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Personal Epistemology Research: Implications for Learning and Teaching

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The ideas that individuals hold about knowledge and knowing have been the target of research programs with disparate names, such as epistemological beliefs, reflective judgment, ways of knowing, and epistemological reflection, all of which appear to be a part of a larger body of work on "personal epistemology." Epistemological perspectives are salient in numerous academic experiences, have been shown to be related to learning in various ways, influence reasoning and judgment throughout our lives, and have implications for teaching. Yet this work has remained outside the mainstream of educational psychology and cognitive development. This paper addresses three main questions: (1) What is personal epistemology research and how is it conceptualized? (2) How are individuals' conceptions of epistemology related to learning and instruction? (3) Given what we know about personal epistemology, what might educators do? Suggestions are also provided for future research and theoretical development.

KEY WORDS: personal epistemology; epistemological beliefs; epistemological development; epistemic cognition; cognitive development.

Throughout their educational experiences, students encounter new information and are called upon to interpret and evaluate it, whether implicitly or explicitly. The cognitive and affective processes that are activated involve a range of issues familiar to educational psychologists. Does the student have adequate prior knowledge to understand the material? Is the student sufficiently motivated to engage in the cognitive tasks required? Does the information fit an existing scheme of knowledge or will it require some alteration

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of current conceptual understanding? Increasingly, educational and instructional psychologists have also become interested in how a student's underlying *beliefs about knowledge and knowing* are a part of the process of learning, and how these beliefs affect or mediate the knowledge-acquisition and knowledge-construction process. What students think knowledge is and how they think they know have become critical components of understanding student learning.

Epistemological perspectives are salient in numerous academic experiences, not only in encounters with new information, as suggested by research on the relation between one's epistemological beliefs and learning. For example, beliefs about the nature of knowledge may influence strategy use (Schommer *et al.*, 1992), cognitive processing (Kardash and Howell, 2000), and conceptual change learning (Qian and Alvermann, 2000). Equally importantly, epistemological thinking is related not only to school learning, but is a critical component of lifelong learning, in and out of school. The research on epistemological understanding helps us understand how individuals resolve competing knowledge claims, evaluate new information, and make fundamental decisions that affect their lives and the lives of others (King and Kitchener, 1994; Kuhn, 1991). How do we know what we know and how do we choose what and whom to believe? Higher order thinking and the ability to make reasoned judgments have long been the hallmarks of liberal education, and knowing more about the role of epistemological thinking as a part of intellectual development can help us chart a path toward these important educational goals (King, 1992). Yet most research suggests that the attainment of a sophisticated, critically aware stance toward knowledge is far rarer in adulthood than we might hope (King and Kitchener, 1994; Kuhn, 1991), and that college has a smaller effect than is often espoused (see Hofer and Pintrich, 1997).

Although there is increasing attention to both theory building and empirical investigations in the realm of personal epistemology, this work has not reached as wide an audience as it may deserve, has yet to be acknowledged as a component of either educational psychology or cognitive development, and is not typically part of a teacher preparation curriculum, in spite of growing evidence of its importance. My sense is that this may be because we are still struggling with some conceptual issues that need resolution and because we are not yet clear about the educational implications of this work. The purpose of this paper is to address three main questions: (1) What is personal epistemology research and how is it conceptualized? (2) How are individuals' conceptions of epistemology related to learning and instruction? (3) Given what we know about personal epistemology, what might educators do? Suggestions are also provided for future research and theoretical development.

CONCEPTUALIZING PERSONAL EPISTEMOLOGY

The territory of epistemology (the nature and justification of human knowledge) has long been of interest to philosophers, but the interest of psychologists is relatively new. Inquiry into the individual development of conceptions of knowledge and knowing was central to the work of Piaget (1950) and has grown in recent decades. These ideas that individuals hold about knowledge and knowing have been the target of research programs with disparate names—epistemological beliefs (Jehng *et al.*, 1993; Kardash and Howell, 2000; Kardash and Scholes, 1996; Qian and Alvermann, 1995, 2000; Schommer, 1990, 1998; Schommer *et al.*, 1992), reflective judgment (King and Kitchener, 1994; Kitchener, 1986; Kitchener and King, 1981; Kitchener *et al.*, 1993), ways of knowing (Belenky *et al.*, 1986; Clinchy, 1995), epistemological reflection (Baxter Magolda, 1992, 1999; Baxter Magolda and Porterfield, 1985), epistemological theories (Hofer and Pintrich, 1997), epistemic beliefs (Bendixen *et al.*, 1998), and epistemological resources (Hammer and Elby, 2002). The research on personal epistemology, although not united in terminology, addresses students' thinking and beliefs about knowledge and knowing, and typically includes some or all of the following elements: beliefs about the definition of knowledge, how knowledge is constructed, how knowledge is evaluated, where knowledge resides, and how knowing occurs. Although the term "personal epistemology" has its own limitations, this is a possible umbrella term for those research programs that address individual conceptions of knowledge and knowing.

A review of the various approaches to the study of personal epistemology suggests that there are several central ways in which individual thinking about epistemological concerns has been conceptualized. One substantial direction of work has been developmental in nature, indicating a general, systematic progression in the development of one's ideas about knowledge and knowing. A second position is that personal epistemology is a system of more-or-less independent beliefs. Each of these clusters of research is reviewed in turn, followed by alternative views of how we might conceptualize this field, and how personal epistemology might be situated within larger psychological traditions. These conceptions of the model inform our thinking about what the educational implications might be.

Developmental Models

The largest body of research in the area of personal epistemology suggests that individuals move through a patterned sequence of development in their beliefs about knowledge and knowing. As elaborated in more detail elsewhere (Hofer and Pintrich, 1997), five major models with a sequenced

trajectory of epistemological development have been empirically identified: the work done by Perry and his associates on "the Perry scheme" (Perry, 1970, 1981), research on "women's ways of knowing" (Belenky *et al.*, 1986; Goldberger *et al.*, 1996), the Epistemological Reflection Model (Baxter Magolda, 1992), reflective judgment (King and Kitchener, 1994), and Kuhn's attention to the levels of epistemological perspectives that underlie argumentative reasoning (Kuhn, 1991). These models have similar origins and parallel trajectories, but significant points of distinction as well.

Origins

Each of these models has its roots in the traditions of cognitive development, although these origins are more explicitly identifiable in some schemes than others. This heritage includes Piaget's work on genetic epistemology (Piaget, 1950), reflective of his abiding interest in how individuals come to know the world (Piaget, 1954, 1963). Central to his theory is an emphasis on the changes that take place throughout childhood and adolescence in the relationship between the knower and the known (Flavell, 1963), a fundamental aspect of most of the models of epistemological development that have followed.

Each of the five developmental models of personal epistemology share a common view that individuals move through some specified sequence in their ideas about knowledge and knowing, as their ability to make meaning evolves. Although none of those who have proposed such models would claim that these are "pure" developmental models with hierarchically integrated stages and invariant sequences—and several have been careful to provide disclaimers to this effect—these models carry other developmental assumptions. They share with the traditional models of cognitive (Piaget, 1950, 1954), moral (Kohlberg, 1969), or ego development (Loevinger, 1976) an interactionist, constructivist, cognitive developmental view of the individual's evolving understanding of the world. Several of the models also draw upon the early work of Broughton (Broughton, 1975, 1978), who outlined stages of natural epistemology in adolescence. (See King and Kitchener, 1994, for a more through review of the theoretical precursors of epistemological development.)

The Perry Scheme

The current developmental models of epistemological understanding all acknowledge some connection to the work of Perry and his research team, whose annual interviews with longitudinal samples of Harvard students in the late 1950s and early 1960s led to a scheme of intellectual development

during the college years. Perry envisioned that the variability in students' responses to instruction were likely an indicator of personality differences, but found instead that the data followed a directional pattern. The nine positions of development identified in Perry's interviews were subsequently classified into four categories. Individuals begin with a *dualistic* perspective of knowledge, characterized by a right-and-wrong, absolutist view and the belief that truth can be known and the role of the teacher is to communicate it. This is eventually modified as *multiplism*, as individuals begin to acknowledge the existence of diverse viewpoints and the possibility of uncertainty. Toward the end of this period of development, individuals are likely to see conflicting views as equally valid. The movement from multiplism to *relativism* is characterized by the recognition that some views are better than others. In the positions that follow, individuals develop a growing ability to forge *commitment within relativism*. Although not all students in Perry's study started college as dualists, nor did all complete the trajectory the researchers traced, the inherent directionality and the patterns of reorganization of meaning suggested a structural, systematic progression of thought in their beliefs about knowledge, knowing, and the function of various educational processes. Perry's scheme has been elaborated and refined by others, who have carried on his work (Knefelkamp, 1999; Knefelkamp and Slepitza, 1978; Moore, 1989, 1991; Widick, 1975).

Four other developmental schemes have followed, each with a particular focus. (For a more thorough comparison and details of the various models, see Hofer and Pintrich, 1997.)

Women's Ways of Knowing

Belenky *et al.* (1986) built on Perry's work to encompass the perspectives of women and those from more diverse backgrounds (female students from nine different educational institutions, as well as women not involved in formal education), as Perry's sample had been predominately male and from an elite institution. These researchers broadened the scope of personal epistemology by articulating the role of the source of knowledge and truth as the foundation of "Women's Ways of Knowing." Their scheme focuses on the role of self as knower, and outlines a progressive integration and coordination of the subjective and objective modes of knowing across five positions: *silence*, *received knowing* (similar to Perry's dualism), *subjective knowledge* (similar to multiplism), *procedural knowledge*, and *constructed knowledge*. A central contribution has been the identification of two distinct epistemological orientations within procedural knowledge: *connected knowing* (an empathic and caring approach to knowing) and *separate knowing* (a

detached and impersonal approach). The integration of these orientations is one aspect of the achievement of constructed knowing.

Epistemological Reflection Model

Gender perspectives also played a role in the research conducted by Baxter Magolda (1992) in the development of the Epistemological Reflection Model. Similar to Perry's scheme, this model primarily targets the epistemic assumptions that affect interpretation of educational experiences in the college classroom, although this has been expanded in continued follow-up studies with original participants (Baxter Magolda, 2002). Based on the first epistemological study to include longitudinal interviews of equal numbers of males and females, Baxter Magolda identified a sequence of four ways of knowing: *absolute*, *transitional*, *independent*, and *contextual*. She concluded that although the overall pattern of development may be similar for men and women, gender-related patterns of knowing may appear in early stages and then converge. Males adopted more "impersonal" and "individualist" ways of knowing, and women more "personal" and "interindividualist" ways of knowing.

Reflective Judgment

Two other models that drew in part on Perry's work focus more explicitly on how epistemological assumptions influence thinking and reasoning (King and Kitchener, 1994; Kuhn, 1991). The primary work in this area is the reflective judgment model (King and Kitchener, 1994), based on 20 years of both cross-sectional and longitudinal research involving interviews with individuals from high school age through adulthood. Although Perry's model has been characterized as focusing primarily on the nature of knowledge, and "women's ways of knowing" as addressing the source of knowledge (Belenky *et al.*, 1986), reflective judgment delineates the development of the *process of knowing and reasoning*. Although often compared with critical thinking, the reflective judgment model is distinct in its emphasis on the intellectual tasks involved in open-ended problem-solving rather than closed-ended, the attention to epistemic assumptions, and the articulation of stages of development. The seven-stage model traverses three levels: *pre-reflective*, *quasi-reflective*, and *reflective*.

The Skills of Argument

Attention to the epistemological nature of solving ill-structured problems has also been addressed by Kuhn (1991), who conducted interviews

with a cross-sectional study of individuals from four age groups, ranging from teens to the sixties. The coding of participant responses to current social dilemmas included identification of the epistemological standards that underlie argumentative reasoning, in terms similar to Perry's. Epistemological views are categorized in one of three stages: *absolutist*, *multiplist*, or *evaluativist*. Kuhn continues to take a "theory-in-action" approach to epistemological thinking with investigations into real-world cognitive activities such as juror decision making (Kuhn and Weinstock, 2002) and argues that it is in this type of activity that epistemological understanding could be expected to make a difference, as well as where it is important to investigate these differences.

Summary of the Developmental Models

These models share interactionist, constructivist assumptions and sketch similar trajectories of development. The path of epistemological development begins with an objectivist, dualistic view of knowledge, followed by a multiplistic stance, as individuals begin to allow for uncertainty. Typically, a period of extreme subjectivity is followed by the ability to acknowledge the relative merits of different points of view and to begin to distinguish the role that evidence plays in supporting one's position. In the final stage, knowledge is actively constructed by the knower, knowledge and truth are evolving, and knowing is coordinated with justification. This culminating perspective has been variously labeled *commitment within relativism* (Perry, 1970), *reflective thinking* (King and Kitchener, 1994), *constructed knowledge* (Belenky *et al.*, 1986), *contextual knowing* (Baxter Magolda, 1992), or *evaluativism* (Kuhn, 1991).

Epistemology as a System of Independent Beliefs

A second approach to understanding personal epistemology was pioneered by Schommer (Schommer, 1990; Schommer *et al.*, 1992), who also drew on the work of Perry in proposing a model of beliefs about knowing and learning that are more or less independent, rather than organized into positions or stages and maturing in synchrony (Schommer-Aikins, 2002). In developing a written instrument to tap multiple dimensions, Schommer adapted items from the original survey that Perry (1970) had developed as a selection mechanism for participants in his study, as well as items from several related lines of inquiry: beliefs about math and the speed of learning (Schoenfeld, 1983, 1985), beliefs about intelligence (Dweck and Leggett, 1988), reflective judgment (Kitchener and King, 1981), and epistemology and comprehension (Ryan, 1984b). The Epistemological Beliefs Questionnaire

was designed to tap five hypothesized dimensions: structure, stability, source of knowledge, and control and speed of knowledge acquisition. Empirical work has generated four of the factors (all but source of knowledge), each of which is viewed as a continuum. These are identified from the naïve perspective as Certain Knowledge (knowledge is certain vs. knowledge is tentative and evolving), Simple Knowledge (knowledge as isolated, unambiguous bits of information vs. knowledge as highly interrelated concepts), Quick Learning (learning occurs quickly or not at all vs. learning as a gradual enterprise), and Fixed Ability (intelligence is fixed vs. intelligence is incremental).

Schommer's approach to the study of personal epistemology, especially the development of a paper-and-pencil instrument, has enabled a group of researchers to begin to more explicitly identify the relation between epistemology and learning. Replicating her factor structure has been most successful for those who have factored item subsets (Schommer *et al.*, 1992), although this has not always been the case (Kardash and Howell, 2000), and is less so for those who have attempted to use the individual items as a basis for the factors (Hofer, 1997; Qian and Alvermann, 1995). As a result of this problem as well as some disagreement about the dimensions that constitute epistemological beliefs, there have been attempts to revise the instrument or to design similar written measures (Hofer, 2000; Schraw *et al.*, 2002), but the Epistemological Beliefs Questionnaire remains the primary written assessment of personal epistemology.

Alternative Conceptions of Personal Epistemology

Challenges to both these views exist, specifically in attempts to explicate the structural nature of personal epistemology based on recent research in cognitive psychology and science learning. One proposal is that an individual's beliefs about knowledge and knowing are organized into personal theories, as structures of interrelated propositions that are interconnected and coherent (Hofer and Pintrich, 1997). An alternative but perhaps compatible view is provided by Hammer and Elby (2002), who argue for an ontological approach in which personal epistemology is viewed as a collection or network of "epistemological resources," connoting something more fine-grained than a theory and more context-specific than any of the current models.

Epistemological Theories

In contrast to either the general stage models of epistemological development or the portrayal of epistemological beliefs as possibly independent, individuals' ideas about knowledge and knowing may be organized

as personal theories. This view retains the explicit multidimensionality of epistemological beliefs but implies more integration among an individual's perspectives. Certainly the preponderance of stage models suggests that epistemological views are coherently organized, and we have little evidence to suggest that these are unrelated propositions. Research in neo-Piagetian cognitive development provides a persuasive case for moving away from traditional stage models (Bidell and Fischer, 1992; Case, 1992). Conceptualizing these ideas as theories may also help us represent epistemological thinking in ways that enhance our understanding of mechanisms of acquisition and change. Furthermore, this allows for the conceptualization of a discipline-specific understanding of epistemology, which is consistent with current work in cognitive psychology. Individuals appear to have differing epistemological assumptions about disciplines (Donald, 1995; Hofer, 2000), rather than general beliefs about knowledge that override disciplinary context.

The proposed model of epistemological theories (Hofer and Pintrich, 1997) consists of dimensions suggested by a review of both the developmental models and the independent beliefs model. One point of contention among researchers has been the extent to which beliefs about learning, education, and intelligence are part of one's epistemology, or whether they are part of a larger set of personal beliefs and theories. For example, beliefs about one's self-efficacy are important psychological constructs with educational relevance but would not be considered epistemological; similarly, beliefs about the incremental nature of intelligence, as conceived by Dweck and Leggett (1988), or about speed of learning, are important for us to understand but may not be part of the explicitly epistemological arena.

Although we are psychologizing about epistemology and are not philosophers, those of us working in this area have appropriated a term with a long history of meaning. If we want to talk about *epistemological* beliefs, development, theories, or resources, then it seems reasonable to delineate the construct by identifying those dimensions that fit within the conventional definition of epistemology, a philosophical field concerned with the nature of knowledge and knowing. These dimensions would then cluster into two areas: the nature of knowledge (what one believes knowledge is), which includes the dimensions *certainty of knowledge* and *simplicity of knowledge*, and the nature or process of knowing (how one comes to know), which includes the dimensions *source of knowledge* and *justification of knowledge*. There is also some empirical support for such a representation (Hofer, 2000). Beliefs about learning and education are peripheral to this particular model, however. These beliefs are central to the original Perry scheme of development but appear more as outcomes of the core beliefs and dimensions in most models. For example, if a student believes that knowledge is certain and

simple, then he or she may have different preferences about desirable learning environments than the student who believes that knowledge is complex and interrelated. Clarity about the components of personal epistemology can help bring precision to the field.

Epistemological Resources

Hammer and Elby (2002) challenge both the levels and methods of analysis implied by the structure of existing models of personal epistemology, as well as the suggested intraindividual consistency across contexts. Beliefs might be consistent *within* a context, for example within a particular physics course (Hammer, 1994), but not *across* contexts, for example, a physics class and a psychology class, or, moreover, a physics class and interpersonal relationships. Representative of the growing contribution to the research on personal epistemology from those engaged in research on science instruction, this framework offers a view of personal epistemology that is more situated and less stable or trait-like. More work is needed to test this model, which shows considerable promise in advancing our conceptions of personal epistemology and better integrating such conceptions with developing understanding of the situated nature of cognition (Brown *et al.*, 1989). It is likely that beliefs about each of the dimensions of knowledge and knowing might differ not only from a physics to a psychology class, but from one physics class to another physics class, depending on such things as the beliefs of the teacher and how these are instantiated in classroom tasks and pedagogy (Hofer and Pintrich, 1999).

Limitations and Promising Directions: Evolving Conceptions of Epistemology

Both the developmental models and the independent beliefs model have given us an important foundation for understanding how individuals think about knowledge and knowing. We have general agreement on the directional nature of epistemological change, several visions of the dimensions that comprise personal epistemology, and a growing sense of the importance of the work. We have yet to persuade a larger audience of this significance, however. Several steps remain: we need to elaborate the cognitive nature of the model in order to better integrate this work within a larger field of cognitive development, both by locating personal epistemology within identifiable territory and connecting it to life-span cognitive development, and we need to better use cognitive psychology to understand mechanisms of acquisition and change, as well as the situated nature of the construct.

Connecting Personal Epistemology to Cognitive Development and Cognitive Psychology

We can advance our understanding of epistemological thinking by identifying the connections to other aspects of cognition and cognitive development and by locating this work within our developing understanding of cognitive psychology. Although the body of work on the development of epistemological theories has grown rapidly, it has remained surprisingly disconnected from other research on cognitive development (Kuhn, 2000b). General stage models have good heuristic value in conceptualizing a rough road map of development; however, it is far more likely that development proceeds not up a single ladder but is more likely to resemble a web of developmental pathways (Bidell and Fischer, 1992), depending on cultural expectations and contexts. As Biggs has noted, general stage structures presume "context-neutral conceptions of cognitive abilities. . . . Education, on the other hand, takes place in and is inextricably tied to specific contexts" (Biggs, 1992, p. 281). Thus we need to develop a more situated view of epistemology and also one that enables us to examine a more microgenetic level of change.

Another problem with general stage structures is the growing recognition by cognitive developmental theorists of domain specificity (Carey and Smith, 1993; Case, 1985, 1992; Ceci, 1989, also see Buehl and Alexander, 2001). If knowledge is more likely to be viewed as organized within domains rather than in unitary structures, it would hardly be surprising to suggest that beliefs *about* knowledge would also be domain-specific. Research on domain-specific beliefs is growing rapidly, such as beliefs about mathematics (Schoenfeld, 1983, 1985) or science (Bell and Linn, 2002; Hammer, 1994; Hammer and Elby, 2002; Hogan, 1999, 2000; Songer and Linn, 1991) and although a review of this literature is beyond the scope of this paper, I believe that any general theory of epistemology must consider how domain-specific beliefs are also incorporated. This also suggests an important and often overlooked connection to the development of expertise (Chi *et al.*, 1988), which is largely domain-specific. As expertise develops, it is likely that epistemological thinking in those domains may become increasingly sophisticated.

Personal Epistemology and Metacognition

We also need to locate epistemological thinking within the broader territory of cognition. Epistemic understanding might best be understood in its relation to metacognition (Flavell, 1979), defined in its broadest sense as knowing about knowing. Two similar proposals have been made in this regard, both based on Flavell's early conceptualization of metacognition as

Table I. Locating Epistemological Thinking in Cognitive Development

3-Level model of cognitive processing (Kitchener, 1983)	3-Level model of meta-knowing (Kuhn, 2000b)
Cognition	
Metacognition	Metacognitive knowing Metastrategic knowing metatask knowledge metastrategic knowledge
Epistemic cognition	Epistemological knowing

broadly encompassing of the epistemological and his recognition of the critical importance of this aspect of metacognition in adult decision making. One is a three-level model of cognitive processing that locates epistemic cognition at a third level beyond metacognition (Kitchener, 1983) and the other is a conceptualization of meta-knowing that encompasses the epistemological (Kuhn, 1999b). (See Table I)

In the three-level model, Kitchener (1983) distinguishes between cognition, metacognition, and epistemic cognition, in which each level provides a foundation for the next. Cognitive processes such as computing, reading, and perceiving are at Level 1; the second level includes the metacognitive processes that permit knowledge about cognitive tasks, particularly the application of strategies and a monitoring of their use. Epistemic cognition, the third level, operates in conjunction with the first two, and involves the monitoring of the epistemic nature of problem solving, including an awareness of the limits and certainty of knowing, and the criteria involved in the process of knowing. This process is particularly critical, according to Kitchener, in the solving of ill-structured problems. Developmentally, epistemic cognition emerges in late adolescence but continues to evolve during adult years.

Kuhn provides a developmental model of metacognition as "meta-knowing," a broad term to encompass any cognition (another or one's own) that has cognition as its object (Kuhn, 1999a,b, 2000a,b). Meta-knowing includes three levels: metacognitive knowing, metastrategic knowing, and epistemological meta-knowing. Knowing about declarative knowledge—or knowing about knowledge as a product—is metacognitive knowing. Knowing about procedural knowing—or knowing about knowing as a process—is classified as metastrategic knowing. Epistemological meta-knowing refers to the more abstract process of knowing about knowledge and knowing, either one's own or another person's. Kuhn suggests that early epistemological meta-knowing begins in the transition "from simply knowing that something is true to evaluating whether it might be" (Kuhn, 2000b, p. 317). The changing criteria that we use to make such determinations are a core aspect of epistemological development.

Monitoring our own understanding of the complexity of problems, the certainty and limits of knowledge, and the evaluation of evidence enables the critical thinking necessary to solve the most pressing problems we may face as individuals and as a society. The importance of epistemic assumptions in the solving of ill-structured problems is another critical tie to the work of cognitive psychologists (Voss and Post, 1988), whose investigations into this area suggest the importance of such tasks in human cognition. Yet the evidence gathered to date suggests that most individuals do not achieve a level of epistemological understanding that makes possible genuine critical thinking (Kuhn, 1999a) or a level of reflective judgment essential to the solving of ill-structured problems (King and Kitchener, 1994). The growing knowledge base in this area may be invaluable to educators interested in the underlying developmental tasks that support such accomplishments.

Using this framework of either epistemic cognition or epistemological meta-knowing provides us with a better sense of where epistemology fits in the larger scheme of cognitive development. This also offers a structure for understanding how the dimensions of epistemological beliefs are related. Two of the dimensions—certainty of knowledge and simplicity of knowledge—appear congruent with this conception of epistemic knowing; two others—innate ability (nature of intelligence) and quick learning (speed of knowledge acquisition)—seem to be metacognitive processes, as conveyed in these models. This may help explain why they seldom appear in other epistemological schemes and may help us better understand their relative independence as dimensions. In summary, viewing epistemological thinking as an advanced form of meta-knowing provides greater clarity and precision to the construct.

Toward a Life-Span View of Epistemological Thinking: What is That is Developing and Where Does It Originate?

I think that one of the issues that has hampered our ability to make sound educational applications of the research on personal epistemology is the absence of a life-span approach, although the path has been sketched for linking epistemological understanding to theory of mind (Hofer and Pintrich, 1997; Kuhn, 1999b, 2000b) on one end of the spectrum and to postformal operational thought on the other (Basseches, 1980, 1984; King and Kitchener, 1994). Most existing studies of epistemological thinking have been conducted with college students. Those that have included high school students or younger often show surprisingly similar trajectories to those evidenced in college students, as well as similar developmental starting points, regardless of the age of the subjects. As Chandler *et al.* (2002) note, it seems counterintuitive that at whatever age we study students, dualism is the initial

phase identified. Perhaps such development is recursive, or that new educational environments or study in new domains prompts a recursion through particular levels of epistemological understanding; if so, this would suggest educational interventions of a particular sort. It is also plausible that we simply lack enough information about the full life span of epistemological development to be able to build a complete model yet.

There are large gaps in the developmental trajectory, notably between early childhood and adolescence, and knowing little about the origins and early development of epistemological awareness restricts our thinking about what it is that schools and teachers might do to enhance this important process. Even those developmental schemes that are based on careful longitudinal studies (King and Kitchener, 1994) do not address the early years of such development. Epistemological thinking may be foreshadowed in the early recognition of other's beliefs, desires, and intentions that make up theory of mind (Wellman, 1990), and be grounded in the attainment of interpretive theory of mind (Chandler and Carpendale, 1998; Kuhn, 2000b). This recognition that others operate as individual makers of meaning with differing perceptions and representations of knowledge is an obvious foundation for the epistemological levels sketched in any of the developmental schemes. Recent research suggests that children as young as 3 and 4 can provide answers to the question "How do you know that?" in ways that demonstrate a link between both their evolving theory of mind and their epistemological understanding (Hofer and Burr, 2001).

Building theoretical and empirical bridges between these areas of cognitive developmental research could enable us to better grasp the fundamental nature of epistemological growth. Arguing for a parsimonious approach to epistemological development, Kuhn and Weinstock (2002) have suggested that at the core of each of these models is a particular developmental task, which they define as the coordination of the subjective and objective dimensions of knowing. The essence of epistemological understanding is achieved in the movement from a certain, objective view of knowledge (absolutism) to uncertain subjectivism (multiplism) to the coordination of the two perspectives (evaluativism). We will have greater clarity for educational implications at all levels if we can develop a more complete picture of this.

Mechanisms for Change

Each of the models carries assumptions about how personal epistemology changes and advances, with consequences for learning and teaching. Developmental models typically presume a cognitive interactionist mechanism and a process similar to assimilation and accommodation, prompted

by a process of disequilibration. Belief change may be similar to *conceptual change*, in that one needs to be dissatisfied with existing beliefs, understand the alternatives and find them viable, and make connections between new and old beliefs (Pintrich *et al.*, 1993). However, research on *theory change* (Chinn and Brewer, 1993) suggests that there are multiple possibilities in individual responses to anomalous data, which include, for example, ignoring, rejecting, or reinterpreting the data, rather than altering one's theory. Individuals' epistemological theories may be equally amenable to such responses and equally entrenched in some cases.

Drawing on research from cognitive psychology, social psychology, and science education, Dole and Sinatra (1998) provide a reconceptualization of the change process in knowledge acquisition and representation that may be helpful in understanding how epistemological conceptions are altered and the variables that affect the cognitive reorganization required in changing one's views of knowledge and knowing. Their Cognitive Reconstruction of Knowledge Model (CKRM) suggests that individuals must be motivated to process new information, find the new information comprehensible and plausible, and be metacognitively engaged (Dole and Sinatra, 1998). Thus the epistemological change required in the movement from positions of dualism to multiplism, or from multiplism to evaluativism, may resemble the radical conceptual change described by the authors and require similar conditions. However, as they note, the conditions required for such change can be difficult for teachers to produce in a classroom setting.

CONNECTING EPISTEMOLOGY TO LEARNING AND INSTRUCTION

A conceptual understanding of how personal epistemology relates to learning and education derives from the particular ontological and theoretical assumptions of each model. Three general views exist:

1. Epistemology is developmental, development is the aim of education (Kohlberg and Mayer, 1977), and thus part of the goal of education is to foster epistemological development (Baxter Magolda, 1992; King and Kitchener, 1994; Perry, 1970).
2. Epistemology exists in the form of beliefs, and learning is influenced by the epistemological beliefs that individuals hold (Ryan, 1984b; Schommer, 1990; Schommer *et al.*, 1992).
3. Epistemology is either theory-like (Hofer and Pintrich, 1997) or exists as more fine-grained epistemological resources, and in the process of learning such theories and resources are activated and engaged in ways that are context-dependent (Hammer and Elby, 2002).

These three views imply different outcomes of interest in the learning process. In the first case, epistemological development is the outcome variable, often seen as indicative of broader intellectual development. In the second, it is typically academic performance that is the dependent measure, and beliefs are seen to affect or mediate that. In the third, the outcome might be learning and knowledge construction, influenced by epistemological resources and theories that have been activated in the process at a metacognitive or meta-knowing level. This leads us to consider the empirical evidence for the relationships between epistemology and education, learning, and instruction.

Epistemological Development as an Aim of Education

Arguing for a developmental perspective in interpreting individual epistemological thinking, Moore (2002) claims that "learning" in its most complete sense is inherently development, that for Perry and others, "true education, especially liberal arts education, was fundamentally about this kind of development—namely, the evolution of individuals' thinking structures and meaning making toward greater and more adaptive complexity." Accordingly, a number of studies have used measures of epistemology as indicators of broader student development during college. For example, advanced epistemological development is sometimes seen as an indicator of the skills of critical thinking, a common objective of western education (Kurfiss, 1988). Thus college assessment studies make frequent use of Perry-type instruments such as the intensive studies of student intellectual development at Alverno College. Similar assessment studies have used measures of epistemic cognition and reflective judgment (King and Kitchener, 2002; Wood *et al.*, 2002).

Researchers in this tradition have been interested in whether higher levels of education are associated with higher stages of epistemological development and what aspects of education foster this process of development. The preponderance of these studies have been conducted with college students—not because these are the available subjects, as has been the criticism of many psychological studies, but because this has been the population of interest, particularly for researchers involved in student development work. As a result, we have some sense of the relation between education and epistemology at this level, less so in the periods that precede and follow, and have a number of remaining questions to answer.

A review of the longitudinal studies of reflective judgment suggest that higher educational attainment is correlated with higher stages of reflective judgment, with just under a half-stage of growth (on a seven-stage scale) occurring on average during the college years (King and Kitchener, 1994).

Advanced development is more likely to occur during graduate school, particularly during the latter half, where students on average score nearly a stage and a half higher than senior undergraduates. Furthermore, nonstudent adults with advance degrees exhibit a similar pattern (King and Kitchener, 2002).

In Perry's original study, increasing numbers of students exhibited higher stage thinking in each of the subsequent years of the interviews, from freshman to senior year. Baxter Magolda had similar findings in her longitudinal study of college students: transitional knowing, the dominant mode of knowing, was used by 32% of first-year students, 53% of sophomores, 83% of juniors, and 80% of the seniors in her study (Baxter Magolda, 2002). However, norming studies with the Measure of Intellectual Development (MID), a written measure of the Perry scheme, indicate little change between 18- and 21-year olds (Moore, 1991). In one of the few studies of individuals across a larger age span, with 169 participants ranging from teenagers to 60-year olds, epistemological level and educational background were positively correlated. Evaluative reasoning, the highest level, was exhibited only by those with advanced education (Kuhn, 1991).

Taken together, what these studies suggest is that college has some small but measurable impact on epistemological development and that advanced epistemological thinking may occur infrequently in the U.S. adult population, the exception being those with graduate education. A comprehensive review of how college affects students concludes that the effect of college is selective, enhancing the ability to weigh evidence and to distinguish among weak and strong arguments, for example, but is less effective in enabling individuals to discriminate among inferences or recognize assumptions (Pascarella and Terenzini, 1991).

Thus the developmental course that appears to culminate in reasoned reflective thinking is not commonly achieved in the adult population in this country. Our "educated citizenry" may in fact be largely composed of individuals who view the world from a position of absolutism, or who simply accept a multiplicity of opinions about complex issues, seeing no need to support positions with evidence. Such individuals might not only lack the skills to solve ill-structured problems (Voss and Post, 1988), but may also lack the motivation to do so. Education that focuses on the progression of epistemological thinking has the potential for addressing this critical need.

Epistemological Beliefs and Their Relation to Learning

Beginning with Ryan (Ryan, 1984a,b), researchers have investigated how beliefs that individuals hold about knowledge and knowing affect the

learning process. His initial finding that there was a relation between students' epistemological level (dualism or relativism) and their information-processing strategies, as measured by applying Bloom's taxonomy to their monitoring of comprehension, engaged educational and instructional psychologists in this field of inquiry. In a series of studies by Schommer, particular dimensions of epistemological beliefs have been demonstrated to relate to learning. For example, a text comprehension study showed that those who viewed knowledge as certain were likely to generate absolute conclusions that were inappropriate, and those who believed in quick learning were likely to give oversimplified conclusions and have low test scores (Schommer, 1990). In a further study of the comprehension of a statistical passage, student performance was negatively correlated with belief in simple knowledge. Path analysis suggested an indirect effect of beliefs on performance, with beliefs affecting the choice of study strategies (Schommer *et al.*, 1992). Epistemological beliefs about the speed and effort involved in learning have also been associated with cognitive-processing strategies (Kardash and Howell, 2000), and beliefs about the certainty of knowledge may affect the interpretation of evidence on controversial issues (Kardash and Scholes, 1996).

Similar findings that epistemological beliefs affect students' use of learning strategies suggest the need to consider a conceptual framework that includes the role personal epistemology plays in self-regulated learning (Garrett-Ingram, 1997). It seems plausible that students' beliefs and theories about knowledge influence the goals and standards that determine engagement in learning, depth of processing, and comprehension monitoring (Hofer and Pintrich, 1997). Based on their qualitative investigations of beliefs and strategy use, Simpson and Nist (2000) recommend that academic assistance programs help students become more aware of epistemological beliefs as a means of fostering awareness of these connections; in particular, they suggest that students may be reluctant to adopt suggested strategy use until they relinquish simplistic views of knowledge that require little active involvement by the student.

Epistemological beliefs have also been linked to conceptual change learning. A study of high school students indicated that a belief about knowledge as certain and simple (as indicated on a combined scale, based on items from Schommer's questionnaire) was negatively correlated with conceptual change learning (Qian and Alvermann, 1995). Similarly, students' beliefs about science—whether it is dynamic or static, or whether beliefs are a mix of the two—predicted their ability to integrate their understanding of a topic (Songer and Linn, 1991) and their strategy use (Davis, 1997). In the latter study, eighth-grade students with a dynamic view were likely to try to

understand science, whereas those with a static view were more concerned with the memorization of facts.

A number of other studies link domain-specific epistemological beliefs about science with science learning, with the basic assumption that students' beliefs about the structure and origin of scientific knowledge and knowing are intertwined with their learning of science (Edmondson and Novak, 1993), although the measures and methods of these studies vary widely. Hogan (2000), for example, has examined proximal and distal knowledge of science, distinguishing between knowledge about the epistemology of professional science (distal) and knowledge about one's own epistemological perspectives on science (proximal). This delineation could have valuable application in broader models of epistemology that often conflate what one believes about how others know with what one believes about his or her own knowing. Others have focused on beliefs about science identified as constructivist or empiricist (Tsai, 1998, 1999), with results of a qualitative study indicating that students with more empiricist beliefs were more likely than constructivists to employ rote-like learning strategies (Tsai, 1998). One of the significant contributions in the research on science beliefs is the inclusion of students across a wider age spectrum than most of the more domain-general studies, with some studies focusing on epistemological beliefs in elementary school students (Elder, 2002; Samarapungavan and Westby, 1999).

Alternative Models of Epistemological Theories and Resources: The Relation to Learning

Other perspectives toward addressing the relation between personal epistemology and learning focus on epistemology as theory-like, or on the activation and engagement of epistemological resources. Hammer and Elby (2002) suggest that individuals, even small children, have a collection or network of epistemological resources activated in different contexts that can be linked in a multiplicity of combinations. Although this model needs further empirical testing, they note that several related studies provide demonstrations of methodological approaches that might be useful for such work, including those that use open-ended interviews (Perry, 1970), classroom observations (Hogan, 1999), and case studies that are conducted in a manner closely aligned to the context of learning under investigation and allow for depth of understanding (Hammer, 1994). This approach avoids the problems inherent in current studies that ask students to make generalized responses about their beliefs without regard to context, which ignores the profoundly different experiences students have in different classes.

How Personal Epistemology Relates to Instruction

Regardless of the model, there has been a presumption of all those working in this area that educational experiences play a role in fostering development or belief change. But what types of experiences are most conducive? What instructional strategies can best be employed? Although the literature is replete with advice, less research exists that clarifies the relation between methods and types of instruction and personal epistemology. This is a transactional concern, as beliefs or stage of development affect perceptions of instruction, and instruction can affect beliefs and epistemological development. The wide variation that exists in knowledge beliefs among college seniors (Baxter Magolda, 1992; Perry, 1970) suggests that we need to further investigate the particular antecedents of development during this period and the role instruction plays. Furthermore, beliefs of teachers may also influence this process. (See Fig. 1 for a working model of these relationships.)

Learners arrive in the classroom with existing epistemological beliefs and theories that lead to interpretations of instruction, and, as these beliefs change, so do these interpretations. This perception on the part of college faculty prompted Perry's initial investigation. Students' views of instruction at each stage of development are suggested in several developmental schemes (Baxter Magolda, 1992; Knefelkamp, 1999). Based on her research with the Perry scheme, Knefelkamp provides an analysis of how students

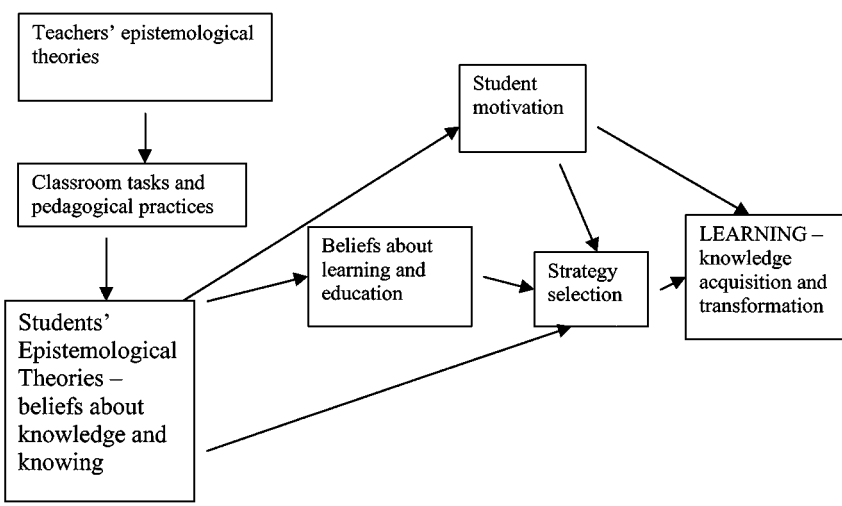

Fig. 1. Working model of how epistemological theories influence classroom learning.

make meaning of the learning process at each of the positions from dualism through contextual relativism. The eight "learner characteristics" that are charted include such categories as views of the role of the instructor and views of the role of the student, and primary intellectual tasks. Similarly, Baxter Magolda (1992) describes how students at each of the four ways of knowing in her model of epistemological reflection demonstrate qualitatively different ways of viewing themselves as learners, their instructors, peers, and the evaluation process.

Other investigations have focused on how students' beliefs affect their involvement with particular academic tasks or in particular instructional settings and the impact this has on achievement. A study that explored eighth graders' scientific epistemological views and their learning in a laboratory setting found that constructivist students focused more on negotiating the meaning of experiments with peers than did empiricist students who engaged in deeper conceptual exploration and had richer understanding as a result (Tsai, 1999). Type of instruction may also influence beliefs. In a study of calculus instruction, college students in constructivist sections evidenced more sophisticated beliefs about mathematics than those in traditional sections (Hofer, 1999). Not all studies have reported such changes, however; Roth and Roychoudhury (1994) report that among high school physics students they studied, objectivist beliefs dominated in spite of a constructivist curriculum.

It is likely that there is an interaction between epistemological beliefs and type of instruction, as would be predicted by some of the early developmental work. Windschitl and Andre (1998) report a belief–treatment interaction in their study of computer simulations designed to foster conceptual change in a college human physiology class. Students who had more advanced epistemological beliefs learned more through a constructivist treatment (an exploratory computer simulation) and those with less advanced beliefs learned more with an objectivist treatment (a confirmatory simulation).

In each of these instructional contexts, teacher beliefs may also be an important, yet understudied factor. Teacher rhetoric is often contradicted by classroom structure, as well as by the reward system (Schoenfeld, 1988). Thus, changing student beliefs may require changing the meaning of knowing and learning in school (Lampert, 1990) as well as focusing attention on teachers' epistemological perspectives. An intervention program that addresses pedagogical attitudes and beliefs of preservice teachers, as measured with the MID, demonstrates some success in this regard (Hill, 2000). Clarification of the components of teachers' beliefs (Pajares, 1992) is another important focus of inquiry that may be closely related to understanding student epistemology. Equally important is the congruence between the instructors' espoused beliefs and their actual practices (Hofer and Pintrich, 1999).

IMPLICATIONS OF PERSONAL EPISTEMOLOGY RESEARCH FOR EDUCATORS

For three decades, since the publication of Perry's book (Perry, 1970), there have been attempts to translate the research on personal epistemology into suggestions for classroom instructors. With the expansion of the research has come a broader set of suggestions but with significant overlap. What researchers recommend to teachers as an outcome of their studies often depends, as noted earlier, on the goals of education implied by the model as well as the assumed mechanisms for change. If we believe that epistemological thinking is important, worry that many individuals do not reach a level that provides for competent adult reasoning, and would like to see education more engaged in addressing this, what do we do? Our prescriptions rest in part on how we conceptualize personal epistemology. Are we building skills, fostering competence, changing beliefs, stimulating reflective thinking, promoting metacognitive development? Our own mental models of the construct inform how we think change happens and what we think educators might do.

Suggestions for Promoting Epistemological Development

Operating from the cognitive interactionist perspective, those who are invested in fostering development often speak of appropriate stage–environment fit, in a manner that might approximate Vygotsky's zone of proximal development (Vygotsky, 1962). Individuals need enough challenge to foster the epistemic doubt that leads to change (Bendixen, 2002), but educational press that exceeds their understanding is likely to be ineffective. Early efforts at fostering epistemological development were similar to those designed to foster moral or ego development, with the belief that students would benefit most from hearing reasoning just a stage above their current level. In general, these ideas have been part of the recommendation that instructors teach toward "the leading edge of growth," as Perry described it, a process that requires both knowledge of the developmental trajectory and some ability to make assessments about individual students.

This close personal attention to individual student growth and development was the hallmark of Perry's approach and explains both its attractiveness to others—with its acknowledgement of the power that teaching has to affect individual growth that is concomitantly cognitive and affective—and the difficulty many have had with implementation, given both the level of knowledge and the degree of attention involved. As noted by Knefelkamp (1999), Perry also emphasized the notion of community with one another

and with faculty members who made their own epistemological thinking, and doubting, evident to students.

More specifically, recommendations for classroom conditions to enhance development across epistemological positions have included encouraging student questions and comments, instructor recognition of student reactions, and increased emphasis on student participation (Baxter Magolda, 1987). Such development may also be furthered by curricular approaches that validate the student as knower, situate learning within the students' experience, and create opportunities for students to construct meaning with others (Baxter Magolda, 1992). Results from a longitudinal study with adults who have been interviewed since their first-year in college suggests the value of a learner-centered approach during college, in which instructors explore with students the ongoing nature of the creation of knowledge (Baxter Magolda, 1999).

King and Kitchener (2002) provide an integrated and comprehensive summary of suggestions drawn from the literature on fostering the development of epistemic cognition. These include providing opportunities for students to discuss and analyze ill-structured problems both in classrooms and in other settings, teaching students the skills of gathering and evaluating data, engaging students in the discussion of controversial issues, and assisting them in examining their assumptions about knowledge and how it is gained. Moreover, instructors are encouraged to show respect for students' assumptions, regardless of developmental level, and to provide feedback and support on both a cognitive and emotional level.

Suggestions for Addressing Epistemological Beliefs in the Classroom

Fewer suggestions about instructional implications come from those studying beliefs, perhaps because we know less about belief acquisition and belief change, an area that needs more attention in the epistemological realm. (See Dole and Sinatra, 1998, for a review of the social psychological literature on belief and attitude change.) These suggestions have generally been quite broad, such as having teachers inform students that knowledge is integrated and that many times there is more than one right answer (Schommer, 1990) or taking special care to encourage the critical evaluation of new information to avoid biased assimilation (Kardash and Scholes, 1996), but these are often outgrowths of complex research projects and not specified, tested instructional strategies.

Kardash and Scholes (1996) caution that interventions focused on epistemological change should focus less on moving individuals from one particular position to another and more on helping students understand several of

the fundamental epistemological assumptions that underlie critical thinking: "that not all problems have a single right answer, although some do; that as science progresses, some of what we once held as true also changes; and that what on the surface appears to be dialectically opposing viewpoints may, in some cases, be synthesized into a new framework" (p. 270). Taken together, such beliefs could be seen as advocating an evaluativist or constructivist epistemological position; however, there is considerable significance in identifying these particular components and learning more about the microgenetic processes involved in acquiring such perceptions of knowledge and knowing.

This also permits a more domain-specific approach to the instruction of epistemological understanding and underscores the importance of making the epistemological assumptions and knowledge-building processes of the disciplines more specific. Research from science instruction provides suggestions for strategies that might foster mature beliefs (Qian and Alvermann, 2000), which include assisting students in examining concepts from different perspectives, engaging in reflective inquiry, using images of scientists' activities, and reflecting on teachers' epistemological objectives, an often overlooked aspect of this process.

Developing an understanding of how knowledge is developed within the disciplines is a fundamental part of the teaching of thinking skills (Baron, 1993). We can be more deliberate in our approach to these matters by including specific information about this in each of our courses. For example, in teaching Educational Psychology I find it useful to discuss not only "what we know" but "*how* we know what we know." A short pretest is a basis for assessing prior knowledge and misconceptions, as well as a platform for examining individual ways of knowing, including personal experience, anecdotal evidence, and empiricism, among others. This has become a valuable starting point for explaining the research methodology of the discipline, as well as for discussing how teachers develop knowledge—and misconceptions. In other psychology classes I often provide a historical progression of central ideas (e.g., the concept of "storm and stress" in adolescent development research) to illustrate the dialectical tensions in knowledge development. Educators might benefit both from collecting and disseminating such examples, as well as from more research that examines the effectiveness of the implications that epistemological researchers have suggested. Most of the suggestions in the literature are carefully derived from theory, but have had little empirical testing.

CONCLUSIONS

A growing body of work provides evidence that personal epistemology is an important component of student learning. The general models identified

here all offer valuable contributions to our deepening understanding of the field, and the work from disciplinary-based epistemology research is rapidly enhancing our understanding of beliefs about knowledge and knowing in educational contexts. We can benefit from deeper consideration of how general and discipline-specific beliefs operate together, as well as from more integration of research from cognitive psychology and cognitive development. Accordingly, we need to continue to consider models that suggest more contextual, situated, nuance understanding of personal epistemology. We may be moving toward an integration of ideas from multiple models: *an identifiable set of dimensions of beliefs, organized as theories, progressing in reasonably predictable directions, activated in context, operating as epistemic cognition*.

There is still much to learn about the development of epistemological understanding. What are the experiences that foster it? Why do some students advance and not others? We need to examine the academic tasks that promote the development to the higher stages of reflective judgment that so rarely occur otherwise. Could the experiences that enhance epistemological thinking be provided at earlier points? Or is there a cognitive or maturational precursor that would explain why the highest stages of reasoning were found only among advanced graduate students (King and Kitchener, 1992)? We need to know more about the type of academic tasks that might be most conducive to fostering intellectual development, how they might best be sequenced, and when they can most effectively be offered to students.

Given the degree to which epistemological development appears to map onto most of the goals articulated for undergraduate education, it seems surprising that the average gain appears to be less than half a stage on any of the particular available measures (Hofer and Pintrich, 1997). What might we learn from studying individual variations in this process, attending perhaps to those who make little movement at all and those who make considerable intellectual progress? What can we learn from more microgenetic analyses of change, and from applying new models of conceptual and theory change to understanding this process? Additionally, we need much more work to understand what happens in the earlier years to foster epistemological understanding, given the paucity of studies at any period prior to the college years.

We need research on the current cohort of students that takes into account the context in which they are now learning, and the vast differences in that environment from the period in which earlier studies were conducted. Issues regarding the "source of knowledge" are now as likely to involve how students interpret information from the Internet as how they interpret the instructor or the text (Hofer, 2001). The demands of the pluralistic educational environment, a new phenomenon in Perry's time, have multiplied vastly. Perry (1970) documented what he called "a revolution in the

very definition of knowledge confronted by freshmen in a college of liberal arts" (p. 6), by graphing the increase in examination topics that required two or more frames of reference. He also noted that college students were confronted with a pluralism of values, not only in courses but in their interaction with a diverse student body. If multiple viewpoints and diversity of the student body are challenges to one's epistemological assumption, then we clearly need more recent information about how students are making sense of a postmodernist curriculum and more highly differentiated cultural diversity, and to learn more about the impact that this may be having on student epistemological development.

As Kuhn and Weinstock (2002) have noted, *epistemological thinking matters*. We need to be concerned about the scarcity of advanced epistemological understanding, given the difference such understanding makes in individuals' abilities to interpret and evaluate information and to make decisions about complex problems. Yet Kuhn and Weinstock and others worry about whether current intellectual and classroom climates may inhibit the reasoned argumentation that fosters epistemological development and whether the values of social tolerance and acceptance may lead students toward reified multiplism. We need to ensure that tolerance of multiple viewpoints among a diverse student body does not foster an inability to weigh competing claims and evidence and thus thwart intellectual commitment, and to be aware that our explanations of social construction may be interpreted through epistemological perspectives different from our own. Our classrooms may be the best place for students to get the practice they need in articulating, defending, reexamining, and claiming their points of view, within a context of supportive community and the modeling of discipline-based expertise and epistemological thinking.

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