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## Epistemic Beliefs and their Instructional Practice: Perspective of a Private University in Ghana

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### **Abstract:**

*The purpose of this study was to investigate the epistemological beliefs of student-teachers in Ghana and how these beliefs related to their projected instructional practice. The results indicated that Ghanaian student-teachers had somewhat novice epistemological beliefs. There were significant differences among the dimensions of epistemological beliefs. Also, there was no significant correlation between the epistemological beliefs and projected instructional practice of student-teachers in Ghana. The implications for practice are discussed.*

**Keywords:** Epistemology, projected instructional practice, student-teachers, discipline, dimensions

### **1. Introduction**

The concept of the epistemological beliefs system (the nature of knowledge and the process of knowing) has been studied for over four decades now, and is one of the areas that continues to attract the attention of researchers (Hofer & Pintrich, 1997; Hofer, 2004). Trigwell and Prosser (2004) observed that “there are systematic relations between the ways teachers’ teach and the quality of their students’ learning” (p. 421). Personal epistemology is closely associated with the reasons why teachers make certain decisions in their classrooms (Hofer, 2001; Hofer & Pintrich, 1997). This implies that the epistemological beliefs of teachers influence their choice of instructional practice. Understanding of epistemological beliefs of teachers and how students perceive knowledge is important in ensuring that students succeed in the teaching learning process (Hofer, 2001; Trigwell & Prosser, 2001; Braten & Stromso, 2006). Knowledge in the epistemological beliefs is important to different aspects of the teaching and learning process.

Within the epistemological beliefs field, much of the research focused on college students’ epistemological beliefs with other academic variables (Baxter Magolda, 1992; Perry, 1970; Hofer, 2000). As a result of these studies, educators have explored college students’ beliefs and theories about the nature of knowledge and the process of knowing (Hofer, 2001; 2004). Despite this rigorous work with college students, it is only in the last few years that the epistemological beliefs of student-teachers have been studied (Schraw & Olafson, 2008). Currently, there are limited empirical research studies that have focused on classroom teachers’ epistemology. Commenting on the problem of limited research on teachers’ epistemological beliefs with college students in Turkey, Chai, Khine, and Teo (2006) lamented that there has not been much research on student-teachers. These researchers explained that the previous studies focused mainly on college students and made it difficult to conceptualize teachers’ epistemological beliefs. In spite of some evidence-based studies on epistemological beliefs of college students in the western world (Brew, 2001), there has not been much research on personal epistemology in other non-western contexts. Ghana, and for that matter, most countries in the Sub-Saharan Africa are yet to add their voice through empirical study on the implication of epistemological beliefs to the teaching and learning. Mawere (2011) stated that “scholars in the field of philosophy have not devoted adequate time to analyze philosophical themes that run through African literature” (p. 1). Apart from the lack of research on student-teachers’ epistemological beliefs in Ghana, there is inadequate literature that explores student-teachers’ epistemological beliefs in relationship to their instructional practice. What is not known in Ghana might possibly be whether the epistemological beliefs of teachers are promoting or inhibiting students’ learning and development. Now that more and more stakeholders are becoming involved in education and are demanding accountability (Findlow, 2008), there is the possibility of enormous pressure on teachers to be mindful of the instructional choices they make in the teaching and learning environment.

Since the availability of information on student-teachers' epistemological beliefs can help educators to reflect on the impact of epistemological beliefs on teaching and learning, this study is critical need. (Cano, 2005). Brownlee (2003b) observed that epistemological beliefs serve as a lens through which teachers make instructional decisions. Therefore, the result of this research is expected to inform policy-makers, educators on how certain epistemological beliefs may impact their instructional environments.

### *1.1. Statement of the Problem*

Personal epistemology is a well-studied area in most western countries (Hofer, 2001). However, Ghana (Sub-Saharan West African nation) has not joined the conversation about this important subject. Therefore, it appears difficult for educators to have access to empirical information that can potentially explain why certain decisions are made in the teaching and learning process. One of the assumptions of this study is that there is inadequate information on personal epistemology in the Ghanaian context. The situation might be one of the possible reasons that account for the country's inability to achieve the aims and objectives of her education.

Two reasons could possibly account for this situation. First, the Ghanaian worldview about reality and second, pressures on educational curricula from external bodies. The former shows up in the beliefs of people regardless of the level of their education. Among the different tribal groups in Ghana, there are shared cultural beliefs that are important to the people. In most cases, some of these beliefs are about divinations and spirituality, which are believed to be beyond human understanding. Compared to the western worldview, these cultural beliefs are likely to influence the personal epistemology of the people, in spite of the level of education. Therefore, it may be inferred that if the cultural indoctrination imbibed during the formative years of student-teachers is not consciously changed, it may still affect their thinking even as they advance through college. Schommer (1990) recommended that researchers study epistemology across cultural lines in order to engage in cross-cultural comparison. Therefore, it could be a disservice to Ghanaian student-teachers to be taught through the lens of western concept of epistemological orientations.

In the latter, teachers are under pressure to help their students to make adequate progress during standardized examinations. Brownlee and Berthelsen (2006) investigated whether teachers practice what they preached in the classroom. They concluded that postgraduate teachers did not demonstrate their instructional practice based on personal epistemological beliefs due to the external pressure on the curriculum. Among the external pressures reported was examination. Similar to their finding, the Ghanaian context has the Basic Education Certificate Examination (BECE) and the West African Secondary School Certificate Examination (WASSCE) for students at the junior and senior high schools levels. Teachers, regardless of their epistemological beliefs, have to prepare their students to pass these two external examinations. Under this condition, teachers will be pressured to adopt strategies that will help students to perform well on the external examinations than considering how they believe students should be taught to think critically and creatively.

### *1.2. Purpose of the Study*

This quantitative study sought to investigate student-teachers' epistemological beliefs and relationship with their projected instructional practice. The results of the study will be useful in adding to the body of research on personal epistemological beliefs as well as how certain epistemological beliefs translate into instructional practice in school settings. With this, teacher education programs can consciously facilitate and nurture certain epistemological worldviews of student-teachers that will lead to the desired results in the classroom (Brownlee, 2003). In the same vein, the attention of developers of professional development programs for classroom teachers will be drawn to some of the dynamics between epistemologies and instructional practice of their teachers. This will be useful in making decisions about teachers in Ghana. As of now, there has not been much emphasis on the need for educators to ascertain information on learners' epistemological beliefs before they design or plan instruction for them. Some experts in the field of instructional design have written extensively on the need to perform learner and other performance-related analysis (Smith & Ragan, 2005; Dick, Carey, Carey, 2009) before the instructional environment is implemented. The result of this study will potentially present a case on the need for epistemological beliefs to be consciously embedded in the teacher education programs in Ghana.

### *1.3. Research Questions*

1. What are the differences between student-teachers epistemological beliefs dimensions?  
→ Null hypothesis 1. There is no difference between the epistemological beliefs of student-teachers
2. What is the relationship between epistemological beliefs and instructional practice of student-teachers?  
→ Null hypothesis 2. There is no relationship between the overall epistemological beliefs and instructional practice  
→ Null hypothesis 3. There is no relationship between the dimensions of epistemological beliefs and instructional practice.

## **2. Literature Review**

### *2.1. Personal Epistemology*

The concept of personal epistemology was first studied in the late 1960s (Perry, 1970). Perry (1970) used college students and found that college students possessed four main stages of beliefs: dualism, multiplicity, relativism, and commitment. Dualism referred to the view of knowledge as either right or wrong that had to be transmitted by leaders or experts (source). The assumption was that authorities connoted absolute knowledge. Multiplicity, as the second stage, implied the mixture of personal views as well as absolute truth. At this stage, college students began to think that there were other ways or sources of knowing besides what had been obtained from authorities. Also, students began to add their voice as a potential alternative to what was known and received from authorities. During the relativist stage, students no longer believed in absolute truth but started to see knowledge as meaning making, which

usually varied from one individual to another. This meant, what was right in one context would not necessarily be so in another context. At the last stage (commitment), college students relied solely on making sense of experiences and using evidence to support what they believed about a particular body of knowledge.

Schommer (1990) defined personal epistemology “as a system of more or less independent beliefs, conceptualized as beliefs about the simplicity, certainty, and source of knowledge” (p. 540). Hofer (2002) stated that epistemology was “concerned with the origin, nature, limits, methods, and justification of human knowledge” (p. 4). Evaluating the epistemological beliefs of student-teachers, White (2000) categorized epistemology into “...certainty of knowledge, simplicity of knowledge, source of knowledge and justification for knowing” (p. 279). From the various definitions cited, epistemology can be summarized as an individual understanding and belief about the nature of knowledge, origin of knowledge, certainty of knowledge, and how one justifies knowing a phenomenon. Despite the availability of different definitions, Brownlee et al. (2009) argued that there is still debate on the right definition of personal epistemologies, since different researchers have used the concept based on the variables they have studied. On this note, the concept continues to attract researchers from within and without the United States, who continue to investigate the different aspects of personal epistemological beliefs (Schommer, 1990; Hofer, 2001; Brownlee, 2003a; Tsai, 2000).

### *2.2. Student-teachers' Epistemological Beliefs*

There are studies in the United States and elsewhere that confirm the close relationship between teachers' epistemology and their instructional practice. Zohar (2006) emphasized that in order to provide adequate support for higher-order learning, teachers require advanced epistemological knowledge that is not directly embedded in the curriculum. Studying the beliefs about knowledge and the process of teaching and learning of fifty-three novice and experienced student-teachers enrolled in one of the teacher education courses at a Hong Kong University, Kember (2001) reported that novice student-teachers found it difficult completing assignments that did not align with their epistemological beliefs. In simple terms, these novices did not have the cognitive ability to engage in higher-order thinking. Similarly, Hermans et al. (2008), studying the impact of teachers' epistemological beliefs as an antecedent to the use of computers for open-ended discussions sampled five hundred and twenty-five elementary school teachers for this study. After the data gathering process and analysis, Hermans et al. (2008) found support for the hypothesis that teacher beliefs are a stronger determinant in explaining why they use computers in their classrooms as tools to improve the efficiency and depth of their learning. Teachers with sophisticated epistemological beliefs were more likely to use computers in their classrooms for higher-order teaching and learning activities whereas those with naïve epistemological beliefs were unlikely to use computers to help students learn. Aypaya (2011) reported a significant relationship between personal epistemology and teaching and learning conceptions. He also added that student-teachers preferred constructivist learning environment to the traditional learning approach.

Chan (2007) used two hundred and thirty-one Hong Kong student-teachers to study epistemological beliefs and conceptions about learning. He found support that epistemological beliefs have stronger predictive relationship in both quantitative and qualitative learning conceptions of student-teachers. He, therefore, concluded that epistemological beliefs play essential role in student learning. In terms of how student-teachers' can learn effectively in a web-based environment, Tsai, Tsai and Hwang (2011) found that teachers with more advanced epistemological beliefs could use different web-search strategies to find relevant information than those with less advanced epistemologies. They also reported a significant correlation between epistemological beliefs and the quality of the open-ended questions generated by the student-teachers. Upon these findings, there is evidence to support the assumption that student-teachers possess relatively advance epistemological beliefs, which might likely influence them to adopt constructivist learning pedagogies in their classroom.

### *2.3. Epistemology and Instructional Practice*

The concept of personal epistemology partially dictates the instructional practice as well as learning preferences of students. Brownlee (2003b) observed that epistemology serves as a “filtering role” as teachers with advanced epistemological beliefs create opportunity for students to construct meaning within the learning environment, whereas those with naïve epistemology see truth as “absolute and categorical,” thereby transmitting knowledge to their students (p. 2). Tsai and Chung (2005) noted that educators have concluded that epistemological beliefs have influence on learning approaches, mode of thinking, and acquisition of information. They intimated that findings in the field support the assertion that constructivist-inclined students tend to use more cognitive resources to attain higher-order learning goals than those who possess simple epistemological beliefs. Tsai (2000) also observed that students with constructivist epistemologies tend to use prior experiences, have better collaboration skills and higher-order task performance.

### *2.4. The Dimensionality of Personal Epistemology*

In order to empirically gather more information on the epistemological beliefs of college students on how they come to know as well as their perception of knowledge, there have been various empirically validated epistemological beliefs' instruments to measure as well as test different variables after the monumental work of William Perry. One of the earliest quantitative instruments designed to measure students' epistemological beliefs was the Schommer epistemological questionnaire (Schommer, 1990). The Schommer's epistemological questionnaire (SEQ) is a 63-item survey Likert scale questions that requires respondents to rate their beliefs from strongly disagree (1) to strongly agree (5) based on certainty of knowledge, control of knowledge, structure of knowledge, speed of acquiring knowledge and source of knowledge. Prior to the validation of this epistemological instrument, most researchers investigating epistemological beliefs used interviews, participant responses and thick descriptions to explain their epistemological

beliefs (Schommer-Aikins, 2004). This means, before the introduction of the epistemological beliefs questionnaire, most of the research studies were qualitative in nature.

With the use of 63- item survey questions, Schommer (1990) originally identified five independent dimensions that formed the epistemological beliefs of college students. These five independent beliefs were certain knowledge (whether knowledge was absolute or fixed to knowledge as constantly changing); simple knowledge (whether knowledge is made up of discreet facts and figures or integrated and interrelated); omniscient knowledge (knowledge was accessible to authorities only); quick learning (that knowledge did not have a particular form, either it was learned quickly or not at all); and innate ability (knowledge is gained at birth and for that matter learning was based on ability). The five dimensions were described by Schommer (1990) as independent due to the idea that students could demonstrate sophistication in one dimension and possess less or naïve epistemological beliefs in another dimension. So, each dimension was a continuum where college students occupied somewhere between the extremes. For example, the simplicity of knowledge dimension ranged between knowledge as pieces of discreet facts to knowledge as integrated and closely interrelated ideas.

Schommer (1993) studied the epistemology and cognition of college students. After the study, she reported more evidence to support the assertion that epistemological beliefs were multidimensional and more or less independent. By comparison between Schommer's understanding of the nature of college students' personal epistemologies and Perry's foundational research, it is clear to find that Schommer believes that personal epistemologies are independent from one another and not a continuum. For that matter, students can hold different levels of epistemological sophistication depending on the nature of the domain being reviewed. There is still an on-going debate regarding the dimensionality of personal epistemologies.

To get a more holistic view of the concept of personal epistemology, more and more researchers began to use Schommer's epistemological questionnaire instrument. In the process, some began to identify how the various items on the 63- point survey questions could clearly or consistently lead to her proposed epistemological beliefs dimensions. The results of this exploration have been controversial since some researchers arrived at all five dimensions whereas others did not (Hofer, 2001; Chan & Elliot, 2000). For this reason, there has been the development of similar epistemological instruments that are either a slight modification of Schommer's epistemological questionnaire or entirely new instruments to measure epistemological beliefs.

In a longitudinal study of college students for five years, Magolda (1992) developed a four-stage model known as model of an epistemological reflection (MER). These four stages reported by Baxter Magolda (1992) were absolute knowing, transitional knowing, independent knowing, and contextual knowing. Like dualism (Perry 1970), Magolda (1992) explained absolute knowing as certainty of knowledge, which was received from authority. Transitional knowledge combined absolute truth as well as uncertainties. Students at this stage had resolved that there were other truths elsewhere that could possibly be known besides what was knowable to authorities. For this reason, these college students continued to explore the world around them with the view of finding the other truths. Independent knowing required that instructors provided the environment for students to make sense or construct their own knowledge, which was different from the teachers' position, whereas contextual knowledge implied that knowledge was context-bound and one needed evidence to back or support a claim. With this, it was appropriate for individuals to have a point of view, yet such views needed to be substantiated by evidence.

Different terminologies were used by Perry (1970) and Magolda (1992) in explaining the different stages of college students' epistemological beliefs. However, there seems to be consistency between these researchers on the characteristics of each of the four stages identified in their separate research studies. For example, whereas Perry (1968) used dualist to represent college students' belief in right or wrong, Magolda (1992) coined the term absolute knowledge. Also, both researchers agree that the concept of epistemological beliefs is a continuum rather than independent sets of beliefs as originally proposed by Schommer (1990).

In a comprehensive meta-analysis and review of the major studies on epistemological beliefs, Hofer and Pintrich (1997) recommended that the concept of personal epistemology be broadly categorized into two main headings. These two headings were the nature of knowledge and the process of knowing. Explaining the nature of knowledge, these reviewers mentioned that the nature of knowledge was concerned with how an individual perceived knowledge. The reviewers further divided this aspect into certainty of knowledge and simplicity of knowledge. Certainty of knowledge referred to the beliefs that individuals held about knowledge as either fixed or constantly changing. The simplicity of knowledge component concerned with whether knowledge was a collection of unrelated facts to knowledge as integrated and closely interrelated. The second area as suggested by Hofer and Pintrich (1997) was the nature of knowing. This aspect referred to the process by which people received or acquired knowledge. Similar to the nature of knowledge, this aspect had two sub-components: source of knowledge and justification of knowledge. The source of knowledge component ranged from knowledge as transmission of discreet information to knowledge as a process of construction and reconstruction of ideas and concepts. The last sub-component justification of knowledge dealt with knowledge as being able to evaluate the accuracy or correctness through evidential support.

### **3. Methodology**

#### *3.1. Participants*

This was a quantitative study to survey student-teachers in Ghana about their epistemological beliefs, and how these beliefs related to their instructional practice. This group of student-teachers comprised one hundred and seven (107) in a four year baccalaureate private university. There was no demographic information collected from the student-teachers. The researchers purposively sampled student-teachers. The student-teachers were surveyed on their epistemological beliefs and projected instructional practice. All questions were

anonymous so that student-teachers could be honest in their responses. Participation in this study was voluntary. In all, the data collection took about three weeks. Student-teachers were juniors and seniors.

### 3.2. Instrument

Hofer's disciplined-focused epistemological beliefs instrument was developed by a team of researchers who were familiar with the literature on personal epistemology. The team of researchers checked the four thematic constructs that seemed to be consistent with most of the research studies in personal epistemology—certainty of knowledge, simplicity of knowledge, source of knowledge, and the justification of knowing (Hofer, 2000). At the end of the study, Hofer (2000) reported that there was evidence to support the dimensionality of these four constructs. However, she observed from the factor analysis that certainty and simplicity of knowledge merged onto one construct (eight items) with source of knowledge (four items), justification for knowing (four items), and attainability of truth (two items) making the last of the dimensions. With this, she cited Qian and Alvermann (1995) as having found similar evidence in the use of domain-general epistemological beliefs questionnaire. Cazan (2013) recently used the Hofer's discipline-focused epistemological beliefs questionnaire and found support for the dimensionality of all four constructs in her research. Cazan (2013) reported Cronbach Alpha for all four dimensions as certainty of knowledge (.75), source of knowledge (.67), simplicity of knowledge (.65), and justification for knowing (.55). Due to the background of the participants as teacher education major students for this current study, most of the items of the epistemological beliefs questionnaire were modified by inserting "*in the field of education*" to remind participants to approach each survey question with a teacher's mindset. The disciplined-focused epistemological beliefs questionnaire instrument had eighteen items based on the conclusion of the factor analysis by Hofer (2000).

Recently, Cazan (2013) surveyed 398 first year psychology students in one of the universities in Romania. At the end of the study, Cazan (2013) obtained all the four constructs (certainty of knowledge, simplicity of knowledge, source of knowledge, and justification of knowing). However, she reported that some of the items fell onto more than one factor during the confirmatory factor analysis. Since several studies have confirmed the dimensionality of the discipline-focused epistemological beliefs questionnaire, this study also used the four dimensions that were originally found by Hofer (2000) due to the small sample size of this study. One important characteristic of Hofer's instrument which should be borne in mind is that higher scores represent agreement with less sophistication. Below is a discussion of the meaning of the four dimensions as applied in the study.

#### 3.2.1. Certainty/Simplicity of Knowledge

Certainty of knowledge refers to the extent to which an individual sees knowledge as stable or constantly undergoing through changes. At the lower level, people begin to see knowledge as unchanging no matter the circumstance or discipline within which such knowledge is discussed. Researchers in this area have come to the conclusion that knowledge becomes tentative and open for interpretation at the advance level (Hofer, 2000). Simplicity of knowledge, as hypothesized Schommer (1990; 1994), can be explained as the view about knowledge as a collection of basic facts or the integration and interrelatedness of ideas. This means, those who are naïve see knowledge as discreet and unrelated facts whereas those who have advanced see knowledge as conditional, contextual, and systemic in nature. Since these two separate dimensions loaded onto the same factor, this subscale will be explained as a continuum between the belief of knowledge as absolute (unchanging) and unrelated to the perception of knowledge as tentative and interrelated. The set of items that loaded onto this scale was 1, 2, 5, 9, 11, 18, 23, and 24 with .74 and .81 Cronbach Alpha for psychology and science students respectively. Like in the original article, items 11 and 23 were reverse coded in order to be in line with the scale. Also, the items on the certainty/simplicity scale were recoded from *certsim\_1* to *certsim\_8*.

#### 3.2.2. Source of Knowledge

This dimension, like the name implies, identifies the situation of knowledge. The question that needs to be asked is whether knowledge is located outside the individual or resides within the individual. In other words, source of knowledge distinguishes between knowledge as a transmission of information to knowledge as a construction of ideas. Perry (1970) explained that individuals, who used to consume or receive knowledge from others, become creators of knowledge. Most of the researchers in this field see source of knowledge as developmental in nature (Schommer, 1990; Baxter Magolda, 1992; King & Kitchener, 1994). The items on the disciplined-focused epistemological beliefs questionnaire were 3, 7, 20, and 26 with .51 and .64 Cronbach Alpha for psychology and science students studied by Hofer (2000). The items were recoded into *sour\_1*, *sour\_2*, *sour\_3*, and *sour\_4*.

#### 3.2.3. Justification for Knowing

The justification for knowing dimension refers to a continuum within which individuals judge the correctness and accuracy of knowledge (Hofer & Pintrich, 1997). At the lower level of Hofer's discipline-focused epistemological scale, individuals discriminate between information based on observation. There are certain times people in such bracket accept whatever comes from authorities or experts without any further inquiries. At the higher level of this scale, the individual uses set of criteria to evaluate the correctness, consistency and accuracy of the knowledge. There are situations where evidence-based research finding should be provided before those who are sophisticated in this dimension accept the information as valid. The items that loaded onto this factor were 12, 21, 25, and 27 with .56 and .61 as the Cronbach Alpha. These items had been recoded into *just\_1*, *just\_2*, *just\_3*, and *just\_4*.

### 3.2.4. Attainability of Truth

As demonstrated in this project, this construct was not originally part of the four dimensions that were hypothesized to be the core of epistemological beliefs (Hofer, 2000). However, it emerged after the exploratory factor analysis on the discipline-focused epistemological beliefs questionnaire did not clearly indicate the four dimensions that were hypothesized in Hofer (2000). With only two items (13, and 17), the items indicate a continuum as to whether experts or scholars will eventually get to the truth. With this, individuals at the higher level will always be seeking new knowledge, even beyond what would be branded as the truth, whereas novices will accept authorities and experts as having the truth. The Cronbach Alpha reported by Hofer (2000) was .60 and .75 for psychology and science students respectively. The items on the attainability of truth had been recoded into attain\_1, and attain\_2.

### 3.2.5. Instructional Practice Questionnaire

Also, the instructional practice questionnaire (Hung, unpublished), which comprised of eleven items on a Likert scale with four of the survey questions reversed. The reversed survey questions were items (intru\_2, instru\_3, instru\_5, and instru\_7). The last three items qua\_1, qua\_2, and qua\_3 on the instructional practice questionnaire were designed to gather additional qualitative information. Item qua\_1 asked student-teachers whether they will be able to practice what they believed to be best practices, whereas item qua\_2 asked teachers to check whether they were constructivist or behaviorist. The last question (item qua\_3) specifically required the participants to choose from nine possible factors that explained why teachers' epistemological beliefs could be inconsistent with their instructional practice. After the survey was administered, the researchers used the Statistics Package for Social Science (SPSS) Software to do all the analysis.

### 3.3. Procedure

In order to respect the rights of the participants, this research commenced after the researchers have satisfied all the requirements of the ethical office of the university. The student-teachers were contacted through their campus email to officially inform them of the impending study as well as how their involvement was needed. Specific dates for the survey administration were emailed to students on two occasions before the actual survey questions are administered. The researchers, in collaboration with the department of education, sent paper-based copies of the survey to respond during one of the lectures. Before the student-teachers began responding to the survey, they were informed that their participation was optional, without any compensation for their time as well as had the right to opt out of the study at any point in time.

## 4. Results

### 4.1. Student-teachers' Epistemological Beliefs

The discipline-focused epistemological beliefs questionnaire is a validated instrument (Cazan, 2013). Therefore, the four dimensions reported by Hofer (2000) were used to test student-teachers epistemological beliefs system. These were certainty/simplicity of knowledge (8 items), justification of knowing (4 items), source of knowledge (4 items), and attainability of truth (2 items). To align the instructional practice instrument with the Hofer's scale, the researchers reverse coded the responses of four items (intru\_1, instru\_4, instru\_6, and instru\_8), in the instructional practice questionnaire, before running the statistical procedure (refer to Appendix A for details in the code book).

The overall epistemological beliefs' reliability for student-teachers was .59. One major thing noted about the student-teachers' data was that the four dimensions of student-teachers' Cronbach Alpha had poor reliability (ranging from .30 to .59). Cazan (2013), using the Romanian version of the discipline-focused epistemological beliefs questionnaire, reported that the Cronbach Alpha of the translated version of this instrument was lower than the reliability scores reported by Hofer (2000). However, since the DFEBQ is a validated instrument, it is a reliable instrument to measure Ghanaian student-teachers epistemological beliefs. Table 1 shows the epistemological beliefs of student-teachers with their Cronbach Alpha.

Variables	Student-Teachers
Overall epistemological beliefs	.59
Certainty/simplicity	.34
Source: authority	.46
Justification: personal	.38
Attainability of truth	.30

Table 1: The four Epistemological Beliefs Dimensions with their Cronbach Alpha

With regards to the individual dimensions on the discipline-focused epistemological beliefs questionnaire as well as the overall descriptive statistics for student-teachers, the researchers ran a frequency statistical procedure for each of the four dimensions after computing the various items of the scale into their respective dimensions. Also, the researchers repeated the same process for the overall epistemological beliefs (all four dimensions put together) and instructional practice. It should be borne in mind that the DFEBQ did not have the same number of items for each dimension. Also, higher scores indicated less sophistication on the Likert scale. See table 2 below.

Dimensions	Student-teachers Mean (SD)
Overall epistemology	3.0 (.54)
Certainty/Simplicity of know.	2.7(.63)
Source of knowledge	3.3 (.95)
Justification for knowing	3.5 (.89)
Attainability of truth	3.3 (1.2)
	(n) = 107

Table 2: Descriptive Statistics on Epistemological Beliefs Dimensions

Note. Individual items were rated on Likert scale; high score indicates agreement with less sophistication. (n = 107).

The previous literature brought to the fore that teachers were not able to practice their educational philosophy due to some possible factors (Cady, Meier & Lubinski, 2006; Yilmaz-Tuzun & Topcu, 2008). The last three questions (qua\_1, 2, and 3) on the instructional practice qualitatively measured some factors that were likely to influence teachers' instructional practice. Responding to item qua\_1 (*I feel that I am not practicing the educational philosophy to which I subscribe to*), 39.3% (42 out of 107) student-teachers indicated somewhat disagree to strongly disagree that they were able to practice their instructional practice based on their educational philosophy. Interestingly, the same number of student-teachers (42 out of 107) felt they were not likely to practice based on their educational philosophy. However, 21.5% (23 out of 107) were neutral.

On item qua\_2 (*I am more inclined to educational philosophy of... constructivism/behaviorism*), 46.7% (50 out of 107) identified with the constructivist philosophical paradigm whereas 53.3% (57 out of 107) indicated being behaviorist. From the data, there was a split between student-teachers based on their educational philosophy. Whereas almost half of student-teachers possibly believed in the need to make lessons student-centered, the other half thought the teaching and learning process should be teacher-led.

The last question on the instructional practice scale (qua\_3) required the student-teachers to rate a number of factors that could possibly influence or constrain them from organizing their instructional environment based on their educational philosophy. Among all the factors, workload was projected as the most dominant factor (with 44.9%) to constrain student-teachers. This was followed by the school culture and government influence with 33.6% and 30.8% respectively. Interestingly, student-teachers did not rate standardized tests (external examinations) higher among the factors. Probably, student-teachers could not connect standardized tests with external examinations. Detailed of the data are presented in the table below.

Factors	Student-teachers	
	Frequency	Percentage (%)
Workload	48	44.9
Culture of the school	36	33.6
Government	33	30.8
Parental expectation	23	21.5
Pressure from school admini.	23	21.5
Inadequate knowledge	21	19.6
Standardized tests	17	15.9
Fear of trying something new	17	15.9

Table 3: Qualitative Instructional Practice Questions

Research Question 1: What are the differences between the epistemological beliefs dimensions of student-teachers?

*Null hypothesis 1.* There is no difference between the epistemological beliefs of student-teachers. Based on studies that have underscored the importance of studying the epistemological beliefs of student-teachers and their relationship to other academic variables (Hofer, 2000), the researchers thought it wise to investigate whether there was a significant difference among the four dimensions of epistemological beliefs for student-teachers. To do this, the paired-sampled t test was used to run the statistical procedure among the four dimensions. At the end of the procedure, it was found that there was a significant difference among all the four dimensions of epistemological beliefs of student-teachers. There were significant differences between certainty/simplicity of knowledge and the other three dimensions with source:  $t(106) = -5.970$ ,  $p < .001$ , justification:  $t(106) = -7.793$ ,  $p < .001$ , and attainability:  $t(106) = -4.731$ ,  $p < .001$ . The rest were source and justification:  $t(106) = -2.100$ ,  $p < .04$ , source and attainability:  $t(106) = -.385$ ,  $p < .70$ , whereas justification and attainability was  $t(106) = 1.234$ ,  $p < .22$ . The results indicated that there were significant differences between the dimensions of epistemological beliefs. The results implied that student-teachers did not have the same level of beliefs across the four dimensions. Based on the significant differences reported, the null hypothesis was rejected. See table 4 for details.

variables	t-value	p-value
Certainty/Source	-5.970	.001
Certainty/Justification	-7.793	.001
Certainty/Attainability	-4.731	.001
Source/Justification	-2.100	.04
Source/Attainability	-.385	.70
Justification/Attainability	1.234	.22

Table 4: T Test for Differences in Student-teachers' Dimensions

Note. Individual items were rated on Likert scale; high score indicates agreement with less sophistication. ( $n = 50$ ).  $*p < .05$ ,  $**p < .01$ .

Research Question 2: what is the relationship between epistemological beliefs and instructional practice of student-teachers?

*Null hypothesis 2.* There is no relationship between the overall epistemological beliefs and instructional practice. In some of the studies that used Hofer's discipline-focused epistemological beliefs instrument, the individual dimensions were compared with other variables and not necessarily testing the overall epistemological beliefs scale with other constructs (Cazan, 2013; Muis, Franco, & Gierus, 2011). So, the researchers consciously wanted to know how the overall student-teachers' epistemological beliefs related to their projected instructional practice. After running the Pearson product moment correlation statistical procedure, the overall epistemological beliefs of student-teachers did not have a significant correlation with their instructional practice. The student-teachers had Pearson coefficient of  $r = .17$ ,  $p = .08$ . The result implied that the Ghanaian student-teachers were not likely to teach based on their educational philosophy. Based on this insignificant correlation, the researchers failed to reject the null hypothesis. Detailed information is presented in table 5.

Variables	Correlation Coefficient ( $r$ )	Significance Level
Overall epistemological beliefs	.17	.08
Certainty/simplicity of knowledge	.44**	.001
Source of knowledge: authority	-.08	.41
Justification for knowing: personal	-.08	.39
Attainability of truth	-.03	.79

Table 5: Relationship between Epistemological Beliefs Dimensions and Instructional Practice of Student-teachers

Note. Individual items were rated on Likert scale; high score indicates agreement with less sophistication. ( $n = 50$ ).  $*p < .05$ ,  $**p < .01$ .

*Null hypothesis 3.* There is no relationship between the dimensions of epistemological beliefs and instructional practice. To test the above null hypothesis, all four dimensions of the student-teachers' epistemological beliefs (certainty/simplicity, source, justification, and attainability) were compared with the eight-item instructional practice construct. The other three dimensions (source of knowledge, justification for knowing and attainability of truth) had insignificant negative correlation with instructional practice. The results implied that there was a possible less sophistication in these dimensions of student-teachers' epistemological beliefs but not to the point of causing a correlation relationship. However, certainty/simplicity of knowledge had moderately positive significant correlation with instructional practice ( $r = .44$ ,  $p < .001$ ). The mean for certainty/simplicity dimension was 2.7 whereas instructional practice dimension was 2.6. This finding seemed to suggest that the more student-teachers believed knowledge was unstable and related, the more they used constructivist methods of learning in their classrooms.

The insignificant negative relationships suggested that whereas some of the dimensions (source of knowledge, justification for knowing, and attainability of truth) of epistemological beliefs of student-teachers did not develop, student-teachers were likely to use more constructivists instructional practice. Since the null hypothesis stated that there was no correlation relationship between the epistemological beliefs and instructional practice of student-teachers, the researchers rejected the null hypothesis based on this evidence of a positive significant correlation between certainty/simplicity of knowledge and instructional practice.

## 5. Discussion

### 5.1. Epistemological Beliefs of Student-Teachers in Ghana

Bearing in mind that higher scores indicated less sophistication, the researchers observed that the level of epistemological development of student-teachers in Ghana was not the same across all the four dimensions. Whereas certainty of knowledge dimension attracted the highest ratings of 2.7, justification for knowing dimension had 3.5 for student-teachers. In comparison to some western studies, the student-teachers in Ghana had novice epistemological beliefs than the first year students in psychology and science (Hofer, 2000), and statistics students (Muis et al., 2011). Though the student-teachers were from level 200 to level 400 (sophomore to senior college students), the differences in years in college did not seem to impact on their epistemological beliefs. Perry (1970) reported that college students in their senior years were more likely to advance in their epistemological beliefs than freshmen. However, due to the differences in the cultural context of the participants, it is not fair to compare on this belief scale.

The student-teachers in Ghana did not seem to demonstrate advanced epistemological beliefs in any of the four dimensions. By implication, these student-teachers could be classified as dualist (Perry, 1970). At the dualist stage, student-teachers were more likely



to perceive knowledge as either black or white. Also, they were more likely to rely on their lecturers (experts or authorities) for knowledge. The question is what does each of the four dimensions of epistemological beliefs system represent? What will be the possible impact on their projected instructional practice if student-teachers demonstrate somewhat less sophistication in a particular dimension of epistemological beliefs? The concept of epistemological beliefs system is the belief about the nature of knowledge and the process of knowing (Hofer & Pintrich, 1997). Therefore, there are ramifications on instructional practice when student-teachers demonstrate less sophistication in any particular dimension. For example, student-teachers who have novice beliefs in the source of knowledge dimension might accept knowledge without questioning its credibility. They will possibly not have holistic belief about the nature of valid knowledge. Eventually, student-teachers' poor beliefs about knowledge will be passed onto their students they will teach in the future.

Again, the poor mean scores reported for the source of knowledge, justification for knowing and attainability of truth dimensions indicated that student-teachers were likely to believe in experts and authorities as source of knowledge with personal observation and what feels right as evidence to check the accuracy or correctness of knowledge. The Ghanaian student teachers are more likely to believe that only experts and authorities have the true knowledge. So, when knowledge seems uncertain, it is likely that student-teachers would possibly evaluate information based on what feels right to them (Hofer, 2000). At the sophisticated level, teachers are expected to "use rules of inquiry and begin to personally evaluate and integrate the views of experts" (Hofer, 2000, p. 381). Thus, they will be in a better position to help their students to distinguish between valid knowledge from opinions and fads. At the end of the instructional process, if teachers fail to inculcate into their future students the skills in discriminating knowledge kinds, their students are more likely to accept information from any source.

The differences in the epistemological beliefs dimensions have been demonstrated in other research studies (Cheng, et al. 2009). For example, Yilmaz-Tuzun, and Topcu, (2008) found that student-teachers did not have the same level of epistemological development in four out of the five epistemological dimensions according to Schommer epistemological beliefs questionnaire (certainty of knowledge, control of knowledge, source of knowledge, speed of knowledge, and structure of knowledge). Also, Tanase and Wang (2010) reported that whereas some teachers easily changed their epistemological beliefs at the end of a course, others maintained the same epistemological beliefs. From these two studies, it can be inferred that it is common for teachers to demonstrate different levels of sophistication in their epistemological beliefs. Tanase and Wang (2010) used a set of interventions to help teachers improve upon their beliefs. Therefore, there are available interventions that can help student-teachers to improve on their epistemological beliefs.

### *5.2. Relationship between Epistemological Beliefs and Instructional Practice*

As indicated in the previous section, there was no significant relationship between epistemological beliefs and projected instructional practice of the student-teachers. With  $r = .17$ ,  $p = .08$ , the teachers were not likely to teach based on their educational philosophy. Whereas 46.7% of student-teachers indicated being constructivist, 53.3% declared behaviorist. So, the expectation was that the overall instructional practice mean should be somewhat average, and this was demonstrated in this research. However, their instructional practice should have been influenced by their epistemological beliefs (Pajares, 1992). The implication of this result is that the student-teachers are less likely to demonstrate the educational philosophy of the nation through their instructional practice. Since they will eventually become in-service teachers, it is important for faculty at the universities and colleges of education to be conscious of the kind of teacher preparatory courses offered to student-teachers in order to better equip them for the challenges of the classroom. The idea that more student-teachers indicated being behaviorist is not consistent with the modern educational paradigm in some industrialized nations (Muis, 2004; Kirschner, Sweller & Clark, 2006). Therefore, if some western studies have reported evidence of significant relationship between epistemological beliefs and instructional practice (Brownlee, 2003b; Hofer, 2001; 2004) then, context and cultural differences are more likely to have impact on student-teachers' decisions in non-western cultures.

The qualitative data obtained for item qua\_3 is worth-discussing. Based on the first three factors that were likely to constrain student-teachers from teaching according to their educational philosophy, workload, school culture, and government had between 30.8% and 44.9% ratings. The various factors, as presented in Table 4, possibly give indication that Ghanaian teacher educators need to be mindful of some of the barriers that prevent teachers from teaching based on the foundational and philosophical paradigms. The data seem to suggest that there is no explicit philosophical paradigm that Ghanaian educators propagate among their student-teachers. As a result, it becomes difficult to evaluate the decisions of student-teachers on their projected instructional practice.

### *5.3. Relationship between Dimensions of Epistemological Beliefs and Instructional Practice*

The analysis showed only one positive significant correlation between certainty/simplicity and instructional practice ( $r = .50$ ,  $p < .001$ ). Since the certainty/simplicity dimension represents the nature of knowledge component (Hofer & Pintrich, 1997), it can be inferred that student-teachers, with the epistemological beliefs that knowledge was ever-changing and interrelated, were more constructivists, and were likely to make their instructional practice student-centered. The belief that knowledge is changing is a reasonable basis for teachers to allow their students to actively participate in the classroom activities.

This finding is consistent with the previous literature that the more advanced in epistemological beliefs, the likelihood teachers use constructivist learning pedagogies (Pajares, 1992; Hofer & Pintrich, 1997; Brownlee, 2003b). However, this finding should be interpreted in its right context, since it was just one out of the four dimensions of epistemology. The certainty/simplicity of knowledge was the only dimension with eight items. With a total of eighteen items, the certainty/simplicity alone was almost half of the total number of items. At this point, it is inconclusive as to whether the only significant correlation reported was due to the number of items that form the certainty/simplicity of knowledge dimension.

Chai (2010) found evidence that teachers, who believed in knowledge transmission, made students passive recipients of information in their respective classrooms. Thus, their epistemological beliefs impacted their instructional practice. Therefore, student-teachers showing negative insignificant relationships between the source, justification and attainability dimensions against instructional practice should have demonstrated more teacher-centered practices. Despite student-teachers' beliefs in external knowledge, and use of observation as basis to check the correctness of knowledge, they were likely to adopt somewhat average instructional practice. The differences in the four dimensions might be due to what they represent as distinct parts of a system. Hofer and Pintrich (1997) broadly categorized epistemological beliefs into the nature of knowledge, and the nature of knowing (process of knowing). With this, the certainty/simplicity dimension represents the nature of knowledge (stable/tentative and related/more fluid) whereas the source, justification, and attainability dimensions represent the nature of knowing (transmission/construction and validated/inaccurate). From this illustration, it will be less difficult for student-teachers to believe that knowledge is ever-changing and interrelated (certainty/simplicity) than recognizing themselves as creators of knowledge and using set of rules to evaluate the accuracy of information (source, justification and attainability). Also, if the above assumptions were true, it is likely that the survey items that represent these three dimensions (source, justification, and attainability) did not make much sense to the student-teachers as compared with certainty/simplicity dimension.

#### *5.4. Implications and Further Research*

The findings indicated that Ghanaian student-teachers had partially developed epistemological beliefs system. The four dimensions, as explained in the third section, come together to form student-teachers' overall epistemological beliefs system. So, if only one out of the four dimensions (certainty/simplicity of knowledge) had a significant correlation between epistemological beliefs and the projected instructional practice of student-teachers, it is an indication that the three other dimensions (source of knowledge, justification for knowing, and attainability of truth) were possibly not developing as they were supposed to develop. There was a significant difference in student-teachers beliefs about the nature of knowledge (knowledge is fluid and interrelated) whereas there was no corresponding advancement in the process of knowing (Hofer & Pintrich, 1997; Hofer, 2001). Therefore, it will be instructionally strategic for faculty members in universities and colleges to monitor the epistemological beliefs development of student-teachers throughout their teacher education program. Teacher educators can design epistemological beliefs profiles to periodically assess the belief's levels of the student-teachers. Such profiling will help student-teacher educators in Ghana to evaluate the beliefs of their students in order to come out with comprehensive interventions to help improve their beliefs.

Another interesting thing that emerged from this study was testing the epistemological beliefs of constructivist and behaviorist student-teachers' with their instructional practice. After the procedure, none of the two categories of student-teachers had relationship with instructional practice. This implied that neither constructivist nor behaviorist student-teachers had a significant correlation between their epistemological beliefs and instructional practice. From this revelation, what readily comes to mind is whether Ghana's educational system has identified itself with any of the philosophical paradigms of education. If it does, then, it seemed the student-teachers are less likely to have better understanding of the educational philosophy that the nation subscribes. If it does not, there is the need for researchers to liaise with curriculum developers in Ghana on evidence-based educational philosophy that is consistent with the challenges of the 21<sup>st</sup> century. In this way, students will be equipped with the necessary tools to solve the numerous teaching and learning problems confronting our educational system.

The analysis also revealed that student-teachers had three negative insignificant relationships between epistemological beliefs and instructional practice. The source, justification and attainability dimensions did not seem to have any corresponding increase, while the certainty/simplicity of knowledge dimension increased. Based on the meanings of the source of knowledge, justification for knowing and attainability of truth dimensions, Ghanaian student-teachers were likely to believe in external sources of knowledge as well as struggle with evaluating the accuracy and correctness of knowledge. In such situation, student-teachers might not be able to use rigorous process to discriminate between valid knowledge from an opinion. Such tendency is likely to affect their future students adversely. Though, the researcher did not find significant negative relationships among these dimensions, yet it is important for the attention of educators and teachers to be drawn to this possible downward trend in their epistemological beliefs. At the same time, there is the need to find strategic ways of approaching the teacher preparatory and professional development curriculum of Ghana so as to address these differences in dimensions before student-teachers graduate from college.

There was an issue of poor reliability among student-teachers. Poor reliability is usually associated with poor construction of survey questions. In this particular situation, the discipline-focused epistemological beliefs questionnaire was a validated instrument. With this, three reasons may possibly explain why there was poor reliability among the student-teachers. First, it is possible that the student-teachers did not know their own epistemological beliefs, and for that matter; rated the survey questions without serious introspection of what they believed about the nature of knowledge and the process of knowing. Second, the student-teachers were sampled from a Sub-Saharan African country, which has distinct beliefs systems from the western countries. Third, it was likely the participants were merely completing the survey in order to make way for their other academic commitments. For example, it is common to find participants who will check random numbers on the Likert scale without necessarily paying attention to the demands of the survey.

The implication of this poor reliability is the possibility to deny researchers from getting valid data that are representative of the studied population. These are just speculations and there might be other possible reasons why student-teachers had poor reliability coefficients. To overcome this problem, researchers should probably have conversation with participants to make sure they understand the content of the survey questions in order to provide the best response. For example, there might be certain terminologies used in the instruments that might not be understood by the participants within the Ghanaian context. Having such conversation can help to

explain these new words. At the same time, researchers can give a general description of the study, and the importance of subjects' participation to help solve a real life problem or get deeper insight on the problem. Researchers should be emphatic on the rights of the participants not to take part in the research, so that those who decide to take part; give honest information.

The use of only self-reported Likert scale made it difficult for the researchers to obtain other relevant information that would have shed more light on the epistemological beliefs and instructional practice of the participants during their practicum. Studies with self-reports only have received negative reactions from several researchers (Hofer & Pintrich, 1997; Muis, 2008). For example, by using interviews, focus groups and classroom observations would have brought out relevant questions for student-teachers to respond. Also, it would have been visible for the researcher to see the kind of projected instructional practice that student-teachers will adopt in the classroom. But, since provision was not made for that, there were serious issues in their responses that needed to have been looked into in a more holistic way.

### 5.5. Conclusion

In conclusion, this quantitative research sought to identify the relationship between epistemological beliefs of student-teachers in Ghana. Previous literature indicated that the epistemological beliefs related to instructional practice. However, majority of these studies were done with western populations. In this study, only the certainty/simplicity of knowledge dimension of epistemological beliefs had a significant relationship with Ghanaian student-teachers' projected instructional practice. Student-teachers had somewhat novice overall epistemological beliefs system (3.0) with somewhat average instructional practice (2.6). Unfortunately, there has not been any research on the epistemological beliefs and relationship in Ghana. As a result, it is not possible to compare the present study with any research within similar context. The current study did find significant differences between the four dimensions of epistemological beliefs with each of the dimensions at somewhat novice level. The researchers speculated that the inability to find correlation relationship could be due to the cultural context of the Ghanaian student-teachers.

The intention of the researchers is create the awareness as well as begin discussion within the academia on the need for educators to periodically monitor and evaluate the epistemological beliefs of their student-teachers. There are many aspects of epistemological beliefs that are yet to be known within the Ghanaian context. Importantly, the nature of the country's educational philosophy, to a greater extent, might determine that quality of the human resource. Therefore, the need exists for further research on teachers and student-students' epistemological beliefs in relation with other academic variables in Sub-Saharan Africa. Such data will help policy-makers, curriculum designers, teacher educators as well as in-service teachers in Ghana to strategically use epistemological beliefs to influence other academic variables positively.

## 6. References

- i. Aypaya, A. (2011). The adaptation of the teaching-learning conceptions questionnaire and its relationships with epistemological beliefs. *Educational Sciences: Theory & Practice*, 11(1), 21-29.
- ii. Baxter Magolda, M. B. (1992). *Knowing and reasoning in college: Gender-related patterns in Students' intellectual development*. San Francisco: Jossey-Bass.
- iii. Braten, I., & Stromso, J. I. (2005). The relationship between epistemological beliefs, implicit theories of intelligence, and self-regulated learning among Norwegian postsecondary students. *British Journal of Educational Psychology*, 75, 539-565.
- iv. Brew, C. (2001). Women, mathematics and epistemology: an integrated framework. *Int. Journal. Inclusive Education*, 5(1), 15-32.
- v. Brownlee, J. (2003a). Paradigm shifts in pre-service teacher education students: Case studies of changes in epistemological beliefs. *Australian Journal of Educational & Developmental Psychology*, 3, 1-6.
- vi. Brownlee, J. (2003b). Changes in primary school teachers' beliefs about knowing: A longitudinal study. *Asia-Pacific Journal of Teacher Education*, 31(1), 87-97.
- vii. Brownlee, J., & Berthelsen, D. (2006). Personal epistemology and relational pedagogy in early childhood teacher education programs. *Early Years* 26(1), 17-29.
- viii. Brownlee, J., Walker, S., Lennox, S., Exley, B., & Pearce, S. (2009). The first year university experience: using personal epistemology to understand effective learning and teaching in higher education. *Higher Education*, 58, 599-618.
- ix. Cady, J., Meier, S.L., & Lubinski, C.A. (2006). Developing mathematics teachers: The transition from preservice to experienced teacher. *Journal of Educational Research*, 99(5), 295-305.
- x. Cano, F. (2005). Epistemological beliefs and approaches to learning: Their change through secondary school and their influence on academic performance. *British Journal of Educational Psychology*, 75(2), 203-221.
- xi. Cazan, A. (2013). Validity of the discipline focused epistemological beliefs questionnaire (DFEBQ) on a Romanian sample. *Procedia-Social and Behavioral Sciences*, 78, 713-717.
- xii. Chai, C. S. (2010). Teachers' epistemic and their pedagogical beliefs: a qualitative study among Singaporean teachers in the context of ICT- supported reforms. *The Turkish Online Journal of Educational Technology*, 9(4), 128-139.
- xiii. Chai, C. S., Khine, M. S., & Teo, T. (2006). Epistemological beliefs on teaching and learning: A survey among preservice teachers in Singapore. *Educational Media International*, 43(4), 285-298.
- xiv. Chan, K. W. (2007). Hong Kong teacher education students: Epistemological beliefs and their relations with conceptions of learning and learning strategies. *The Asia-Pacific Education Researcher*, 16(2), 199-214.

- xv. Chan, K. W., & Elliott, R. G. (2000). Exploratory study of epistemological beliefs of Hong Kong teacher education students: Resolving conceptual and empirical issues. *Asia Pacific Journal of Teacher Education*, 28(3), 225-234.
- xvi. Chan, K. W., & Elliott, R. G. (2002). Exploratory study of Hong Kong teacher education students epistemological beliefs—Cultural perspectives and implications on beliefs research. *Contemporary Educational Psychology*, 27(3), 392-414.
- xvii. Cheng, M. M. H., Chan, K., Tang, S. Y. F., & Cheng, A. Y. N. (2009). Pre-service teacher education students' epistemological beliefs and their conceptions of teaching. *Teaching and Teacher Education*, 25, 319–327.
- xviii. Dick, W., Carey, L., & Carey, J. O. (2005). *The systematic design of instruction*. (7<sup>th</sup>ed.). Upper Saddle River, NJ: Pearson Education, Inc.
- xix. Findlow, S. (2008). Accountability and innovation in higher education: a disabling tension? *Studies in Higher Education* 33(3), 313–329.
- xx. Hermans, R., Tondeur, J., Braak, J. V., & Valcke, M. (2008). The impact of primary school teachers' educational beliefs on the classroom use of computers. *Computers & Education*, 51, 1499–1509.
- xxi. Hofer, B.K. (2000). Dimensionality and disciplinary differences in personal epistemology. *Contemporary Educational Psychology*, 25, 378-405.
- xxii. Hofer, B. K. (2001). Personal epistemology research: implications for learning and teaching. *Educational Psychology Review*, 13(4), 353-383.
- xxiii. Hofer, B. K. (2004). Introduction: Paradigmatic approaches to personal epistemology. *Educational Psychologist*, 39(1), 1-3.
- xxiv. Hofer, B.K., and P.R. Pintrich. 1997. The development of epistemological theories: Beliefs about knowledge and knowing and their relation to learning. *Review of Educational Research*, 67(1), 88–140.
- xxv. Kember, D. (2001). Beliefs about knowledge and the process of teaching and learning as a factor in adjusting to study in higher education. *Studies in Higher Education*, 26(2), 205-221.
- xxvi. Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist*, 41(2), 75–86.
- xxvii. Mawere, M. (2011). Epistemological and moral implications of characterization in African literature: A critique of Patrick Chakaipa's 'Rudo Ibofu' (love is blind). *Journal of English and literature*, 2(1), 1-9.
- xxviii. Muis, K. (2004). Personal epistemology and mathematics: A critical review and synthesis of
- xxix. research. *Review of Educational Research*, 74(3), 317–378.
- xxx. Muis, K. R. (2008). Epistemic profiles and self-regulated learning: Examining relations in the context of mathematics problem solving. *Contemporary Educational Psychology*, 33, 177–208.
- xxxi. Muis, K., Franco, G., & Gierus, B. (2011). Examining epistemic beliefs across conceptual and procedural knowledge in statistics. *ZDM*, 43(4), 507-519.
- xxxii. Olafson, L. J., & Schraw, G. (2006). Teachers' beliefs and practices within and across domains. *International Journal of Educational Research*, 45, 71–84.
- xxxiii. Pajares, M. F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research*, 62, 307–332.
- xxxiv. Perry, W. G. (1970). *Forms of Intellectual and Ethical Development in the College Years: A Scheme*, Holt, Rinehart and Winston, New York.
- xxxv. Schommer, M. (1990). The effects of beliefs about the nature of knowledge on comprehension. *Journal of Educational Psychology*, 58, 498-504.
- xxxvi. Schommer, M. (1993). Epistemological development and academic performance among secondary students. *Journal of Educational Psychology*, 85, 406–411.
- xxxvii. Schommer-Aikins, M. (2004). Explaining the epistemological beliefs system: Introducing the embedded systematic model and coordinated research approach. *Educational Psychologist*, 39(1), 19-29.
- xxxviii. Smith, P. L., & Ragan, T. J. (2005). *Instructional design* (3rd ed.). San Francisco: Jossey-Bass
- xxxix. Tanase, M., & Wang, J. (2010). Initial epistemological beliefs transformation in one teacher education classroom: Case study of four preservice teachers. *Teaching and Teacher Education*, 26, 1238-1248.
- xl. Trigwell, K., & Prosser, M. (2004). Development and use of the approaches to teaching inventory. *Educational Psychology Review*, 16(4), 409-424.
- xli. Tsai, C.-C., & Chung, S.-C. (2005). The correlation between epistemological beliefs and preferences toward Internet-based learning environments. *British Journal of Educational Technology*, 36(1), 97-100.
- xl.ii. White, B. C. (2000). Pre-service teachers' epistemology viewed through perspectives on problematic classroom situations. *Journal of Education for Teaching*, 26, 279–305.
- xl.iii. Yilmaz-Tuzun, O., & Topcu, M. S. (2008). Relationships among preservice science teachers' Epistemological beliefs, epistemological world views, and self-efficacy beliefs. *International Journal of Science Education*, 30(1), 15, 65–85.
- xliv. Zohar, A. (2006). The nature and development of teachers' metastrategic knowledge in the context of teaching higher-order thinking. *The Journal of Learning Sciences* 15(3), 331-377.

**Appendix A**

Code Book

Labels	Survey Questions
<b>Certainty/Simplicity of Knowledge</b>	
certsim_1	Truth in the field of education is unchanging.
certsim_2	In the field of education, most work has only one right answer.
certsim_3	All professors in the field of education would probably come up with the same answers to questions in this field.
certsim_4	Most of what is true in the field of education is already known.
certsim_5	In the field of education, it is good to question the ideas presented (R).
certsim_6	Principles in the field of education are unchanging.
certsim_7	Answers to questions in the field of education change as experts gather more information (R).
certsim_8	All experts in the field of education understand the field in the same way
<b>Source of Knowledge</b>	
sour_1	Sometimes you just have to accept answers from the experts in the field of education, even if you don't understand them.
sour_2	If you read something in a textbook for this subject, you can be sure it is true.
sour_3	If my personal experience conflicts with ideas in the textbook, the book is probably right.
sour_4	I am most confident that I know something when I know what the experts think.
<b>Justification for Knowing</b>	
just_1	Correct answers in the field of education are more a matter of opinion than fact.
just_2	There is really no way to determine whether someone has the right answer in the field of education.
just_3	I am more likely to accept the ideas of someone with first-hand experience than the ideas of researchers in the field of education
just_4	First-hand experience is the best way of knowing something in the field of education.
<b>Attainability of Truth</b>	
attain_1	If scholars try hard enough, they can find the answers to almost anything.
attain_2	Experts in the field of education can ultimately get to the truth.
<b>Instructional Practice</b>	
instru_1	I see myself as a facilitator who helps students to construct their own knowledge (R).
instru_2	I think lectures are the most effective way for the students to learn a maximum amount of content knowledge.
instru_3	Group work has limited effects on learning. Students have to study individually in order to acquire important content knowledge.
instru_4	When appropriate, I will encourage my students to give their own opinions or viewpoints on the topic we are studying (R).
instru_5	It is important for me to make sure my students learn the correct facts and information from me.
instru_6	I will encourage my students to make sense of the knowledge with their own personal experience or real life situations (R).
instru_7	The most important thing for my students to learn is the definitions of the concepts or principles that they are studying
instru_8	I will encourage group discussions in my class for the students to see different viewpoints (R).
<b>Other Instructional Practice Items</b>	
qua_1	I feel that I am not practicing the educational philosophy to which I subscribe to.
qua_2	I am more inclined to educational philosophy of... (check either one) <ul style="list-style-type: none"> <li>• Constructivism</li> <li>• Behaviorism</li> </ul>
qua_3	Which of these cause(s) discrepancies between what you believe and what you practice in the classroom? <ul style="list-style-type: none"> <li>• Workload</li> <li>• Mandated state standardized tests of my students</li> <li>• The culture of the school where I work</li> <li>• Fear of trying something different</li> <li>• I know the philosophy, but don't know how to do it in the classroom</li> <li>• Government</li> <li>• Parents' expectation of their children getting high scores on standardized tests</li> <li>• Pressure from the school administration</li> <li>• Others, please specify _____</li> </ul>

*Note: items with R were reverse coded.*