Synthesizing Epistemological Belief Research: Tentative Understandings and Provocative Confusions

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The definition of epistemological beliefs takes on different shades of meaning from study to study; but, in general, researchers of personal epistemology are interested in what individuals believe about the source, certainty, and organization of knowledge, as well as the control and the speed of learning. Epistemological beliefs have been found to relate to reading comprehension, learning in complex and ill-structured domains, as well as learners' active participation and persistence in learning. Researchers are at odds on the issues of epistemological development and the roles that education and culture play in epistemological beliefs.

INTRODUCTION

Beliefs about the nature of knowledge and learning, or epistemological beliefs, would appear to innervate almost every aspect of individuals' day-to-day lives. Although these implicit beliefs are likely to affect reasoning, learning, and decision making, they are often ignored in educational research.

In this article I will synthesize epistemological belief literature that is relevant to those interested in the psychology of learning, in general, or education, specifically. The majority of studies cited will be from the late 1970s to the present along with a few classic pieces published earlier. By focusing on recent research, many of the epistemological studies will have

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been influenced by the most recent findings in cognitively-oriented re-
search. Several key questions will be addressed: (a) How are epistemologi-
cal beliefs conceptualized?, (b) How do epistemological beliefs relate to
learning?, (c) How do epistemological beliefs develop?, and (d) What fac-
tors influence epistemological beliefs? Within each of these sections I will
present research results that address the question followed by an integrative
summary. In the final section of this paper, I will summarize and reflect
on the literature, overall.

HOW ARE EPISTEMOLOGICAL BELIEFS CONCEPTUALIZED?

A review of the epistemic literature makes it apparent that "personal
epistemology" takes on different shades of meaning from study to study.
Furthermore, conceptions of epistemological beliefs in cognitively-oriented
research move away from the traditional philosophical inquiries which as-
sume true, universal, and absolute knowledge. Instead, cognitive re-
searchers focus on what individuals believe about the degree to which
information is true, the organization of information, the acquisition of
knowledge, and the justification of knowledge claims.

The conceptualization of epistemological beliefs in any study is influ-
enced by the focus of the researcher. Researchers, who are primarily in-
terested in eradicating learning problems in a particular discipline, tend to
define personal epistemology in straightforward, unidimensional terms. For
example, in the fields of science (Burbules & Linn, 1991; Songer & Linn,
1991), physics (diSessa, 1988), and mathematics (Schoenfeld, 1983, 1985),
researchers have described poorly performing students as believing that
knowledge is best characterized as a list of unrelated facts, that learning
is quick, or that the learner has no control over learning. Rather than pro-
viding elaborate definitions of epistemological beliefs, researchers tend to
use phrases, such as "knowledge in pieces" (diSessa, 1988), knowledge as
a "mere basket of facts" (Anderson, 1984), "only geniuses are capable
of . . .understanding mathematics" (Schoenfeld, 1988), "fixed ability to
learn" (Dweck & Leggett, 1988), and "prepackaged schemas" (Spiro, Coul-
son, Feltovich, & Anderson, 1988).

In contrast, researchers who focus primarily on the nature of intel-
lectual growth have developed elaborate models of epistemological beliefs.
Three research programs of particular interest are those of Perry (1968,
1970), Kitchener and King (1981), and Belenky, Clinchy, Goldberger, and
Tarule (1986).

Research that Focuses on the Nature of Intellectual Growth. Perry devel-
oped a model of adult epistemological development by administering ques-

tionnaires and conducting follow-up interviews with Harvard University undergraduates. He concluded that college students go through nine "positions" of epistemological belief. Table I includes a summary of these positions.

Some of the most naive students enter college with a dualistic view of the world. In this pattern of thought students believe in absolute, black-or-white knowledge that is handed down by authority. For example, one of Perry's subjects conveyed the following:

> When I went to my first lecture, what the man said was just like God's word, you know. I believed everything he said, because he was a professor, and he's a Harvard professor, and this was, this was a respected position . . . (Perry, 1968, p. 18)

As students encounter different view points in their academic classes, they begin to acknowledge multiple views, yet maintain their belief in the certainty of knowledge. Students account for this diversity of opinion with the explanation that professors are not well prepared or are actually using trick exercises to encourage students to find the right answer for themselves. This view evolves into the first acknowledgment of uncertainty, but this uncertainty is viewed as temporary. In time, authority will determine the answer.

As students advance in their epistemological views, they come to embrace knowledge as complex and tentative. The source of knowledge begins to shift from the simple transfer of knowledge from authority to processes of rational thinking:

> There was one thing I expected — I expected that when I got to Harvard . . . . I came up here expecting Harvard would teach me one universal truth . . . [pause]. Took me quite a while to figure out . . . that if I was going for a universal truth or something to believe in, it had to come within me. (Perry, 1968, p. 38)

By the senior year many students grapple with the uncomfortableness of uncertainty and find a commitment toward belief which is amenable to change when necessary:

Table I. A Summary of Students' Beliefs Using Perry's (1968) Positions

1.	Acknowledges absolute knowledge handed down by authority.
2.	Acknowledges differences of opinion that are the result of poorly qualified authority.
3.	Acknowledges uncertainty as temporary.
4.	Acknowledges relativistic knowledge as the exception to the rule.
5.	Acknowledges absolute knowledge as the exception to the rule.
6.	Apprehends the need for personal commitment in a relativistic world.
7.	Initial commitment is made.
8.	Exploring commitment.
9.	Acknowledges commitment as an ongoing, complex, and evolving process.

. . . Well "tentative" implies . . . perhaps, 1 mean, uncertainty and, and readiness
to change to anything, and-ah, it's not that. It's openness to change but, but not
looking for change, you know-ah . . . . At the same time-ah, believing pretty
strongly in what you do believe . . . (Perry, 1968, p. 41)

In summary, Perry's work suggests that many students enter college
believing knowledge is simple, certain, and handed down by authority. As
they encounter complex, tentative information in their college classes, they
experience conflict with their epistemological beliefs. Presumably, students
go through epistemic changes throughout the college years.

Karen Kitchener and Patricia King have refined Perry's epistemologi-
cal conception. They focus on intellectual development with a special in-
terest in individuals' ability to cope with ill-structured problems. They, and
their colleagues (e.g., King, Kitchener, Davison, Parker, & Wood, 1983;
Kitchener, 1986; Kitchener & King, 1981) describe a model of intellectual
development which is referred to as The Reflective Judgment Model. In
their model summarized in Table II, individuals go through seven stages
of beliefs about knowledge and reality.

Each of these stages is related to individuals' justification of their
claims. In the early stages individuals see knowledge as absolute. "Beliefs
require little or no justification since it is assumed that one must only ob-
serve to know the truth" (King *et al.*, 1983, p. 107). For example, an indi-
vidual responding to his/her beliefs in special creation rather than
evolution, justifies his/her conclusion with the following, "I believe in my
religion. God created man as a person. We did not evolve . . . . I was
taught by my parents and the church. It's worked into me that way" (Kitch-
ener & King, p. 90, 1981). As individuals progress through the stages of
reflective judgment, they come to believe knowledge is temporarily uncer-
tain. In time absolute answers can eventually be found. Hence, justification
for assertions can be put in waiting. "While evidence is incomplete, no one

Table II. A Summary of the Epistemological Beliefs Aspect of Kitchener and King's
(1981) Reflective Judgment Stages

1.	Absolute knowledge is handed down by authority.
2.	Absolute knowledge exists, but is not necessarily immediately known.
3.	Some knowledge is temporarily uncertain.
4.	All knowledge is uncertain. Hence, there is no way to determine which claim is correct or better.
5.	Knowledge is subjective. Claims are made through subjective interpretation.
6.	Objective knowledge is not possible. The knower plays an active role in constructing claims.
7.	Knowledge is an ongoing process of inquiry and must be perceived as approximations of reality.

(including authorities) can claim to 'know' beyond his or her own personal impressions or feelings" (King *et al.*, 1983, p. 108).

In more advanced stages adults begin to see multiple perspectives and conclude that all knowledge is subjective. No objective knowledge is obtainable. "Justification is limited to a particular case, time or issue" (Brabeck, 1984, p. 20). In the seventh stage, knowing is seen as an ongoing process. Objective justification can be made in the sense that some justifications are better than others. The decision may be the best at a particular time or in a particular situation, but claims must be left open to scrutiny because the justification process is not perfect. For example in deciding whether Egyptians built the pyramids, one student justifies his/her response with the following: "Right or wrong are not comfortable categories to assign to this kind of item . . . more or less likely are reasonable . . . more or less in keeping with what the facts seem to be" (Kitchener & King, 1981, p. 100).

Studies testing the reflective judgment model indicate that sophistication in reflective judgment increases with age and education (Kitchener & King, 1981, 1990) and that changes in reflective judgment follow a fixed sequence (King *et al.*, 1983; Kitchener, King, Wood, & Davison, 1989).

In summary, Kitchener and King hypothesize that individuals go through seven stages of development in their beliefs about knowledge and reality. These beliefs guide individuals' reasoning in justifying knowledge claims. One implication of this model is that individuals with naive epistemological beliefs may fail to comprehend sophisticated lines of argument. This may have serious implications for individuals in situations where justification of argument is critical, such as being put in a position of resolving conflicts like being a juror, parent, or teacher.

Belenky *et al.* (1986), refined Perry's research by focusing on women's ways of knowing, particularly women's assumptions about knowledge, reality, and authority. Belenky *et al.* were not satisfied with Perry's conceptualization. Although Perry's research sampled from both Harvard and Radcliffe, the number of Radcliffe women in the sample was very small. Furthermore, with rare exception, deep analyses of interview data excluded the Radcliffe sample.

Belenky *et al.* have also been influenced by Carol Gilligan's (1982) work on women's moral development. Gilligan suggests that Kohlberg's model of moral development is based on the male perspective, which is preoccupied with individual rights and blind, objective justice. Women, on the other hand, are more concerned about responsibility, caring, and relationships. Gilligan hypothesizes three basic stages of moral development for women. They include (a) conventional goodness, in which the moral obligation is to please others, (b) authentic good, in which the moral ob-

ligation is to help others, and finally (c) responsible caring, in which the moral obligation is to help one's self as well as others. The underlying theme for women is to care for others and to avoid hurting others.

Through intense interviews with 135 women, Belenky *et al.* (1986, p. 15) derived five epistemological perspectives that reflect a blend of Perry's and Gilligan's work. Table III presents a summary of these five perspectives. `

Although Belenky *et al.* make it clear that they have not uncovered a developmental model, a progressive trend in sophistication can be seen across their epistemological perspectives. In their sample, a few women started with the perspective of silence and moved into the perspective of received knowledge. In these perspectives women have little respect for their own thoughts and rely exclusively on external authority:

> I never used to think of myself as smart. I really didn't. Most people have never really said anything about it, because I'm quiet. My mother doesn't know how smart I am. My sister never thought I was very intelligent. I never had evidence of it before. So coming here I see myself reflected by other people, what they think of me. It really boosted my ego — I need that, I think. (Belenky *et al.*, 1986, p. 49)

Other women seem to have a more sophisticated epistemological perspective when they acknowledge their own inner voice, a perspective Belenky *et al.* call subjective knowledge. These women feel knowledge is personal, private, and derived from intuition:

> I think what one person sees to be a fact is not necessarily a fact in the eyes of another. So I tend to weigh anything in light of how I feel about it. I am only searching for what is valid for me. I don't try to suffocate people with my ideas or anything like that. I only know for myself. This is truth for me. I believe in myself and my powers. (Belenky *et al.*, 1986, p. 70)

Other women in this sample can be classified into more sophisticated perspectives of procedural knowledge and constructed knowledge. These

Table III. A Summary of Belenky *et al.*'s (1986) Epistemological Perspectives Developed from Interviews with Women

1.	Silence: Women perceive themselves as mindless and voiceless. All knowledge is held by authority.
2.	Received knowledge: Women assume they can receive and reproduce knowledge that has been handed to them from authority. They cannot generate knowledge themselves.
3.	Subjective Knowledge: Knowledge is considered personal, private, and intuitive.
4.	Procedural knowledge: Knowledge is obtained and communicated with objective procedures.
5.	Constructed knowledge: Knowledge is obtained with both objective and subjective processes.

women appreciate both subjective and objective strategies of knowing, as well as the complexity of knowledge:

> . . . I feel that everyone has something unique to say, but some people know how to develop it. Some people can go even further — they can go outside the given frames of reference . . . . (Belenky *et al.*, 1986, p. 133)

In science you don't really want to say that something's true. You realize that you're dealing with a model. Our models are always simpler than the real world. The real world is more complex than anything we can create . . . . (Belenky *et al.*, 1986, p. 138)

> I am starting to *care* about academics. I'm beginning to feel my courses have been connected. It's much more interesting once one discipline starts to interconnect with others . . . . (Belenky *et al.*, 1986, p. 140)

Belenky *et al.*, cautiously suggest that these epistemological perspectives are not solely confined to women. On the other hand, they do assert that more women than men share in these views of knowledge and learning.

In summary, Belenky *et al.* have developed a model of epistemological beliefs based on women's point of view. By focusing on a female sample, Belenky *et al.* have provided a different conceptualization of epistemological beliefs. The five epistemological perspectives they have uncovered indicate an intertwining of beliefs about self with beliefs about authority and knowledge. Their model suggests that epistemological belief researchers need to take into consideration beliefs other than those of the certainty and source of knowledge.

Research that Focuses on Learning. Other models of epistemological beliefs come from researchers who focus on the relationship between epistemological beliefs and learning. Two lines of research of particular interest are those of Ryan (1984a, b) and Schommer (1990, 1992, 1993a, b, 1994).

Michael Ryan (1984a), whose focus is relating epistemological beliefs to comprehension monitoring, simplified Perry's conceptualization of personal epistemology. Ryan developed a seven-item instrument from Perry's original survey that allowed him to classify students as predominately dualistic or predominately relativistic in their thinking. By classifying students in this way, the data indicated that relativistic thinkers had higher standards for comprehension monitoring. Whereas dualistic thinkers were sure they understood material when they could recall facts, relativistic thinkers were sure they understood material when they could apply facts to new situations. Glenberg and Epstein (1987) who use Ryan's dualist scale, did not replicate this relationship (e.g., Glenberg & Epstein, 1987). One possible reason for these inconsistent findings is that the dualistic scale may be an oversimplified measure of personal epistemology.

I initiated a line of research with a focus on relating epistemological beliefs to numerous aspects of learning (Schommer, 1990). I was interested in linking epistemological beliefs to more than justification of argument and comprehension monitoring. And I was impressed by the strong resemblances in the conceptualization of epistemological beliefs among Belenky *et al*'s. categories, Perry's positions, Kitchener's Reflective Judgment stages, and Ryan's dualistic scale. Although the dimensions varied in content and elaboration from researcher to researcher, all of these characterizations represented personal epistemology as unidimensional. This means of conceiving epistemological beliefs may fail to capture the complexity of personal epistemology and may mask the multiple links between personal epistemology and different aspects of learning. Thus, I proposed that epistemological beliefs be reconceived as a system of more or less independent beliefs. By system, I mean that there is more than one belief to consider. And by more or less independent, I mean that individuals may be sophisticated in some beliefs, but not necessarily sophisticated in other beliefs. With this conceptualization, epistemological beliefs can be studied individually or in various combinations. An underlying assumption is that individual beliefs, as well as unique combinations of beliefs, may have different effects on learning. For example, individuals who believe in absolute (certain) knowledge that is simple (compartmentalized) may study history by memorizing lists of facts and dates. Furthermore, they may assume all historical information is objective. On the other hand, individuals who believe in absolute knowledge that is highly complex (interconnected) may search for the big picture and relate events to each other. They would assume this big picture would give them the definitive story of history.

I have hypothesized five beliefs about the nature of knowledge and learning (Schommer, 1990), to date. These beliefs were initially conceived as continuums. These continuums are shown in Table IV. Titled from a naive perspective they include belief in: (a) Omniscient Authority, (b) Certain Knowledge, (c) Simple Knowledge, (d) Quick Learning, and (e) Fixed Ability. This set of beliefs is not exhaustive; rather these five continuums serve as a starting point for this program of research.

I have conducted several studies to test the construct validity of this emerging model of epistemological beliefs. A 63-item questionnaire was developed to assess these five hypothesized beliefs. College students rated their degree of agreement to statements about knowledge and learning on a 5-point scale. For example, "If scientists try hard enough, they can find the answer to anything." Exploratory factor analysis has yielded four out of the five epistemological beliefs: simple knowledge, certain knowledge, quick learning, and fixed ability (Schommer, 1990). This factor structure has been replicated with other college students (Schommer, Crouse, &

Table IV. Schommer's (1990) Hypothesized Epistemological Dimensions

1. Source of knowledge: From knowledge is handed down by omniscient authority to knowledge is reasoned out through objective and subjective means.
2. Certainty of knowledge: From knowledge is absolute to knowledge is constantly evolving.
3. Organization of knowledge: From knowledge is compartmentalized to knowledge is highly integrated and interwoven.
4. Control of learning: From ability to learn is genetically predetermined to ability to learn is acquired through experience.
5. Speed of learning: From learning is quick or not-at-all to learning is a gradual process.

Rhodes, 1992), high school students, (Schommer, 1993a), and by other researchers (Dunkle, Schraw, & Bendixen, 1993). Close approximations to all five hypothesized epistemological beliefs have been found through confirmatory factor analysis by other researchers (Jehng, Johnson, & Anderson, 1993) who have combined the Schommer Epistemological Questionnaire with the Spiro Epistemological Questionnaire (Spiro, 1989). Using this model, epistemological beliefs have been linked to several aspects of learning, which are discussed later in this paper.

More recently, I have refined and elaborated on my conceptualization of epistemological beliefs (Schommer, 1994). In order to capture the complexity of beliefs, personal epistemological dimensions may be pictured as frequency distributions rather than as a single point along a continuum. For example, sophisticated learners may believe a vast amount of knowledge is evolving, some knowledge is yet to be discovered, and a very small amount of knowledge is unchanging. With this belief distribution, individuals would be critical readers, yet when enough evidence was presented, they would come to believe the veracity of information. On the other hand, naive learners may believe a vast amount of information is certain, some knowledge is yet to be discovered, and a very small amount of knowledge is changing. With this belief distribution, individuals would be uncritical readers. They are likely to be people who are susceptible to advertisements that boast of a cure for baldness or an answer to losing weight without dieting or exercising. Research is underway to test this refined conceptualization of epistemological beliefs.

In summary, in my research on epistemological beliefs and learning, beliefs are conceived as a system of more or less independent distributions. There are multiple dimensions to be considered and these dimensions can be thought of independently, as well as together. These two features have

important implications. They suggest that epistemological beliefs do not necessarily develop in synchrony. Furthermore, single beliefs as well as combinations of beliefs may affect learning. This characterization and assessment of epistemological beliefs provides the means for testing these implications. An extended discussion of my emerging theory of epistemological beliefs can be found elsewhere (Schommer, 1994).

To summarize across these models of epistemological beliefs, individuals' beliefs in the source, certainty, and organization of knowledge, as well as the speed, and control of knowledge acquisition are key concerns of personal epistemology.[2] Conceptions of personal epistemology include both affective and cognitive components. Philosophers may find these conceptualizations of knowledge too simplistic or too applied. Yet, for educational psychologists, the applied aspects are as important as the theoretical. In the next section, I focus on those applied aspects and describe data regarding the relationship between personal epistemology and learning.

HOW DO EPISTEMOLOGICAL BELIEFS RELATE TO LEARNING?

The cognitively oriented literature provides evidence for numerous relationships between epistemological beliefs and learning. Studies focus either on the conception of epistemological beliefs, in general, or on effects of epistemological beliefs on learning in specific disciplines. An integration of the literature indicates that epistemological beliefs affect the degree to which individuals: (a) actively engage in learning, (b) persist in difficult tasks, (c) comprehend written material, and (d) cope with ill-structured domains. In each of these areas, the evidence suggests that epistemological beliefs may either help or hinder learning.

Active Learning. Epistemological beliefs may affect students' degree of active involvement in learning. One belief some students hold is that the learner's role in learning is to be passive. The idea behind passive learning is that one listens quietly, without actively asking questions for either clarification or criticism of what is being taught. Three major strands of research have approached this belief in different ways.

McDevitt has initiated a program of research on students' beliefs about listening. In a series of studies, McDevitt and her colleagues, asked mothers, children, and college undergraduates to describe what they believe

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[2]There are also definitions of epistemological beliefs that are more philosophically oriented and may be of interest to educational psychologists involved in social issues. These include Chandler's Adolescent Development Model (Chandler, 1987; Boyes & Chandler, 1992), Royce's World View Model (Royce & Powell, 1983), and Unger's Attitude About Reality Scale (Unger, Draper, & Pendergrass, 1986).

is good listening behavior and what is appropriate behavior when they encounter difficulty in understanding. Beliefs about good listening behavior ranged from sitting still and looking vigilantly at the speaker to blocking out distractions and asking the speaker for clarification. Among college students, only 15% indicated that they would typically ask a professor a question for clarification (McDevitt, 1990; McDevitt, Sheehan, & McMenamin, 1991; McDevitt, Spivey, Sheehan, Lennon, & Story, 1990).

The belief that passive listening is an appropriate approach to learning is consistent with two of Belenky *et al.*'s epistemological categories, silence and received knowledge. Two key elements are involved in the passive reception: Knowledge is absolute, and authority has the knowledge. This is apparent in Belenky *et al.*'s comments:

> Being recipients but not sources of knowledge, the students feel confused and incapable when the teacher requires that they do original work. Angela had a professor who burdened her with just such expectations. She said he was wrong — "wrong in his method of teaching," not, of course, "wrong because of what he said." Knowing all the "right answers" himself, the professor refused to pass them on. "He would make you feel stupid. He would make you find the answers on your own. And he wouldn't even give you any hints on what the right answers were." How could she learn if the teacher refused to pass along the knowledge? (Belenky *et al.*, 1986, p. 40)

This passive acceptance of information has also been shown in studies focusing on the belief about historical knowledge (Fournier & Wineburg, 1993; Wade & Thompson, 1993, Wineburg, 1991). Poorer learners of historical text have been shown to believe that historical accounts are merely reports of the "facts," which should be passively accepted. Poor learners do not grasp the idea that historical texts are interpretations of past events and that authors may be making a persuasive argument to convince the reader to believe their interpretations.

Persistence. Epistemological beliefs have also been shown to relate to persistence. The research indicates that at least two epistemological beliefs may contribute to the degree students will persist when engaged in a difficult task: belief about the control of learning (Dweck & Bempechat, 1983; Dweck & Leggett, 1988; Livengood, 1992; Miller, Behrens, Greene, & Newman, 1993) and belief about the speed of learning (Horwitz, 1988; Schommer, 1990; Schoenfeld, 1983, 1985, 1988).

Carol Dweck's research has focused on the belief that the learner can control learning. Dweck and her colleagues have developed a theory about children's beliefs about intelligence. Some children believe the ability to learn is fixed (fixed theorists). Other children believe that intelligence can actually be improved (incremental theorists). For the fixed theorists, the purpose of an academic task is to document their intelligence. For the incremental theorists, the purpose of an academic task is to improve intel-

ligence. When engaged in an easy task, the two types of child theorists perform about the same. When a task becomes difficult, the fixed theorists' reflections are negative, such as "this is too tough," "I can't get this." They perseverate on the same study strategies and cease to try. The incrementalists' reflections are positive, "I need to try harder," "I have to try different things." They tend to persist and outperform the fixed theorists.

Belief in quick all-or-none learning also relates to persistence in solving mathematical problems (Schoenfeld, 1983, 1985, 1988), reading comprehension across disciplines (Schommer, 1990), and learning communication skills in foreign languages (Elbaum, Berg, & Dodd, 1993; Horwitz, 1988). For example, Schoenfeld has found many high school mathematics students believe that mathematic problems should be solved in 12 minutes or less. Any more time spent is a waste of time. Some of the students in his study tended not to spend more than 5 or 6 minutes on a problem! In my own research, results indicate that of the four epistemological beliefs I assess, belief in quick all-or-none learning was the strongest predictor of high school students' grade point average, after controlling for general intelligence (Schommer, 1993a). The less students believe in quick learning, the higher grade point average they earn.

Reading Comprehension. Epistemological beliefs play an important role in various aspects of reading. Some students believe learning to read means memorizing words. For example, adult illiterates have described their own experiences as young children and concluded that this misconception was an important contributor to their failure to learn to read (Johnston, 1985). Other students believe that reading to learn means reading to memorize facts. As discussed earlier, Ryan (1984a) found that the more college students believe knowledge is right or wrong with no shades of grey, the more likely they are to feel they understand the information if they recall basic facts and definitions. On the other hand, students who believe in relativistic knowledge feel they understand information when they can apply the facts to new situations.

Still other students believe reading to learn should be a quick process which reveals absolute (certain) information. In one study (Schommer, 1990), college students were asked to read complex passages with tentative findings. The final paragraph was removed from the passages. Students assessed their own comprehension of the passage, wrote a concluding paragraph, and completed a comprehension test. One month prior to this testing situation, these students had completed the Schommer Epistemological Questionnaire. Results indicated that the more college students believe in quick all-or-none learning, the less they understand passage information. This was evidenced in their poorly written conclusions to the passages, their poor passage test performance, and their overconfidence in

rating their passage comprehension. In addition, students who had strong beliefs in certain knowledge, distorted passage information and interpreted tentative knowledge as absolute.

Epistemological beliefs are related to integrating information within text as well as between text and to the learner's prior knowledge. The belief that knowledge is best characterized as bits of isolated knowledge has been shown to relate to understanding scientific concepts, such as Ohm's Law and thermodynamics (Burbules & Linn, 1991; Cleminson, 1990; diSessa, 1988; Jegede & Okebukola, 1991; Lederman, 1992; Linn, Songer, & Lewis, 1991; Songer & Linn, 1991; Spiro, Coulson, Feltovich, & Anderson, 1988); and mathematical concepts, such as geometric relationships and algebraic proofs (Mtetwa & Garofalo, 1989; Schoenfeld, 1983, 1985, 1988; Schommer, Crouse, & Rhodes, 1992; Underhill, 1988). Songer and Linn (1991) describe epistemological beliefs about the integration of knowledge as either static or dynamic beliefs. When students are asked what learning science is like for them, a static believer responds, "Memorizing words and facts. That is how I learn science, that is how I learn the best . . . when I drink orange juice, I don't break down the chemicals or minerals, I just drink it." In contrast a dynamic believer responds, "Doing puzzles, because in science sometimes the pieces don't fit in your head . . . . Sometimes the facts don't give you all the information you need" (Songer & Linn, 1991, p. 770).

Ill-Structured Problems. Epistemological beliefs also relate to students' ability to cope with ill-structured problems. The issues involved in coping with ill-structured questions are that there may be more than one right answer, there may be more than one route to solving a problem, or there may not be any clear cut answer. Research in the areas of argument justification, (Dunkle, Schraw, & Bendixen, 1993; Chandler, Boyes, & Ball, 1990; Kitchener, 1983, 1986; Kitchener & King, 1981; Kuhn, 1992) and advanced knowledge acquisition, such as learning in the medical field (Silva & Nicholls, 1993; Spiro, Coulson, Feltovich, & Anderson, 1988; Spiro, Vispoel, Schmitz, Samarapungavan, & Boerger, 1987) serve to uncover the links between epistemological beliefs and ill-structured knowledge. For example, Kuhn (1992) asked subjects why prisoners become repeat offenders. As she probed into subjects' justifications of their argument, Kuhn was able to discern individuals' epistemological beliefs:

Question: Do experts know for sure what the cause is?
Absolutist: If they're experts, they know.
Multiplist: I don't think anybody knows for sure really, because there really isn't one right answer . . . .
Evaluative: Well, I think they're close. I mean, nothing's for sure, but I'm sure they have good ideas about why people fail. (Kuhn, 1992, p. 169)

Spiro and his colleagues (1988) have investigated how one becomes an expert in the field of medicine. Their research suggests that some medical students tend to oversimplify information and fail to recognize irregular structure. For example, some students may not realize that patients' symptoms for the same illness will vary from individual to individual. As medical students gain deeper knowledge they may encounter obstacles. "Obstacles to advanced knowledge acquisition include conceptual complexity and increasing ill-structuredness . . . . By ill-structuredness we mean that many concepts (interacting contextually) are pertinent in the typical case of knowledge application, and that their patterns of combination are inconsistent across case applications of the same nominal type" (Spiro *et al.*, 1988, p. 375). The medical students were found to use single analogies to comprehend phenomena that required multiple analogies, to compartmentalize information that should be integrated, and to fail to modify their schemata from case to case. For example, Spiro and his colleagues present advice to cope with students' persistence in using single analogies:

> Where we find that misconceptions about the nature of force production by muscle fibers often develop because of a common analogy to the operation of rowing crews (sarcomere "arm" and oars both generate force by a kind of "pulling"), other analogies are introduced to mitigate the limited rowing crew analogy. An analogy to turnbuckles corrects misleading notions about the nature of relative movement and the gross structures within the muscle. And analogy of "finger handcuffs" covers important information missing in the rowing crew analogy about the limits of the fiber length. (Spiro *et al.*, 1988, p. 380)

In summary, epistemological beliefs are related to students' persistence, active inquiry, integration of information, and coping with complex and ill-structured domains. All of these attributes are related to higher level learning. If memorization were all that were needed in learning, epistemological beliefs would be of little concern. But higher level learning continues to rise in importance as our society becomes more technologically advanced and informationally oriented. The next logical questions are, "How do individuals' epistemological beliefs evolve in order to cope with higher level learning?" and "What are the factors that influence this evolution?"

HOW DO EPISTEMOLOGICAL BELIEFS DEVELOP?

If the diversified conceptions of epistemological beliefs seem confusing, synthesis of research involving the development and modification of epistemological beliefs generates true enigmas! Consider the development of epistemological beliefs. To date, only Perry, Kitchener, and King have addressed development in a systematic way. Perry, does not claim that changes in college students' epistemological beliefs are stages. Presumably

that is why he chose the term "positions." Students can delay, escape, or retreat from the development of their epistemological beliefs. Perry reported that 75% of the students in his sample had reached higher levels of epistemological development. Other researchers testing development with Perry's model have found only 25% of the college students in their sample reached Perry's final position (Lavallee, Gourde, & Rodier, 1990).

Kitchener and King, who refined Perry's model, do claim that the Reflective Judgment Model is a stage model. Kitchener, King, and their colleagues have tested the stage assumption (Kitchener, King, Wood, & Davison, 1989). In a 6-year longitudinal study, three groups of subjects were evaluated. These groups were high school juniors, college juniors, and doctoral level graduate students in 1977. In 1977, 1979, and 1983 their reflective judgments were measured and analyzed. There was a substantial positive correlation between age and stage of reflective judgment, as well as a significant increase in stage of reflective judgment across time. Subjects moved through the Reflective Judgment stages sequentially.

The enigma involves researchers' interpretation of the development of epistemological beliefs. There appear to be two camps or two different interpretations of this development. One camp suggests that reaching Perry's highest level of intellectual development involves reaching Piaget's formal operations stage (e.g., Boyes & Chandler, 1992; Chandler, 1987; Chandler, Boyes, & Ball, 1990). Boyes and Chandler (1992) describe changes in epistemological beliefs as a part of the transitional process of adolescent development. A brief description of these stages is included in Table V.

Table V. Boyes and Chandler's (1992) Epistemic Substages During Growth from Concrete Operations to Formal Operations

1. Naive realism: Knowledge is acquired through exposure to raw facts. Difference in opinions is thought to be a consequence of being exposed to a different set of experiences. If everyone is exposed to the same set of facts, they will acquire the same knowledge.
2. Realism: Differences of interpretation of the same facts are excused by classifying the differences as "opinion."
3. The dogmatism/skepticism axis: Formal operations is achieved. With the advanced reasoning ability, adolescents move from occasional case-specific acknowledgments of uncertainty to generic doubt. Two reactions to this awareness are "dogmatism" and "skepticism." They may cling to religion or science as a resource of hope in the state of uncertainty or they may ignore all authority and "do their own thing," because there is no hope for rational consensus.
4. Postskeptical relativism: Especially mature young people may come to the subjective nature of knowledge and find it possible to make decisions that are not based on absolute facts.

As young people move from concrete operations to formal operations, they become aware of the uncertainty of knowledge. An initial reaction to this awareness can range from extreme dogmatism — clinging to religion or the scientific method as a source of absolute answers — to extreme skepticism, abandoning all efforts to evaluate information and resolving this limbotic state by thinking anything goes. Boyes and Chandler have found support for the notion that only those adolescents who are well beyond the onset of formal operations display a resolved acknowledgment of the uncertainty of knowledge.

That Boyes and Chandler maintain this epistemic movement as a part of formal operations, rather than post-formal operations, is apparent in their discussion of other researchers' epistemic findings.

> It is . . . clear that neither epistemic development nor the identity formation process are complete by the end of the high school years . . . . Perry's model assumes that young people enter the college years in either a dualistic (realistic) epistemic stance or having only recently abandoned one. The model advanced and tested in this study, by contrast, indicates that young people may leave such realistic assumptions behind in their junior high school years. This suggests that what Perry and others (Kitchener & King, 1981; King *et al.*, 1983; Strange & King, 1981) may be tracking as they mark college students' movement through positions of epistemic dogmatism and skepticism (relativism) is actually the students' second pass through these same developmental levels. (Boyes & Chandler, 1982, p. 298)

The other camp sees this highest level of epistemic development as a post-formal operational stage (e.g., Basseches, 1986; Benack, 1984; Broughton, 1984; Kitchener, 1986; Kramer, 1983; Labouvie-Vief, 1984; Sinnott, 1984). Broughton (1984) describes Piaget's claim of formal operations as a clear, definite, and final one. Some post-Piagetian authors have argued that the formal operational construct is "either *erroneous, penultimate,* or *biased*" (Broughton, 1984, p. 396). A synthesis of this three-pronged attack is that Piaget's insistence on the centrality of formal logic in the final stage of cognitive development is inadequate. The more cognitively mature individual thinks epistemologically, relativisticly, and dialectically — thinking that goes beyond formal logic — beyond formal operations. These two views have not been reconciled.

I have carried out one study that attempts to address epistemological belief development. The Schommer Epistemological Questionnaire was administered to over 1000 high school students. Analyses revealed that beliefs in simple knowledge, certain knowledge, and quick learning decreased from freshmen to senior years. Although this study does not address the Piagetian stage controversy, it does suggest that the beliefs of high school students are changing. Because this was a cross-sectional design, these data must be interpreted with caution. It could be that high school students are slowly advancing in their views of learning and knowledge. On the other

hand, it could be that students with extremely naive epistemological beliefs, for example maintaining strong beliefs in absolute, compartmentalized facts to be accepted without question, have dropped out of high school. A longitudinal study is in progress to clarify this issue. All-in-all, development of epistemological beliefs appears to be an area requiring much more research. The question still remains, "What causes epistemological beliefs to change?"

WHAT FACTORS INFLUENCE EPISTEMOLOGICAL BELIEFS?

Anderson (1984) asserts that epistemological beliefs are a product of both the home and formal education.

> . . .Children not only acquire experience, they acquire interpretations of experience. It stands to reason that the beliefs about knowledge that a child develops will be influenced by those of his parents. Parents' beliefs about knowledge will be conditioned by educational and occupational status. . . .Later, teachers become mediators of experience.

The enigma is, what are the different roles of education and culture? Of course, education is a part of culture. Yet, researchers and educators who are concerned about making a difference, may want to understand how these two factors, culture inside education and culture outside of education, contribute to individuals' epistemological beliefs. First, evidence for education's influence on epistemological beliefs will be discussed, followed by the influence of culture outside (or in interaction with) education.

Epistemology Inside the Classroom. The question of educational influence on epistemological beliefs is typically embedded in larger research issues. Careful synthesis of the literature does provide several insights: (a) a historical legacy of philosophical underpinnings of education, (b) evidence of instruction that instills naive epistemological beliefs, (c) recommendations for philosophically sound instruction, and (d) recommendations for teacher education.

Among the articles reviewed, a historical legacy of believing in simple, certain knowledge, handed down by an all knowing authority can be seen in the fields of science, mathematics, and language arts. Cleminson (1990) has claimed that the philosophy of logical positivism, which separates the knower from the known, continues to influence science teaching. Students are expected to be good observers only. This is consistent with students' belief in passive learning found in studies discussed earlier. In mathematics, Schoenfeld talks about the heritage of the "absorption model," a model described by Helms and Novak (1984, cited in Schoenfeld, 1988) in which traditional classroom teachers teach mathematics as if it were a fixed body

of knowledge which the learner is supposed to absorb. A good teacher is the teacher who finds ten different ways to teach the same thing so that eventually the students get it. The assumption is that students are passive recipients who must depend on the teacher to fit information into their minds.

· Perhaps the most intriguing historical legacy is found in a study by Walker (1985). He analyzed Canadian textbooks, Department of Education reports, curriculum guides, and anecdotal records from 1905 to 1985. In his analyses, he found that memorizing and analyzing grammar terminology was considered the science of language. It was assumed that there was one correct usage of speech and writing. Speech and writing did not differ. Learning entailed memorizing, abstracting, and reasoning. These cognitive activities served as exercises for the mind that would enhance thinking in other domains. Making learning interesting was actually considered counterproductive. "A nineteenth-century British schoolmaster was reported to have said that once you interest boys in a subject, it loses half of its disciplinary value" (Walker, 1985, p. 27). The positivists' influence was clear. Grammar was composed of a body of objective facts that the student was to master. Walker concluded his article with a caveat to today's language arts teachers.

> If . . . we adopt a deductive approach [to teaching] we do so out of an allegiance to an old-fashioned set of assumptions about what language is, what it means to learn it, and what constitutes language . . . . If you teach children how to find adverbial clauses of manner in sentence exercises, you are committing yourself to certain beliefs. . . . "Do you really hold these beliefs?" (Walker, 1985, pp. 32-33)

Although many assert that today's teaching reflects the vestiges of history, the most direct evidence comes from qualitative studies, such as case studies (Cronin-Jones, 1991; Schoenfeld, 1988) and discrete observations (Rigden & Tobias, 1991). For example, Schoenfeld (1988) carried out a case study of instruction in a geometry class. Although all of the teacher's actions were well intended, performance on the Regents examination was considered a reflection of success for the teacher, as well as for the students. Proofs were emphasized the most on this exam, and only one construction problem was required. With this goal in mind, the teacher taught proofs as a step-by-step procedure to be memorized. Construction was included at the end of the school year. In construction problems, students are to apply rules that allow them to create figures, such as an isosceles triangle, with the use of a straight edge and compass only. No measuring instrument may be used. When construction was taught, the teacher made it clear that "You'll have to know all your constructions cold. . . . This is where practice at home comes in" (Schoenfeld, 1988, p. 155). The message

was clear. Learn the construction so well you can retrieve it quickly, as opposed to reasoning it out.

Other evidence comes from an intriguing study in which college teachers were observed. Rigden and Tobias (1991) had faculty members and graduate students pose as real students. They attended introductory science classes and wrote journal notes of their experiences and perceptions. These surrogate learners found that examinations emphasized the memorization of isolated facts. There was a special emphasis on single, correct answers. Not once were they asked to explain or elaborate on a concept.

Although this research sounds pessimistic, some of the research examining the influence of teaching on students' epistemological beliefs is optimistic. For example, Beers (1988) found that some teachers may be unconsciously instilling sophisticated epistemological beliefs. Beers interviewed college teachers in an attempt to understand their educational goals.

> . . .Few were interested in transmitting the content *per se* to students. Rather . . . it seemed that these teachers were primarily concerned with helping them develop particular attitudes and styles of thinking. A biologist, for example, said she "hated facts," and spoke of "getting students excited about the way the world works." . . .When these teachers were discussing their educational goals, they were referring to a set of epistemological assumptions — a sense of what knowledge consists of and procedures that one does to obtain and assess knowledge. (Beers, 1988, p. 87)

Hence, it cannot be concluded that all instruction instills naive epistemological beliefs.

Sifting through the literature, one can see recommendations for education that nurture epistemological beliefs in students that are more consistent with what is known about facilitating learning. No single author provides all the answers, but a synthesis of the works of several researchers provides some guidelines for teachers, teacher educators, and educational policy makers (Baxter Magolda, 1992; Beers, 1988; Burbules & Linn, 1991; Cleminson, 1990; Darling-Hammond, 1993; Dweck & Bempechat, 1983; Schoenfeld, 1988; Schommer, 1990; Short & Burke, 1989; Toulmin, 1972).

First, teach in a way that communicates learning as an active, personal construction of knowledge. This personal construction influences how individuals learn additional knowledge. For example, provide hands on experiences in science laboratories that allow students to generate knowledge.

Second, communicate that higher level learning typically requires a struggle, and that this struggle generates emotion. The emotion should be interpreted in a positive way. One source of emotion is coping with difficult tasks. As in Dweck's terms, encountering difficulty should be interpreted as facing a challenge rather than facing failure. The response should be to work harder, longer, and to try different strategies to reach the goal. Teachers can provide experiences to encourage this reaction to academic strug-

gles. For example, they can present complex problems that do not have clear cut answers. They can encourage students to take their time and to search for multiple solutions. Teachers can then help students distinguish between fuzzy, yet acceptable answers, in contrast to mindless, meandering thoughts (Langer, 1993).

Another source of emotion comes from the relationship between students and teachers. In some of my ongoing research, I am engaging in lengthy epistemological interviews. When I have asked students what advice they would give universities to improve instruction, a very common response is that teachers should show that they care. This response came from both men and women. Although these data are yet to be fully analyzed, I have drawn some tentative conclusions. If teachers are perceived by the students as doing their job just to earn a paycheck, then learning is devalued. When students feel that teachers are genuinely concerned about their academic performance, students are more likely to believe that learning is important.

Third, teach in a way that conveys learning as seeing the connections among ideas and that these connections are always evolving in nature. For example, students need to see the link between what they learn in the classroom and what they learn in the world. They need to discover that the application of knowledge will need to be adjusted for specific situations. Requiring students to interpret or apply knowledge within several contexts may facilitate students' awareness of the intricate and dynamic nature of knowledge.

These suggestions are applicable to the teaching of pre-service teachers, as well as elementary, secondary, and other post-secondary students. Baxter Magolda (1992) captures these notions in her reflections of her 4-year interview study in which she investigated college students' attitudes about their role as learners, and the role of instructors and their peers in the learning process. Her analyses of these data lead her to make the following recommendations.

> We must start with students' knowledge rather than teachers' knowledge, recognizing that helping students think about their perspectives is more useful than having them memorize those of others. Helping students struggle together to sort out their perspectives seems less efficient than providing them with a good summary of material. However, the difference in impact for these students makes it clear that helping them struggle is the best option for promoting complex thinking. Perhaps pedagogy should balance a focus on the thinking process with a focus on learning specific content. Finally, the students' stories show that the learning process is richly laced with emotion. Learning across all epistemological perspectives was more effective when professors expressed regard for students as learners and knowers. (Baxter Magolda, 1992, p. 286)

Epistemology Outside the Classroom. These conclusions regarding epis-
temology inside the classroom sound straightforward, right? In a sense,
what has been gleaned is a prescription for epistemological beliefs. But
what if this prescription conflicts with students' home epistemology? Many
educational psychologists would say that the above prescription is based
on sound cognitive research, gathered in an objective manner, and dealing
with cognitive processes that should be the same across all cultures. But
this issue is not clear cut. Herein comes the role of factors outside educa-
tion, another enigma!

In my review, I did not find a preponderance of research that focused
specifically on epistemological beliefs and culture. Rather, this relationship
is uncovered in research that has different foci, such as multicultural edu-
cation and family influences on education. In this literature, a sense of
conflict between epistemology in school and epistemology at home can be
detected, as well as confusion between researchers who are most likely un-
aware of each other.

Research about family influences on epistemological beliefs comes
from cross-cultural studies. For example, Pai (1990) suggests that one rea-
son so many youngsters from disparate cultural groups have difficulty with
mainstream American schooling rests in how they perceive learning. The
assumption in many American schools is that learning occurs through per-
sonal involvement and active communication. The motivation behind learn-
ing is individual achievement. In contrast, Pai reports that shared-function
groups (for example, Asian Americans, African Americans, Hispanic
American, and Native Americans) believe learning occurs through docility
with emphasis on observation and emulation. The motivation behind learn-
ing is group achievement. These traditions of learning are nurtured in the
home, as well as in other social institutions, such as religion.

Notice the conflict. Pai is suggesting that traditional American edu-
cation is already pushing for active involvement. Yet, much of the research
I presented earlier describes traditional teaching as if students were being
encouraged to passively receive knowledge. Again, it is as if there are two
camps of thought and these two camps do not know about each other.

Another intriguing dilemma arises in the definition of epistemological
beliefs. Earlier, the issue of control of knowledge acquisition was consid-
ered critical to students persisting in the face of a difficult task. In Dweck's
terms, this is related to children's beliefs about intelligence. Undoubtedly,
this notion is also related to locus of control. Pai presents a fascinating
account of how mainstream America could be misinterpreting minority cul-
tures' epistemological views:

Studies indicate that when compared with white middle-class individuals, members
of minority cultures are significantly more inclined toward the external locus of
control (Sue, 1981, p. 75; Yum, 1988). . . . There is a fundamental flaw in the prem-
ise that locus of control can be clearly classified into internal and external catego-
ries. As a matter of fact, when viewed from different cultural perspectives, the
meaning of what is internal and what is external are not clear at all. For example,
to the Native Americans who believe that they are one with nature, what Westerners
call external natural forces cease to be external to Native Americans. Similarly,
Asians or Asian Americans who believe that the values of their family are an or-
ganic, inextricable part of their very being, absolute obedience to the family deci-
sions cannot be seen as external in the Western sense of the term. In a very real
sense, use of the terms internal and external cannot relate to a world view that
does not see reality and life in terms of either/or disjunctions. (Pai, 1990, p. 219)

Have researchers from mainstream culture misunderstood individuals from
other cultures? I offer this question as a serious issue to be pondered.

In an attempt to tease apart the influences of education and life's
experiences on epistemological beliefs, I conducted a study (Schommer,
1993b) with students from the same culture. In order to control for the
confound between education and age (one measure of life's experiences)
adults from all walks of life were sampled. One third of the sample had
no more than a high school education. Another third had no more than a
college education. The remaining third had been exposed to graduate edu-
cation. These adults completed the Schommer Epistemological Question-
naire and a demographic/upbringing survey. To briefly summarize the
results, background variables of adults predicted beliefs in quick all-or-none
learning and fixed ability. For example, the older they were and the more
opportunities they were given to discuss important issues with their parents,
the less likely they were to believe in quick learning and fixed ability. Level
of education predicted their belief in simple knowledge and certain knowl-
edge. The more education they had, the less likely they were to believe in
simple and certain knowledge. It is interesting to note that the beliefs about
learning, which seem to intimately involve "the self," were predicted by the
adults' home life. Beliefs about knowledge, which might be considered by
some of the adults in this sample as more distant from "the self," were
influenced by education.

The issue of what influences epistemological beliefs is murky at best.
There is little doubt that both education and culture influence these beliefs.
But how do these influences interact with each other? How often do we
misunderstand our students with different epistemologies? And these dif-
ferent epistemologies can come from different socioeconomic groups, oc-
cupational groups, as well as ethnic and cultural groups. How do we bridge
the gap? How do we even know to which epistemology to aspire?

FINAL THOUGHTS

The domain of epistemological beliefs is clearly ill-structured. What can be gleaned from recent studies is that the definition of epistemological beliefs varies from study to study. Taken as a whole, beliefs in simple knowledge, certain knowledge, omniscient authority, fixed ability to learn, and quick all-or-none learning have been found to hinder critical aspects of learning.

The majority of this research is based on observations, interviews, or correlational data. On the one hand, a variety of methodologies provide different insights. On the other hand, lack of true experimental studies does not allow for inferences of causal relationships. What can be concluded is that there is enough accumulated evidence to suggest that epistemological beliefs are critical to the learning process. It is up to future researchers to carry out both qualitative research to broaden our conception and understanding of epistemological beliefs and quantitative research to identify causal relationships between epistemological beliefs and other aspects of cognition.

In day-to-day classroom life, this philosophically laden topic is seldom discussed. In order to enhance students' higher level thinking, epistemological beliefs need to be brought out in the open. Dealing with epistemological beliefs is a messy business. But that should not be an excuse to ignore them. Pajares (1992) presents a convincing argument about the need to address beliefs (in general) in educational research. His argument is applicable to epistemological beliefs, as well.

> If the hesitancy of many researchers to study beliefs and of teacher educators to make them a focus of teaching and teacher preparation has been due to, as one colleague put it to me, the concern that beliefs are "messy" things, I suggest that the construct is less messy, far cleaner, and conceptually clearer than it may appear. When they are clearly conceptualized, when their key assumptions are examined, when precise meanings are consistently understood and adhered to, and when specific belief constructs are properly assessed and investigated, beliefs can be as Fenstermacher (1979) predicted, the single most important construct in educational research. (Pajares, 1992, p. 329)

The study of epistemological beliefs is more than an esoteric exercise. Epistemological beliefs play a subtle, yet critical role in learning. Therefore, it is important that we develop a deep understanding of the nature of these beliefs. With the spirit of Pajares' words in mind, this synthesis of the literature was written in order to articulate the conceptions, assessments, and implications of epistemological beliefs developed most recently. This synthesis may provide some explanations for phenomena that teachers encounter in the classroom, such as students' insisting on the single, simple answers

or students firmly believing that cramming is the most efficient way to study. And this synthesis may provide the impetus for more researchers to take on the challenge of investigating individuals' deeply entrenched, predominately unconscious epistemological beliefs.

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