that all factors of personal epistemology predicted grade point averages, especially beliefs about the Speed of Learning. However, when middle school students completed the 30-item Attitudes About Education epistemological beliefs questionnaire, only three factors were found. The Structure of Knowledge factor was absent (Schommer et al., 1999). In addition, these three factors were found to correlate with each other. As a result of these findings, it was postulated that personal epistemology is developmental in nature and that epistemological beliefs for middle school students focus more on concrete concepts rather than abstract concepts.

Therefore, in this study the 30-item Attitudes About Education epistemological beliefs questionnaire was used not only to confirm previous findings that high school students have a four-factor epistemological belief structure but also to confirm that the questionnaire was capable of detecting all four factors. If the questionnaire elicited four factors with high school students then the findings of a three-factor structure among middle school

students would be more distinct. It would further point to the possibility of a developmental issue among middle school students and their personal epistemology.

The 30-item Attitudes About Education epistemological beliefs questionnaire is designed so that students respond using a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). It contains an equal number of positively and negatively posed statements with the expectation of agreement or disagreement from a less epistemologically developed perspective. For example, students who respond with more agreement to the statement "It is hard to learn from a textbook unless you start at the beginning and learn one chapter at a time" would have stronger beliefs in simple knowledge. Students who respond with more disagreement to the statement "If I can't understand something right away, I will keep on trying" would have stronger beliefs in quick, all-or-none learning. Table 1 lists the 30 items on the Attitudes about Education epistemological beliefs questionnaire. The items are organized according to the four-factor structure found for high school and college students. Cronbach alpha reliability data were not reported in the Schommer et al. (1999) study for the 30-item Attitudes About Education epistemological beliefs questionnaire.

Mathematics Belief Questionnaire. Although not a significant part of this study, the mathematics belief questionnaire entitled Views about Math was included for a twofold purpose. One purpose was to give the cooperating schools additional information about their students' beliefs about math and second, these data will be used in larger research analyses. With this additional information, teachers in both schools may be more able to influence students towards mathematics motivation and success. This 36-

Table 1

Attitudes About Education Questionnaire Items

Epistemological Belief	Valence	Item	Item no.
Ability to Learn	+	Some people are just born smart, others are born dumb.	6
	-	What students learn from a textbook depends on how they study it.	8
	-	A class in study skills would probably help slow learners.	12
	+	Working hard on a difficult problem only pays off for the really smart students.	15
	+	An expert is someone who is really born smart in something.	16
	+	The really smart students don't have to work hard to do well in school.	26
	+	Students who are "average" in school will remain "average" for the rest of their lives.	29
	-	Getting ahead takes a lot of work.	31

(table continues)

Table 1 (continued)

Epistemological Belief	Valence	Item	Item no.
Ability to Learn	-	The knowledge of "how to study" is usually learned as we grow older.	32
Speed of Learning	-	If I can't understand something right away, I will keep on trying.	2
	+	You cannot learn anything more from a textbook by reading it twice.	9
	-	Learning something really well takes a long time.	13
	+	Successful students understand things quickly.	17
	+	If I cannot understand something quickly, it usually means I will never understand it.	19
	+	If I am ever going to be able to understand something, it will make sense to me the first time I hear it.	23
	+	If I find the time to re-read a textbook chapter, I get a lot more out of it the second time.	28

(table continues)

Table 1 (continued)

Epistemological Belief	Valence	Item	Item no.
Stability of Knowledge	+	I can depend on facts written in my school books for the rest of my life.	11
	+	Scientists can get to the truth if they just keep searching for it.	20
	-	Today's facts may be tomorrow's fiction.	24
	-	The only thing you can be sure of, is that nothing is sure.	27
	+	If scientists try hard enough, they can find the truth to almost everything.	30
Structure of Knowledge	+	It is hard to learn from a textbook unless you start at the beginning and learn one chapter at a time.	1
	+	The best thing about a science course is that most problems have only one right answer.	3
	+	You will get mixed-up if you try to combine new ideas in a textbook with what you already know.	4

(table continues)

Table 1 (continued)

Epistemological Belief	Valence	Item	Item no.
Structure of Knowledge	-	I like it when experts disagree.	5
	+	Being a good student generally involves memorizing facts.	7
	-	Thinking about what a textbook says is more important than memorizing what a textbook says.	14
	+	I really do not like listening to teachers who cannot seem to make up their minds as to what they really believe.	18
	+	Most words have one clear meaning.	21
	-	To me studying means getting the big ideas from the textbook, rather than the details.	25

Note. Positive and negative valences indicate the presumed agreement or disagreement to the item from the perspective of a less epistemologically developed student.

item questionnaire was originally entitled Indiana Mathematics Belief Scales (Kloosterman & Stage, 1992). In this study, two additional items were added

to assess student cooperation. The Views About Math questionnaire was developed for use with secondary school and college students and was designed to assess beliefs about mathematics as a subject and about how mathematics is learned. The questionnaire assesses six beliefs which include: (a) "I can solve time-consuming mathematics problems" (students with no motivation to solve problems that they cannot solve quickly will eventually have difficulty in higher level mathematics courses); (b) "There are word problems that cannot be solved with simple, step-by-step procedures" (if students believe this they will stay motivated to finish the word problem using common sense rather than trying to apply a rule); (c) "Understanding concepts is important in mathematics" (students who believe that mathematics is simply a memorizing of procedures are destined to fail when memorizing discreet bits of information will no longer work as mathematics gets more complicated); (d) "Word problems are important in mathematics" (in college and real life situations, ability to work through word problems is important and therefore this item assesses students' beliefs about whether word problems are more important than computation); (e) "Effort can increase mathematical ability" (students who feel that they can improve their mathematical ability will be more motivated to study to increase their problem-solving skills); and (f) "Mathematics is useful in daily life." Kloosterman and Stage hypothesize that beliefs about mathematics directly influence motivation which is a key factor for success in mathematics.

Students respond using a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). There are six statements for assessing each belief and all but "Effort can increase mathematical ability" contain an equal number of positively and negatively posed statements with the expectation of

agreement or disagreement from a more developed perspective. "Effort can increase mathematical ability" contains statements that are all positively posed. For example, students who respond with more agreement to the statement "Math problems that take a long time don't bother me" would more strongly believe that they can solve time-consuming mathematics problems. Students who respond with more disagreement to the statement "Math classes should not emphasize word problems" would more strongly believe that word problems are important in mathematics. Cronbach alpha reliability data reported for the Views About Math questionnaire ranged from .54 to .84 (Kloosterman & Stage, 1992). See Table 2 for a list of the 36 items on the Views About Math questionnaire, organized according to the six separate beliefs.

Procedure

In each school, the data from the questionnaires were collected in one day. To standardize the administration, teachers were given a sheet of paper that contained explicit instructions (see Appendix B). At Newton High School, during a class period known as seminar period, the packets were administered by teachers to the entire student body at one time. This period was originally designed as a study period and as a period in which other necessary functions could occur, such as assemblies. Therefore, the students completed the packets during a period in which teachers did not lose class time. At Berean Academy High School, due to the nature of the smaller, private school, two teachers were responsible for administering the packet throughout the day in their own classes until the entire high school body had

Table 2

Views About Math Questionnaire Items

Mathematics Belief	Valence	Item	Item no.
I can solve time-consuming mathematics problems.	+	Math problems that take a long time don't bother me.	5
	-	If I can't solve a math problem quickly, I quit trying.	10
	-	If I can't do a math problem in a few minutes, I probably can't do it at all.	15
	+	I feel I can do math problems that take a long time to complete.	25
	+	I find I can do hard math problems if I just hang in there.	30
	-	I'm not very good at solving math problems that take a while to figure out.	37
There are word problems that cannot be solved with simple, step-by-step procedures.	-	Learning to do word problems is mostly a matter of memorizing the right steps to follow.	1

(table continues)

Table 2 (continued)

Mathematics Belief	Valence	Item	Item no.
There are word problems that cannot be solved with simple, step-by-step procedures.	+	There are word problems that just can't be solved by following a pre-determined sequence of steps.	7
	+	Memorizing steps is not that useful for learning to solve word problems.	16
	-	Most word problems can be solved by using the correct step-by-step procedure.	22
	+	Word problems can be solved without remembering formulas.	28
	-	Any word problem can be solved if you know the right steps to follow.	33
Understanding concepts is important in mathematics.	-	It doesn't really matter if you understand a math problem if you can get the right answer.	2
	+	Time used to investigate why a solution to a math problem works is time well spent.	8

(table continues)

Table 2 (continued)

Mathematics Belief	Valence	Item	Item no.
Understanding concepts is important in mathematics.	-	Getting a right answer in math is more important than understanding why the answer works.	17
	+	In addition to getting a right answer in mathematics, it is important to understand why the answer is correct.	23
	-	It's not important to understand why a mathematical procedure works as long as it gives a correct answer.	34
	+	A person who doesn't understand why an answer to a math problem is correct hasn't really solved the problem.	35
Word problems are important in mathematics.	-	Word problems are not a very important part of mathematics.	3
	+	A person who can't solve word problems really can't do math.	11
	+	Computational skills are useless if you can't apply them to real life situations.	19

(table continues)

Table 2 (continued)

Mathematics Belief	Valence	Item	Item no.
Word problems are important in mathematics.	-	Math classes should not emphasize word problems.	21
	-	Learning computational skills is more important than learning to solve word problems.	26
	+	Computational skills are of little value if you can't use them to solve word problems.	31
Effort can increase mathematical ability.	+	By trying hard, one can become smarter in math.	4
	+	Hard work can increase one's ability to do math.	12
	+	I can get smarter in math by trying hard.	18
	+	Ability in math increases when one studies hard.	32
	+	Working can improve one's ability in mathematics.	38
	+	I can get smarter in math if I try hard.	24

(table continues)

Table 2 (continued)

Mathematics Belief	Valence	Item	Item no.
Mathematics is useful in daily life.	+	I study mathematics because I know how useful it is.	6
	-	Mathematics is of no relevance to my life.	9
	+	Mathematics is a worthwhile and necessary subject.	14
	-	Mathematics will not be important to me in my life's work.	20
	+	Knowing mathematics will help me earn a living.	29
	-	Studying mathematics is a waste of time.	36

Note. Positive and negative valences indicate the presumed agreement or disagreement to the item from the perspective of a more epistemologically developed student.

participated. At Berean Academy High School, the research was administered during the week known as buffer week; the week between athletic seasons in which no athletic practices or games were held.

Grade point averages were obtained at each school in order to closely replicate Schommer's previous study (1993b) which involved the 63-item epistemological beliefs questionnaire and high school students. Once the data from the surveys were connected with individual grade point averages, all information that could identify the participant was removed.

Because all participants were minors, preliminary measures were taken to ensure parental permission. A statement was published in newsletters at each school which announced that this research was going to take place. Parents were given the option of calling the school if they had questions or if they did not want their child to participate. At Berean Academy High School the following statement was given to the school to be published in the October 1999 parent newsletter:

> "During the second week of November, a former Berean Academy student will be presenting two questionnaires to the high school student body in partial fulfillment of a master's degree in education. The questionnaires assess students' attitudes about math and learning in general. Grade point averages will also be collected. All information will be kept confidential. If you have any questions or would not like your student to participate, please contact...before..."

At Newton High School the following statement was given to the school to be published in the November 1999 parent newsletter:

> "During the month of November, a Wichita State University graduate student will be presenting two questionnaires to the student body. The questionnaires assess information regarding attitudes about learning in general and attitudes about math. Grade point averages will also be

collected. All information gathered will be kept confidential. If you have any questions or would not like your son or daughter to participate, please contact...by..."

After these statements were published, no negative responses were received. At Newton High School, upon recommendation from the school principal to further inform students as well as elicit more enthusiasm, the following statement was given to the school to be published in the student newsletter:

> "Coming this November, students at Newton High School will have the opportunity to be a part of educational research. Robyn Walter, a graduate student at Wichita State University, will be surveying students' attitudes about learning and math. The more teachers and educators understand how students think and feel, the better teachers they can become. Packets that include two surveys will be distributed during the seminar period on ... and will take approximately 25 minutes to complete."

Each of these statements were published with minor editing. Information gathered regarding students' beliefs about education and students' views about mathematics was compiled and given to each school.

Analyses

Utilizing the computer program SPSS (1999), exploratory factor analysis was used to determine if the four-factor epistemological belief structure (the Ability to Learn, the Structure of Knowledge, the Speed of Learning, and the Stability of Knowledge) found among high school students was replicated with the 30-item Attitudes About Education epistemological beliefs questionnaire. In order to determine if epistemological beliefs predicted grade point averages, stepwise regression was carried out. Students' grade point

averages were regressed on the four epistemological belief factors, gender, and grade level. The variable accounting for the most variance entered at each step of the analysis.

CHAPTER FOUR

Results

The results of these data analyses are presented in this chapter. The two main questions in these analyses were: (a) Does the 30-item epistemological beliefs questionnaire entitled Attitudes About Education (Schommer et al., 1999) generate a four-factor epistemological belief structure similar to the four-factor structure found with Schommer's 63-item epistemological beliefs questionnaire?; and (b) Will epistemological belief factors generated from the 30-item Attitudes About Education questionnaire predict students' grade point averages (GPA)? The four epistemological belief factors found with Schommer's 63-item epistemological beliefs questionnaire (Bendixen et al., 1994; Schommer, 1990, 1993b; Schommer et al., 1992) were: the Ability to Learn (ranging from the belief that ability is fixed at birth to the belief that ability can be improved over time), the Structure of Knowledge (ranging from the belief that knowledge is simple and organized as isolated bits of information, to the belief that knowledge is complex and organized as highly integrated concepts), the Speed of Learning (ranging from the belief that knowledge is acquired quickly or not-at-all, to the belief that knowledge is acquired gradually), and the Stability of Knowledge (ranging from the belief that knowledge is absolute to the belief that knowledge is tentative). Within that study, Schommer also found that all four factors predicted grade point averages, with the strongest predictor being beliefs about the Speed of Learning.

Four-Factor Structure

To determine whether these two main questions were supported, the data were analyzed in four phases. The purpose of the first phase was to

examine the items for skewness and range of response. In order for an item to be informative, some students should respond to each possible choice and furthermore, no items should be highly skewed. Descriptive statistics for all of the items revealed that responses covered the full range (one through five) and the majority of the items were not skewed (skewness less than 1.0). Therefore, no items were eliminated at this point in the analyses. Table 3 provides the descriptive statistics for each item in the 30-item epistemological beliefs questionnaire. As noted previously, items 10 and 22 were added to assess students' cooperation and therefore no data are recorded for these items.

The purpose of the second phase of these analyses was to test the hypothesis that a four-factor structure would be found with the 30-item Attitudes About Education epistemological beliefs questionnaire. Exploratory factor analysis was conducted with varimax rotation to determine the factor structures. Varimax rotation assumes that the factors are not correlated and therefore demonstrates the most distinct aspects of each factor. An eigenvalue of 1.0 was used as the cutoff which resulted in a nine-factor solution. Examination of the extraction sums of squared loadings and the scree plot indicated that between three to four factors accounted for the most variance. Three factors accounted for 27.58% of the variance and four factors accounted for 32.65% of the variance.

In order to determine that varimax rotation was the best choice in determining factor structure, an exploratory factor analysis was run using an oblique rotation. An oblique rotation assumes factors are correlated. This analysis failed to converge in 25 iterations. This suggested that the data were

Table 3

Descriptive Statistics for Each Item in the 30-item Epistemological Beliefs Questionnaire

Item	N	M	SD	Skewness
1	898	3.06	1.13	-0.09
2	901	3.97	0.96	-0.88
3	899	2.88	1.11	0.00
4	900	2.75	1.20	0.14
5	900	3.05	1.09	-0.06
6	899	2.46	1.39	0.49
7	898	3.35	1.22	-0.38
8	897	3.95	0.96	-0.96
9	897	2.08	1.12	0.98
10	--	--	--	--
11	897	2.41	1.10	0.43
12	896	3.47	1.03	-0.56
13	897	3.22	1.07	-0.14
14	895	3.92	1.01	-0.77
15	894	1.99	1.09	1.04
16	895	1.97	1.13	1.11
17	892	2.84	1.16	0.09
18	894	3.91	1.14	-0.83

(table continues)

Table 3 (continued)

Item	N	M	SD	Skewness
19	893	1.97	1.00	0.99
20	893	3.75	1.11	-0.74
21	893	2.65	1.11	0.19
22	--	--	--	--
23	892	2.18	1.03	0.70
24	893	3.61	1.07	-0.54
25	892	2.95	1.07	0.00
26	893	2.61	1.34	0.34
27	891	3.19	1.17	-0.19
28	893	3.77	1.09	-0.80
29	893	2.04	1.10	1.03
30	893	3.32	1.17	-0.32
31	893	4.13	0.95	-1.15
32	892	3.70	0.99	-0.56

Note. Dashes indicate the items that were included to assess student cooperation.

not consistent with correlated factor scores, that is, it was inappropriate to assume that these factors were correlated and varimax rotation was the solution to use.

In order to determine whether the three-factor or four-factor solution was best, exploratory factor analyses were conducted twice, one that forced a three-factor solution and one that forced a four-factor solution. Careful examination of factor loadings indicated that the four-factor solution provided the factors that were the most logical conceptually. See Table 4 for the factor loadings for the four-factor solution and Table 5 for the factor loadings for the three-factor solution. Items that are reverse scored are followed by an upper case R.

Table 4

Factor Loadings for the Four-Factor Solution

		Factor			
Item no.	Item	1	2	3	4
15.	Working hard on a difficult problem only pays off for the really smart students.	0.62			
19.	If I cannot understand something quickly, it usually means I will never understand it.	0.60			
16.	An expert is someone who is really born smart in something.	0.57			
6.	Some people are just born smart, others are born dumb.	0.53			

(table continues)

Table 4 (continued)

Item no.	Item	Factor 1	2	3	4
17.	Successful students understand things quickly.	0.47			
29.	Students who are "average" in school will remain "average" for the rest of their lives.	0.47			
23.	If I am ever going to be able to understand something, it will make sense to me the first time I hear it.	0.47			
26.	The really smart students don't have to work hard to do well in school.	0.45			
9.	You cannot learn anything more from a textbook by reading it twice.	0.40			
2R.	If I can't understand something right away, I will keep on trying.	0.40			
28R.	If I find the time to re-read a textbook chapter, I get a lot more out of it the second time.		0.48		
8R.	What students learn from a textbook depends on how they study it.		0.44		

(table continues)

Table 4 (continued)

Item no.	Item	Factor 1	Factor 2	Factor 3	Factor 4
12R.	A class in study skills would probably help slow learners.		0.42		
7.	Being a good student generally involves memorizing facts.		-0.35		
20.	Scientists can get to the truth if they just keep searching for it.			0.65	
30.	If scientists try hard enough, they can find the truth to almost everything.			0.63	
21.	Most words have one clear meaning.			0.27	
24R.	Today's facts may be tomorrow's fiction.				0.47
27R.	The only thing you can be sure of, is that nothing is sure.				0.36
14R.	Thinking about what a textbook says is more important than memorizing what a textbook says.				0.34
5R.	I like it when experts disagree.				0.30
11.	I can depend on the facts written in my school books for the rest of my life.				0.26

(table continues)

Table 4 (continued)

Item no.	Item	Factor 1	2	3	4
18.	I really do not like listening to teachers who cannot seem to make up their minds as to what they believe.				-0.23

Note. The letter R in the Item no. refers to the item scores that were reversed.

Table 5

Factor Loadings for the Three-Factor Solution

Item no.	Item	Factor 1	2	3
15.	Working hard on a difficult problem only pays off for the really smart students.	0.62		
19.	If I cannot understand something quickly, it usually means I will never understand it.	0.61		
16.	An expert is someone who is really born smart in something.	0.56		
6.	Some people are just born smart, others are born dumb.	0.52		

(table continues)

Table 5 (continued)

Item no.	Item	Factor 1	Factor 2	Factor 3
23.	If I am ever going to be able to understand something, it will make sense to me the first time I hear it.	0.47		
29.	Students who are "average" in school will remain "average" for the rest of their lives.	0.47		
17.	Successful students understand things quickly.	0.46		
26.	The really smart students don't have to work hard to do well in school.	0.43		
9.	You cannot learn anything more from a textbook by reading it twice.	0.41		
2R.	If I can't understand something right away, I will keep on trying.	0.41		
28R.	If I find the time to re-read a textbook chapter, I get a lot more out of it the second time.		0.50	
20.	Scientists can get to the truth if they just keep searching for it.		-0.47	
30.	If scientists try hard enough, they can find the truth to almost everything.		-0.42	

(table continues)

Table 5 (continued)

Item no.	Item	Factor 1	Factor 2	Factor 3
8R.	What students learn from a textbook depends on how they study it.		0.39	
21.	Most words have one clear meaning.		-0.36	
12R.	A class in study skills would probably help slow learners.		0.34	
24R.	Today's facts may be tomorrow's fiction.			0.45
14R.	Thinking about what a textbook says is more important than memorizing what a textbook says.			0.35
5R.	I like it when experts disagree.			0.31

Note. The letter R in the Item no. refers to the item scores that were reversed.

The purpose of the third phase of these analyses was to examine the items within the four-factor solution for internal consistency using Cronbach's alpha scale. Factor one retained all ten items and resulted in an alpha of .76. Factor two originally contained four items but one item (item number 7) was eliminated which resulted in a Cronbach alpha of .47. Factor three was composed of three items and had a Cronbach alpha of .55. Factor four originally had six items, but one item was eliminated (item number 18) and the resulting Cronbach alpha was .40. These four factors were then

assigned shortened titles based upon the items within each factor. These titles include the following: Learning Rate and Ability (ranging from the belief that the ability to learn is a natural ability hallmarked by quick learning to the belief that the ability to learn is acquired over time and the learning process is not always quick), Utility of Study Skills (ranging from the belief that study skills are not useful to the belief that study skills are useful), Structure of Truth (ranging from the belief that there is a single truth found by experts to the belief that there is a multifaceted truth found by experts), and Stability of Knowledge (ranging from the belief that knowledge is unchanging and unambiguous to the belief that knowledge is changing and ambiguous). Table 6 lists the Cronbach alpha for each factor.

Table 6

Reliability Analysis: Cronbach's Alpha Scale

Factor	Cronbach's Alpha	No. of items
1: Learning Rate and Ability	0.76	10
2: Utility of Study Skills	0.47	3
3: Structure of Truth	0.55	3
4: Stability of Knowledge	0.40	5

Factor Structure Comparisons

In order to compare the factor structures for the high school and middle school, data comparisons can be made on the number of factors that emerged from the analysis, the items that remained in the entire analysis, and how the items were distributed among the factors. These comparisons are displayed visually in Table 7. There were four factors that emerged in the high school analysis compared to the three factors in the middle school analysis. All items that were present in the middle school final analysis were also included in the final analysis of the high school data. There was a remarkable similarity in how items were distributed as rank ordered by factor loadings and factor order, with the exception that the first two factors of the middle school data were represented as the first factor in the high school data.

Prediction of GPA

The purpose of the fourth phase of these analyses was to determine if epistemological beliefs as assessed by the 30-item Attitudes About Education epistemological beliefs questionnaire predicted students' academic success as measured by GPA. There were two possibilities for measuring GPA. One possibility was the present GPA, which at the time the survey was given was the GPA for the first nine weeks of school for all of the students in the analysis. The second possibility was the cumulative GPA. Although the cumulative GPA seemed to be a broader assessment of student academic performance, the GPA at each progressive grade level was calculated on progressively more information. The freshmen GPA was made up of nine weeks, the sophomores' cumulative GPA was made up of one school year and nine weeks, the juniors' cumulative GPA was made up of two school years and nine weeks, and the seniors' cumulative GPA was made up of

Table 7

Comparing the Factor Structures From the High School and Middle School Data

High School	Middle School		
	Rank Order of Items		
Item no.	by Factor Loadings		
Factor 1	Factor 1	Factor 2	Factor 3
15		1	
19	1		
16		2	
6		3	
17			
29		5	
23	2		
26		4	
9	3		
2R	4		
Factor 3			
20			1
30			2

three years and nine weeks, or more if the student was retained. It seemed that the present GPA was a more comparable measure of academic success for

students across grade levels. Also, if epistemological beliefs change as students develop, present GPA is more apt to match present beliefs.

Nevertheless, separate tests were run for each GPA measure using GPA as the dependent measure and allowing for six predictor variables to compete for entry in stepwise regression. By stepwise regression, it is meant that the factor that accounted for the most variance entered the equation first, the factor that accounted for the next most variance entered the equation next, and so on. The factors that were included as predictor variables were gender, grade classification, and the four epistemological belief factors. Scores for epistemological belief factors were calculated by summing the items composing each factor and dividing by the total number of items.

There was a total of 826 students that had given complete information for the epistemological beliefs questionnaire, gender, and grade classification. Furthermore grade point averages were obtained from student records. These data were used in the regression analyses. With present GPA as the dependent measure, five predictor variables were significant. The first variable to enter was Learning Rate and Ability, the second was gender, the third was grade classification, the fourth was Structure of Truth, and the fifth was Utility of Study Skills. See Table 8 for summary of regression results using the present GPA. A total of 14% of the variance was accounted for and the essence of these results were: the more students believed that the ability to learn is a natural ability hallmarked by quick learning, that there is a single truth found by experts, and that study skills are not useful, the more likely they were to earn low GPAs. Furthermore, girls outperformed boys and

Table 8

Regression with Present Grade Point Average

Predictor Variable	b weight	R Square Change	F Change	df1	df2
Factor 1: Learning Rate and Ability	-0.37	0.08	75.12**	1	824
Gender	-0.25	0.02	19.81**	1	823
Grade Classification	0.11	0.02	18.90**	1	822
Factor 3: Structure of Truth	-0.06	0.01	4.74*	1	821
Factor 2: Utility of Study Skills	-0.09	0.01	5.39*	1	820

*$p < .05$. **$p < .01$.

students in higher grades were doing better than students in lower grades. Table 9 details the descriptive statistics for the predictor variables in this regression analysis.

A second multiple regression analysis was run using the same six predictor variables with cumulative GPA as the dependent measure. Four variables entered the equation: Learning Rate and Ability, gender, Structure of Truth, and grade classification. A total of 8% of the variance was accounted for. These results were similar to the first regression with the exception that

Table 9

Descriptive Statistics for the Predictor Variables in the Regression Analysis Using Present Grade Point Average

Predictor Variable	M	SD	N
Factor 1: Learning Rate and Ability	2.21	0.65	826
Gender	1.44	0.50	826
Grade Classification	2.35	1.11	826
Factor 3: Structure of Truth	3.55	0.99	826
Factor 2: Utility of Study Skills	2.26	0.71	826

Utility of Study Skills was not significant. See Table 10 for summary of regression results using the cumulative GPA and Table 11 for descriptive statistics for the predictor variables in this regression analysis.

In summary, the questionnaire items were thoroughly examined for acceptable minimum and maximum scores and skewness. For each item, students answered in full range and the skewness of the items was acceptable. Second, the underlying epistemological belief factors were examined using exploratory factor analysis with varimax rotation. Eigenvalues initially suggested nine factors but deeper analysis including use of the scree plot suggested three to four factors. Rotated factor matrices for both the three- and

Table 10

Regression with Cumulative Grade Point Average

Predictor Variable	b weight	R Square Change	F Change	df1	df2
Factor 1: Learning Rate and Ability	-0.30	0.06	50.89**	1	827
Gender	-0.19	0.01	12.10**	1	826
Factor 3: Structure of Truth	-0.08	0.01	9.32**	1	825
Grade Classification	0.05	0.00	3.98*	1	824

*$p < .05$. **$p < .01$.

Table 11

Descriptive Statistics for the Predictor Variables in the Regression Analysis Using Cumulative Grade Point Average

Predictor Variable	M	SD	N
Factor 1: Learning Rate and Ability	2.21	0.65	829
Gender	1.44	0.50	829

(table continues)

Table 11 (continued)

Predictor Variable	M	SD	N
Factor 3: Structure of Truth	3.55	0.99	829
Grade Classification	2.35	1.11	829

four-factor solutions were examined. The four-factor solution contained items that were the most logical conceptually, therefore, it was determined to be the most appropriate. Within the third phase of these analyses, every item that was included in the four-factor solution was examined for internal reliability using Cronbach's alpha scale. Only a few items were eliminated. Data comparisons were made between the high school and middle school factor structures. Finally, stepwise regression was used to determine which variables predicted academic success as measured by grade point average. In both regression analyses Learning Rate and Ability, Structure of Truth, gender, and grade classification predicted GPA. In addition for one regression analysis, Utility of Study Skills predicted GPA as well.

CHAPTER FIVE

Discussion

Summary

The purpose of this study was to investigate whether the shortened and revised 30-item epistemological beliefs questionnaire entitled Attitudes About Education designed by Schommer (Schommer et al., 1999) had similar psychometric qualities compared to the original 63-item epistemological beliefs questionnaire (Schommer, 1990). In this study the 30-item epistemological beliefs questionnaire was one part of a survey packet given to 901 students from two Midwestern high schools. Included in the survey packet was a demographics page that asked for information about gender, age, and ethnicity and a mathematics beliefs scale entitled Views About Math (Kloosterman & Stage, 1992) which gathered additional information. Both present and cumulative grade point averages were obtained for all students. Data analyses were conducted using exploratory factor analysis with varimax rotation to determine the factor structure of the questionnaire. Multiple regression analyses were carried out to determine whether academic success measured through grade point average was predictable.

Conclusions

Based on a review of the literature (Chapter Two), it was hypothesized that the 30-item Attitudes About Education epistemological beliefs questionnaire would measure a four-factor epistemological beliefs structure, the factor structure would be different than the three-factor structure found with middle school students, and the epistemological factors would predict students' grade point averages. The results largely supported these expectations.

Before the main analyses were conducted on the data acquired from the Attitudes About Education epistemological beliefs questionnaire, individual items were evaluated for psychometric standards. It was found that for each of the items, student responses covered the entire possible range from one (strongly disagree) to five (strongly agree). The majority of the items also maintained a low level of skewness. It was concluded that no items solicited obvious responses.

Through use of exploratory factor analysis, data gathered from the 30-item Attitudes About Education questionnaire elicited a four-factor solution. The varimax rotation option was implemented. This was based on the assumption that the factors were not correlated with each other. Results of this analysis indicated each factor in the solution was distinct from each other; the loadings were not shared among factors. The oblique rotation option was attempted but the test would not run because there were no correlations among factors. These findings further supported the notion that epistemological beliefs are independent from each other and personal epistemology is multidimensional.

In order to examine the internal consistency among items that composed each factor, a series of Cronbach alphas were calculated. Only two items were removed in order to improve internal consistency. Reliability scores for the items that made up the four-factor solution ranged from .40 to .76.

Factor structure comparisons were made between the high school data and previously collected middle school data. Differences were found in the

number of factors that emerged from the analyses and similarities were found in the number of items that remained useful and how the items were distributed among the factors.

Stepwise regression analyses were carried out to determine if epistemological belief factors predict grade point averages (GPA). In addition to demographic variables, three of the four epistemological belief factors predicted GPA, Learning Rate and Ability, Structure of Truth, and Utility of Study Skills.

Discussion

As was hypothesized, the data gathered from a high school population using the 30-item Attitudes About Education epistemological beliefs questionnaire elicited a four-factor structure of personal epistemology. These findings were comparable to those from a previous study in which the original 63-item epistemological beliefs questionnaire was used to survey high school students (Schommer, 1993b). In the previous study, the four factors accounted for 55.2% of the variance and in the study being reported, the four factors accounted for 33% of the variance. The factors found in the study involving the longer version of the questionnaire were more concisely constructed. The original questionnaire measured these four factors, listed in order of loadings: the Ability to Learn (ranging from the belief that ability is fixed at birth to the belief that ability can be improved over time), the Structure of Knowledge (ranging from the belief that knowledge is simple and organized as isolated bits of information, to the belief that knowledge is complex and organized as highly integrated concepts), the Speed of Learning (ranging from the belief that knowledge is acquired quickly or not-at-all, to the belief that knowledge is acquired gradually), and the Stability of

Knowledge (ranging from the belief that knowledge is absolute to the belief that knowledge is tentative) (Bendixen et al., 1994; Schommer, 1990, 1993b; Schommer et al., 1992). In this study, the 30-item epistemological beliefs questionnaire measured these four factors, listed in order of loadings: Learning Rate and Ability (ranging from the belief that the ability to learn is a natural ability hallmarked by quick learning to the belief that the ability to learn is acquired over time and the learning process is not always quick), Utility of Study Skills (ranging from the belief that study skills are not useful to the belief that study skills are useful), Structure of Truth (ranging from the belief that there is a single truth found by experts to the belief that there is a multifaceted truth found by experts), and Stability of Knowledge (ranging from the belief that knowledge is unchanging and unambiguous to the belief that knowledge is changing and ambiguous).

A closer examination of the factors elicited from the 30-item epistemological beliefs questionnaire suggested that each factor contained characteristics of several factors from the original version. For example, the factor entitled Learning Rate and Ability was quite similar to the Ability to Learn factor but included a portion of the epistemological belief factor found in studies involving the 63-item epistemological questionnaire called Speed of Learning. Examples of items that composed the Learning Rate and Ability factor are: (a) "Working hard on a difficult problem only pays off for the really smart students" (item number 15); and (b) "Some people are just born smart, others are born dumb" (item number 6). These two items were included in the original Ability to Learn factor. An item included in the Learning Rate

and Ability factor that was originally included in the Speed of Learning factor was item number 19: "If I cannot understand something quickly, it usually means I will never understand it."

The second factor entitled Utility of Study Skills was somewhat analogous to the Speed of Learning factor. The highest loading for the Utility of Study Skills factor was item number 28: "If I find the time to re-read a textbook chapter, I get a lot more out of it the second time." Although this was considered an item within the Speed of Learning subset from the original 63-item epistemological beliefs questionnaire, it referred to rereading a textbook chapter which is often a study skill taught in the classroom. The remaining items within this factor strictly focused on the use of study strategies or skills. For example, item number 8: "What students learn from a textbook depends on how they study it."

The third factor entitled Structure of Truth was similar to the Structure of Knowledge factor but also drew characteristics from the Stability of Knowledge factor from the original 63-item epistemological beliefs questionnaire. For example, item number 21, which states "Most words have one clear meaning," was an explicit example of beliefs about a simple truth and was originally included in the Structure of Knowledge factor. On the other hand, item number 20, "Scientists can get to the truth if they just keep searching for it," was an item within the original Stability of Knowledge factor.

The fourth factor entitled Stability of Knowledge was quite similar to the original Stability of Knowledge factor although characteristics were taken from the Structure of Knowledge factor. An item included in this factor was number 24, "Today's facts may be tomorrow's fiction," which measures

beliefs about the uncertainty of knowledge. Also included in this factor was item number 5, "I like it when experts disagree," which measures beliefs about the Structure of Knowledge.

Not only were the results of this study compared with the results from the previous high school study (Schommer, 1993b), but this study was also compared to the Schommer et al. (1999) study in which middle school students were surveyed with the 30-item epistemological beliefs questionnaire. The data from the survey of the middle school students revealed a three-factor solution. This was found through confirmatory factor analysis which assumes that the items will only load on the factors that they were designed to indicate. This three-factor structure included, listed in order of loadings: Speed of Learning, Ability to Learn, and the Stability of Knowledge. The factor, Structure of Knowledge, was absent. A comparison was made as to what items were included for both high school and middle school students. It was noted that all nine items included in the first two factors in the middle school study (Speed of Learning and Ability to Learn) were included in the first factor (Learning Rate and Ability) of this study. Although this may suggest that the high school students' personal epistemology had converged, it must be noted that in the middle school study, the two factors (Speed of Learning and Ability to Learn) were highly correlated (greater than .80). Furthermore, it should be noted that confirmatory factor analysis was used in the middle school study which imposes items onto a factor. If exploratory factor analysis had been done, these items may have merged as they did in the data from the high school students.

Another interesting comparison between the high school and middle school data is how many items remained in the analyses. Of the original thirty items in the shortened questionnaire, eleven of the items remained useful for the middle school students, whereas twenty-three items were useful for the high school students. Furthermore, another interesting occurrence was the comparison of the items that failed to load on any factor in this study. Of the seven items that did not load, six of them also did not load for the middle school students. It appears that there is a clear pattern and consistency of the items. Further research among college students with the 30-item Attitudes About Education epistemological beliefs questionnaire would be beneficial. If all items would be useful for the college students, it would further confirm that the 30-item epistemological beliefs questionnaire captures the epistemological beliefs it was designed to measure.

In order to further test the integrity of the 30-item epistemological belief instrument, its predictive validity was examined. Previously, all four epistemological belief factors found using the 63-item epistemological beliefs questionnaire predicted GPA for high school students (Schommer, 1993b). In that study the factors listed by order of entry were: Speed of Learning, the Structure of Knowledge, the Stability of Knowledge, and Ability to Learn. The factors found to predict GPA in this study were Learning Rate and Ability, Structure of Truth, and Utility of Study Skills. Because the factors found in the shortened version included characteristics from all four factors from the previous study, the findings from each study are not necessarily contradictory. Other variables that predicted GPA in this study were gender and grade classification. Girls outperformed boys and students in higher grades did better than students in lower grades.

The evidence continues to implicate the important role that epistemological beliefs may have on learning. With this new evidence, the finding that epistemological beliefs predict GPA is apparent from middle school through college. This would suggest that at no time during one's education should epistemological beliefs be ignored.

Implications

The purpose of this study was to determine if the 30-item epistemological beliefs questionnaire entitled Attitudes about Education elicited results similar to those from the original 63-item epistemological beliefs questionnaire. This research was prompted by the results, conclusions, and hypotheses drawn in the Schommer et al. (1999) study of middle school students in which this tool was used for the first time. The general conclusion drawn from the 1999 study was that there is a developmental issue among middle school students' personal epistemology and therefore the middle school years may be the appropriate time to begin introducing and reinforcing more mature epistemological beliefs. Two hypotheses generated from within that study were: (a) Belief constructs are not clearly differentiated in the minds of younger students and (b) beliefs about learning may precede the development of beliefs about knowledge.

The first hypothesis was generated because the factors within the three-factor structure of middle school students' personal epistemology were found to highly correlate with each other. In this study, an orthogonal solution was the only means to reduce the data, suggesting minimal correlations among factors. This finding affirms the possibility that middle school students' belief constructs are not as clearly differentiated as those of high school students. As students progress through high school their beliefs do become more distinct.

The second hypothesis was generated from the middle school data because of the number of items that loaded on each learning factor for the middle school students. It was proposed that the middle school students were more developed in their beliefs about learning than in their beliefs about knowledge. A plausible explanation for this proposal was that ideas about knowledge are more abstract than ideas about learning. In this study, a developmental pattern seems to be indicated. For the middle school students, 18% of the items that remained after factor analyses and Cronbach alpha analyses were items about the nature of knowledge. Among the high school students in this study, 39% of the items that remained were about the nature of knowledge. A testable hypothesis for future research would be that a greater percentage of items about the nature of knowledge would become a part of the factors with college students.

In summary, the comparison between the middle school students' results and the high school students' results indicated a strong underlying similarity of results with differences appearing in the manifestations of maturation and development. To elaborate this point, in the middle school students' data, three factors were derived and in the high school data, four factors were derived. Also, the first factor of the high school data appeared to be a combination of Factor 1 and 2 in the middle school data. The significance of this difference was tempered by the fact that in the middle school data, the two factors were highly correlated. Therefore the two factors in the middle school data and the one factor in the high school data could virtually be the same factor. If exploratory factor analysis had been used with the middle school data, the two factors may have emerged as one factor. A significant difference between the three-factor and four-factor structures was the increase

in the number of knowledge items in the high school data. Only 18% of the items that were included in the three-factor structure in the middle school data were about knowledge whereas 39% of the items that were included in the four-factor structure for high school students were about knowledge. A similarity between middle school and high school results was that GPA was predictable in both sets of data. For the middle school students, Ability to Learn and Speed of Learning both predicted GPA and in this study, Learning Rate and Ability (which is for all purposes like Ability to Learn and Speed of Learning in the middle school data) predicted GPA as well as Structure of Truth and Utility of Study Skills.

An intriguing issue is how comparable the 30-item epistemological beliefs questionnaire is to the original 63-item epistemological beliefs questionnaire. Although the intent of this study was not to make a direct comparison between the 30-item and the 63-item questionnaires, some interesting similarities can be noted. First of all, four factors were elicited with the 30-item questionnaire as it was with the 63-item questionnaire. Furthermore, three out of the four factors predicted GPA among the high school students in this study. Previously, all four epistemological belief factors predicted GPA among the high school students with the 63-item epistemological beliefs questionnaire (Schommer, 1993b). These noted similarities hint at the idea that the 30-item questionnaire can perhaps serve as a substitute for the 63-item questionnaire if time to administer the questionnaire is an issue. There is one caveat to consider. It is apparent that since all 63 items from the original questionnaire are not represented in the

30-item questionnaire, the beliefs assessed have slightly different qualities compared to the original beliefs structure. Further studies are needed to test the preciseness of the shortened questionnaire.

Limitations of This Study

This was only the second study which implemented the 30-item revised and shortened epistemological beliefs questionnaire entitled Attitudes About Education. Therefore, the process of determining whether the questionnaire is a valid instrument has only begun. The search to create a shortened questionnaire is valuable because the use of a shorter instrument requires less effort to administer and is less taxing on shorter attention spans of younger students. It is only logical that a shortened questionnaire would elicit less concise factors. A weakness exhibited in this study was that each factor within the four-factor structure found using the 30-item epistemological beliefs questionnaire had characteristics of combinations of factors from the original questionnaire.

Future Research Implications

The psychometric qualities of the 30-item epistemological beliefs questionnaire can further be examined through testing among college students, with an older adult population, or replicating this study or the Schommer et al. (1999) middle school study. A direct comparison between the 30-item and the original 63-item epistemological belief questionnaires would also prove beneficial. Research could be carried out by surveying a certain population with the 30-item questionnaire and then resurveying the same population with the 63-item questionnaire.

Potential Implications for Practice

This research has practical implications as well. Previously, researchers have found that epistemological beliefs correlate with critical inquiry skills, understanding ill-structured problems, conceptual change, and comprehension monitoring. Although causal claims cannot be made from these correlational findings, these diverse lines of inquiry uncover the possibility of practical application. For example, educators could help students improve their critical inquiry skills by challenging students' beliefs about knowledge and ability instead of merely giving students theoretical rules of critical inquiry. To encourage the understanding of ill-structured problems, educators could challenge students' beliefs about the tentative nature of knowledge. As teachers make efforts to improve students' abilities to make conceptual changes, teachers may want to examine students' epistemological beliefs and seek to redirect those as well. Since education includes many opportunities for comprehension such as reading and understanding teacher lectures, educators could support students' comprehension monitoring success by encouraging students' beliefs about the tentative nature of knowledge and the gradual learning process.

The idea that middle school students do have epistemological beliefs has certainly been alluded to in the research. The fact that they can be measured with a multidimensional model has utility in the sense that past research indicates that epistemological beliefs influence the learning process.

With the use of an epistemological beliefs questionnaire designed specifically for middle school students, educators can begin to assess their students' epistemological beliefs. Assuming that there is variability among the middle school students' epistemological beliefs, teachers can begin to

encourage students who have less developed epistemological beliefs that the ability to learn is more than a natural ability but one that can be acquired. Teachers can reinforce the concept of patience and the usefulness of taking time in the learning process. Teachers can begin to develop the idea that knowledge can be organized. In past research with middle school students, there is a sense that middle school students do not even understand the idea that knowledge is organized (Schommer et al., 1999). Middle school teachers may have to be explicit in their instruction and first talk about how knowledge is organized on a piece of paper, being careful to show how knowledge is interconnected. Once middle school students have a clear illustration of the organization of knowledge, teachers can explain that knowledge is organized in the mind in a similar fashion. Activities such as outlining and concept mapping will facilitate instruction.

If this epistemological beliefs instrument can be further developed for middle school teachers to use, to understand their students' epistemological beliefs, then teachers will be in a better position to modify their teaching to guide students to not only learn content but also to develop the middle school students' understanding of the nature of knowledge and learning itself.

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Appendix A

Student Packet

WICHITA STATE UNIVERSITY

Department of Administration, Counseling, Educational & School Psychology

INFORMED CONSENT DOCUMENT

You are invited to participate in a study of students' attitudes toward education. As teachers and educators, we realize the more we understand what students think and feel, the better teachers we can become. You were selected as a potential participant in this study because you are enrolled at Newton High school.

If you decide to participate in this session, you will be asked to complete two questionnaires, a demographics sheet, and two comprehension passages. This will take approximately 25 minutes (total time) to complete. No risks or discomforts are contained in this study.

Any information which could identify you will be kept strictly confidential. Participation in this study is entirely voluntary. Your decision whether or not to participate will not affect your future relations with Newton High School. If you decide to participate, you may withdraw from this study at any time without affecting your status as a student.

If you have any questions about this research, please ask. If you have any additional questions during the study, I will be glad to answer them. You can contact me, Robyn Walter, or Dr. Marlene Schommer at the Wichita State University Department of Administration, Counseling, Educational and School Psychology or call (316) 978-3326.

If you have questions pertaining to your rights as a research participant, or research-related injury, you can contact the Office of Research Administration at Wichita State University, Wichita, KS 67260-0007, telephone (316) 978-3285.

You are under no obligation to participate in this study. Your signature indicates that you have read the information provided above and have voluntarily decided to participate.

If you wish, you may have a copy of this consent form to keep.

_____

Participant signature Date

_____

Principal Investigator Date

_____

Co-Investigator Date

Wichita State University, Wichita, Kansas 67260-0123 Telephone: (316) 978-3326 Fax: (316) 978-3102

ATTITUDES ABOUT EDUCATION

Directions:
1. Print your name and today's date.

Name_____ **Date**_____

2. Using the scale below, rate the degree to which you agree or disagree with the following statements. Place your answers to the left of the statements. There are no right or wrong answers.

Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
1	2	3	4	5

_____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 <u>more</u> 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.

_____12. A class in study skills would probably help slow learners.

_____13. Learning something really well takes a long time.

_____14. <u>Thinking</u> about what a textbook says is more important than <u>memorizing</u> what a textbook says.

Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
1	2	3	4	5

_____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.

_____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.

DEMOGRAPHIC INFORMATION

Directions: Please answer the following questions by either circling the category that applies to you or filling in information.

1. What is your gender?

A. Female

B. Male

2. What is your ethnicity?

A. African American

B. Asian American

C. Hispanic American

D. Native American

E. White American

F. Other

3. What is your date of birth?

(Month/Day/Year) _____

4. What is your grade classification?

A. Freshman

B. Sophomore

C. Junior

D. Senior

VIEWS ABOUT MATH

Directions:

Using the scale below, rate the degree to which you agree or disagree with the following statements. Place your answers to the left of the statements. There are no right or wrong answers.

Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
1	2	3	4	5

_____1. Learning to do word problems is mostly a matter of memorizing the right steps.

_____2. It doesn't really matter if you understand a math problem if you can get the right answer.

_____3. Word problems are not a very important part of mathematics.

_____4. By trying harder, one can become smarter in math.

_____5. Math problems that take a long time don't bother me.

_____6. I study mathematics because I know how useful it is.

_____7. There are word problems that just can't be solved by following a pre-determined sequence of steps.

_____8. Time used to investigate why a solution to a math problem works is time well spent.

_____9. Mathematics has no relevance to my life.

_____10. If I can't solve a math problem quickly, I quit trying.

_____11. A person who can't solve word problems can't do math.

_____12. Hard work can increase one's ability to do math.

_____13. Please leave this line blank and go on to number 14.

_____14. Mathematics is a worthwhile and necessary subject.

_____15. If I can't do a math problem in a few minutes, I can't do it at all.

_____16. Memorizing steps is not that useful for learning to solve problems.

_____17. Getting a right answer in math is more important than understanding why the answer works.

Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
1	2	3	4	5

_____18. I can get smarter in math by trying harder.

_____19. Computational skills are useless if you can't apply them to real life situations.

_____20. Mathematics will not be important to me in my life's work.

_____21. Math classes should not emphasize word problems.

_____22. Any word problem can be solved by using the correct step-by-step procedure.

_____23. In addition to getting a right answer in mathematics, it is important to understand why the answer is correct.

_____24. I can get smarter in math if I try hard.

_____25. I feel I can do math problems that take a long time to complete.

_____26. Learning computational skills is more important than learning to solve word problems.

_____27. Please leave this line blank and go on to number 28.

_____28. Word problems can be solved without remembering formulas.

_____29. Knowing mathematics will help me earn a living.

_____30. I find I can do hard math problems if I just hang in there.

_____31. Computational skills are of little value if you can't use them to solve word problems.

_____32. Ability in math increases when one studies hard.

_____33. Any word problem can be solved if you know the right steps to follow.

_____34. It's not important to understand why a mathematical procedure works as long as it gives a correct answer.

_____35. A person who doesn't understand why an answer to a math problem is correct hasn't really solved the problem.

_____36. Studying mathematics is a waste of time.

_____37. I'm not very good at solving math problems that take a while to figure out.

_____38. Working can improve one's ability in mathematics.

Comprehension Passages

Directions:

Please read the following passages and answer the questions as best as you can.

Passage 1:

Background: What is biology? What does dissecting mean? In this passage, James is about to take biology.

James had always excelled in science, winning every science fair and making straight A's. But this year, he would be taking Biological Studies, and he knew that meant dissecting animals. He was agonizing over the thought of cutting up a creature that had been alive. He couldn't even envision cutting into a cockroach–and he hated those! James started the summer with an overpowering fear of embarrassing himself. By July, he had worked himself into a state of near hysteria.

To solve his problem, James bought a dissecting kit to practice. Inside the kit, he found an address to order preserved animals. After some contemplation, James chose an earthworm, a crawfish, a frog, and a snake.

When the animals arrived, James carefully dismantled the corrugated box so he wouldn't damage the contents. When he reached the innermost container, he was shocked beyond words! There must have been a a mistake! Not only were these animals not preserved, they weren't even dead! James looked at the order form and discovered his mistake. He had marked the wrong code!

Suddenly, James was the proud owner of four creatures who were very much alive. He had no idea what to feed any of these animals, nor any desire to find out. Deciding to dispose of them as quickly as possible, he biked to the nearest pet shop to sell the animals. The manager told him they only bought from licensed dealers. He tried the administrator of the zoo, but she didn't have room for any more animals just now. James was disheartened. He realized he would have to accept responsibility for the animals himself.

First, James went to the library. There he learned that the animals would have to be housed in separate containers. He went back to the pet store and bought four small aquariums. By the end of the summer, James had learned an extensive amount of information about his new pets. What had started as a dissection project had turned into a valuable study of live animals.

1. What school subject was James best at?

2. Why was James worried about taking biology?

3. How did James decide to solve his problem?

4. Why was James surprised when he opened the boxes?

5. How do we know that James cared about animals?

6. How did James' mistake become a positive experience?

Passage 2:

Background: What is a journalist? In this passage, Kate has decided she wants to be a kind of journalist.

Kate's greatest ambition is to be a journalist. Throughout her high school years, she has been a photographer on the school newspaper. Now she is the senior editor of her high school newspaper, but her goal is to be a foreign correspondent. Kate is taking a class in photography and learning how to use pictures to tell a story. Kate would like to find a way to combine writing about international relations and photography, perhaps writing for a news magazine or for a TV news show, but using her own photographs.

Two years ago, Kate's history class took a trip to the southeastern states. She took her camera and photographed the eroded seacoasts. When Kate's pictures were published in the local newspaper, there were many letters to the editor, praising her work.

Last year, when Kate was a junior, her class went to Mexico. Kate took pictures of how the recent earthquake had devastated the entire region. When Kate showed her pictures to the editor of the town newspaper, he asked her to write an article to go with her pictures. He told Kate that she had a unique talent for capturing people's attention with a profound photograph. He said if she wrote an article to go with the pictures, people would understand the message in the photographs better. This time, public reaction was phenomenal! Kate could finally see a way to combine her ability to write with her interest in photography!

Now in her senior year, Kate is deciding where to go to college. Kate's inclination is to go to a prestigious college in Washington, D.C. or New York. She wants to be near the ambassadors and diplomats. Kate has never abandoned her goals to be a foreign correspondent. She keeps that in mind through all her decisions.

1. What does Kate want to be?

2. How did Kate get started in journalism?

3. How will Kate's experiences in high school help her accomplish her goals?

4. How did the newspaper readers feel about Kate's pictures from the southeast?

5. How did the local editor help Kate see a way to accomplish her goal?

6. How will Kate make her decision about which college to attend?

Appendix B

Standardized Administration Teachers' Guide

Teachers' Guide for Standardized Administration of Robyn Walter's Survey

Please read aloud:

"Today you have a chance to participate in educational research. Robyn Walter, a graduate student at Wichita State University, has prepared a survey that asks what you think and feel about school, about learning, and about education in general.

All of your answers will be confidential. No one, but the researcher, will know how you answered. The researcher is obliged by research law to keep all your comments confidential.

This is your chance to let educators know how you feel. The researcher's goal is to help universities educate brand new teachers in a way that they can understand the student's opinion.

Please do not talk about this survey to anyone later. The researcher will be giving this survey to many students in Kansas, and she does not want the answers to be influenced by conversations with other people.

I'll hand out the surveys now. Just read each page and follow the instructions."

[Hand out the surveys. wait five minutes. Then say...]

"If you have any questions, just raise your hand and I will come to your desk."

Special Note to the Teacher:

You may explain what a word means, but please do not interpret an item for the student.

For example: If a student wants to know what the word "pre-determined" means, it is okay to define it for them. On the other hand, if a student wants to know what the statement "Today's facts may be tomorrows fiction.", tell them, "it means, whatever you think it means." In other words, you can't interpret the item for the students.

Also, remember that once ALL of the students have reached the last pages of the survey, which are bright yellow color, you may pick up the packets and conduct your normal classroom activities, or if you wish, you can have the students complete the entire survey before resuming normal classroom activities.