Epistemologies of the Sciences, Humanities, and Social Sciences: Liberal Arts Students’ Perceptions

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To help students achieve the essential learning outcomes, it will be necessary to spend time, across all levels of school and college education, revisiting the larger purposes of education and rethinking the kinds of connections across disciplines and levels of learning that will best prepare graduates for a complex and fast-paced world.

—Association of American Colleges and Universities (2007, p. 20)

As this quotation from the Association of American Colleges and Universities (AAC&U) illustrates, an essential role of postsecondary institutions is preparing college graduates for the work world. In particular business leaders are calling for more and better liberal education to address the dynamic nature of today’s job market and the global economy. Yet one recurring critique of the current practices at many institutions is that the knowledge disseminated in the classroom is taught in an isolated and disconnected fashion, both within general education requirements and between general education and the major (AAC&U, 2007; Arnold, 2006).

All types of academic institutions focus on the creation and dissemination of knowledge as a fundamental goal of the institution (Altbach, 1998), and in the case of disseminating knowledge, at least a part of that defining activity takes place in the classroom. There is little disagreement about the responsibility of faculty to teach knowledge, and yet we rarely discuss whether we share
with our students an understanding of what “knowledge” is, how knowledge is created, and the implications of these beliefs and activities. Nor do we discuss how knowledge claims in one discipline might relate to knowledge claims in another. General education courses are no different from others in their obligation to address this need, and one might argue that the need to address our understandings of disciplinary knowledge and the interrelationship of knowledge claims across disciplines in these courses is increasing.

Epistemology refers to the study of knowledge and sources of knowledge. The term personal epistemology has recently been adopted by educational theorists to refer specifically to the beliefs an individual learner holds regarding the complexity and certainty of knowledge, the process of knowing, and the sources and justification of knowledge claims (Hofer & Pintrich, 1997). Although there are many theories of personal epistemology in the educational literature (Hofer & Pintrich, 1997), most developmentally based theories agree on a common pattern of cognitive development that progresses from simple, right/wrong thinking, through an exploration of multiple perspectives, to an understanding of knowledge and knowing that uses contextualized and reasoned choices among competing beliefs. Nondevelopmental theories examine an interconnected set of beliefs about knowledge and learning but do not necessarily contradict the underlying construct of simple versus complex epistemological perspectives (Schommer, 1993, 1994).

Early explorations of epistemology assumed that individuals hold a uniform personal epistemology across knowledge domains. Somewhat recently, discipline-specific epistemologies have been proposed and studied (Hofer, 2000; Jehng, Johnson, & Anderson, 1993; Paulsen & Wells, 1998; Schommer, 1993). In a prior qualitative study, we proposed a grounded theory of college student understandings of discipline-specific epistemologies in the sciences and humanities. In a study of sixty undergraduate students, we proposed a grounded theory that individual students may exhibit differing and conflicting epistemologies in these two broad disciplinary domains (Palmer & Marra, 2004).

Our original grounded theory was derived from a sample of junior and senior science and engineering majors. Even though these students had accumulated fewer courses in the humanities, half of the sample still exhibited more sophisticated epistemologies in humanities than in sciences. Another subset described a more complex set of beliefs about knowledge in the sciences than in the humanities (Palmer & Marra, 2004). The current study tested the original grounded theory with a new set of juniors and seniors who were, in contrast to the original sample, primarily studying the liberal arts. In this qualitative analysis, we sought to determine if the original grounded theory that showed discipline-specific epistemologies in the sciences versus the humanities applied
to a new sample of students. Based on the data from both studies we also expand the original theory, developing a more complex picture of how domain epistemologies influence and are influenced by other aspects of the learning environment with a specific focus on individual class experiences and curriculum design.

**Previous Research**

Students’ personal epistemological beliefs are an important area of research because it is thought that they may influence a variety of behaviors related to learning (Tittle, 2001). Theories regarding how knowledge domain (i.e., academic discipline) influences personal epistemology are still developing. However, several theorists have begun to envision a tentative relationship between general and domain-specific personal epistemologies that is nested and connected. In other words, an individual may describe a relatively stable general epistemology, but subsumed under that general epistemology is a series of domain-specific epistemologies that may or may not be consistent (Buehl & Alexander, 2006; Hofer, 2006).

In a prior qualitative study of domain-specific epistemology (Palmer & Marra, 2004), we note that individual students exhibited different epistemological perspectives in humanities versus scientific knowledge domains. Based on these results we proposed a grounded theory including three developmental epistemological orientations each for the sciences and the humanities that may be held by individual learners (see Figures 1–2). These orientations mirror much of the work of theorists of domain-general epistemologies.

In their review of nineteen empirical studies investigating the question of the domain generality versus the domain specificity of epistemological beliefs, Muis, Bendixen, and Haerle (2006) found evidence for both sets of beliefs. They argue that the evidence across these various studies points to an interactive relationship in which a student may hold somewhat disparate beliefs in different domains. These domain-specific beliefs, at the same time, may loosely correlate with an overall set of domain-general beliefs.

**FIGURE 1** Epistemological Orientation for Science.
A recent proliferation of primarily quantitative research tests whether personal epistemology is influenced by knowledge domain (i.e., academic discipline). For example, Schommer and Walker’s (1995) research on domain-dependent epistemologies found that a majority of students displayed a consistent level of epistemological sophistication for texts in mathematics and social sciences. The researchers do not report the number of students who were inconsistent across domains. In a more recent study, researchers have reported similar results when they investigated the beliefs of learners in sciences versus business and social sciences (Schommer-Aikens, Duell, & Barker, 2001). In contrast, Gallagher (2001), in a study of adolescents in grades 9–11, found that only three of twenty-one students demonstrated consistent epistemological sophistication across ill-structured problems in different domains. Hofer (2000) also studied domain-specific epistemologies when she surveyed first-year college students about their beliefs regarding the nature of knowledge and the process of knowing in two fields (psychology and science). She found that students viewed knowledge as more certain in science than in psychology and relied on authorities for knowledge more in science. Similarly, Lonka and Lindbloom-Ylanne (1996) found evidence of domain-specific beliefs for psychology and medicine, and Edmondson and Novak (1993) studied students’ beliefs about science learning, also indicating that students exhibited different epistemological beliefs for different domains. The Muis and colleagues (2006) literature review, however, concludes that the results of domain-specific epistemology studies are inconsistent but, in general, indicate the likelihood of the existence of discipline-specific epistemologies.

Muis and colleagues (2006) also hypothesize that domain-specific epistemological belief is based on the nature of the knowledge domain under discussion. They argue that some academic disciplines have stronger paradigmatic underpinnings and, thus, more certainty about knowledge than others. In their view, differences in domain-specific epistemologies can be explained by the nature of the discipline and its patterns of justification of knowledge claims. Therefore, students’ epistemological beliefs in soft domains (Biglan, 1973) with less certain knowledge.
justification would more likely allow for multiple sources of knowledge, while students' epistemological beliefs in hard domains would more likely be dualistic. Although the theory proposed by Muis and her colleagues that would “predict” personal domain-specific epistemological beliefs based on the nature of how the certainty of knowledge is portrayed in those domains seems plausible, the results from our study do not bear this out. In our sample, students did not exhibit a single predictable pattern of more complex beliefs in one domain or another. Rather, some students viewed the sciences as more certain, and some viewed the humanities and social sciences as more certain.

The majority of the studies described above were quantitative in nature, a paradigm that allows the researcher to test a relationship among constructs but which does not necessarily provide insight into the mechanisms of how and why a particular phenomenon occurs. Clearly questions remain regarding the nature of domain-specific epistemologies and how they relate to academic disciplines for a variety of students. This qualitative study provides additional data to expand our understanding of domain-specific epistemologies and how they may be developed within the context of classrooms and institutions.

Method

Data for this analysis originated from verbatim transcripts of interviews with thirty junior and senior college students. As in the first study, we intentionally sampled upper-division students who would arguably have more collegiate experiences to discuss during the interview. We used a criterion-based sampling technique to specifically recruit nonengineering and nonscience students attending a midsized research university in the Rocky Mountain West. Because we wanted a heterogeneous sample that met our criteria, we recruited students by approaching them on campus complemented by snowball sampling to help locate students in a variety of liberal arts majors. Students in education were excluded from the sample to eliminate potential bias related to existing relationships with us.

There were six juniors and twenty-four senior students; fourteen students were male, and sixteen students were female. Students' majors were primarily concentrated in traditional liberal arts disciplines across multiple colleges, although we also recruited four students who would be considered preprofessional (two business majors and two architecture majors). The breakdown of their colleges is as follows: nineteen students or 63 percent were from the College of Letters and Sciences, seven students were from the College of Arts and Architecture, two were from the College of Business, and two were from Health and Human Development.
We contacted students by phone, via e-mail, or in person to request that they voluntarily participate in a research project on learning. Interviews lasted for approximately forty-five minutes. At the conclusion of the interview, each student received a small gift certificate as a thank-you. The semistructured interview protocol was based on one used previously in studies of intellectual development (Pavelich & Moore, 1996) and was designed to ascertain students’ epistemological views. The interviewer asked students to discuss their views on the role of the teacher in structuring the learning environment, the role of experts in transmitting knowledge, significant learning experiences, their definition of knowledge and truth, and their perception of knowledge and truth in the sciences and in the humanities. For purposes of consistency, one interviewer—trained in the use of the protocol—conducted all thirty interviews.

We read entire interview transcripts and coded them for each phrase, sentence, or group of sentences that addressed domain-specific knowledge. In the first iteration of coding, we and one additional trained coder applied the coding scheme represented by Figures 1 and 2 (e.g., Science [sc] I–III, Humanities/Social Science [h/ss] I–III) to the first fourteen interviews to obtain frequencies of codes for each orientation for each student. We conducted inter-rater checks among the three raters on all fourteen interviews and resolved all rating discrepancies. Having established acceptable coding reliability, we coded the remaining sixteen interviews. We noted during coding that in all cases where students discussed their science or social science epistemologies the codes we established in 2004 (Palmer & Marra, 2004) applied. Using the coding frequencies, we classified each student into one science and one social science orientation. When a student received codes in more than one domain orientation (e.g., sc I and sc II) we examined the relative frequencies of codes in that domain, discussed the content of the coded statements, and decided on a domain orientation for that student. In some cases, students were classified as being “in between” orientations (e.g., sc I–II).

Results

Domain-Specific Orientations

Given that one purpose of this study is to validate the grounded theory previously proposed, we present many of our results in comparison to the results from the original study. Table 1 shows the domain orientation frequencies and percentages for the original (first) and new (second) samples. For the new sample epistemological orientations in sciences varied from sc I to sc III, with a large majority of students viewing science knowledge in epistemologically
simple ways. Forty-three percent of the students expressed a view of knowledge in the sciences as fact (sci i), and 33 percent of the sample, as “science is fact with exceptions” (sci i–ii). In contrast, only one student in the new sample viewed knowledge in the humanities from a simpler orientation (h/ss i–ii), with the majority (63 percent) describing a humanities/social science epistemology of knowledge as multiple opinions (h/ss ii).

The first study, with its larger sample size, shows a broader orientation distribution—especially in the sciences. In the first sample, similar to the second sample, the mode for the sciences is Orientation i, with 30 percent. However, the proportion of students who describe science epistemologies in the higher ranges (sc ii–iii) is smaller in the new sample than in the previous sample. For the humanities/social sciences, the first sample also has a broader distribution than the second sample. Both samples show the majority of students (70 and 63 percent) exhibiting h/ss ii—that is, knowledge is opinions and multiple opinions. However, the first sample of science and engineering majors had nearly equal numbers of students falling above and below this modal point, whereas the second sample has proportionately more students rated at the higher h/ss ii–iii orientation than below Orientation ii.

**Relative Epistemological Orientations**

A key result from the first study was that *individual* students held contrasting epistemological beliefs for the two disciplines; that is, the same student might be relatively sophisticated epistemologically in the humanities/social sciences and hold less complex epistemological beliefs for science knowledge (Palmer & Marra, 2004). This differentiated our domain-specific results from prior work

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### Table 1: Orientation Categorization Frequencies and Percentages for First and Second Samples
in this area. Although not as varied in its distribution, our second sample shows 
this same result. Table 2 depicts the relative orientations for individual students 
in both samples. The majority of the second sample (77 percent) shows a more 
advanced humanities/social science orientation than science. The modal domain 
epistemological combination \( (n = 10) \) for the second sample is Science Orienta-
tion i–ii and h/ss Orientation ii.

The following comments from a second-sample student who was majoring 
in architecture provide an example of this frequently demonstrated comparative 
stance: “[Humanities] is all open for interpretation. . . . Everybody gets a say in 
the matter. There isn’t a textbook I can open up and say, ‘This is the answer to 
world hunger. This is the answer to crime in America.’ Whereas in science you 
open up the book and say, ‘This is how you do calculus. This is how you find a 
sine wave.’ You can’t do that in humanities. I think knowledge is very diff erent.”
In contrast, another second-sample student who was following a pre–physical 
therapy curriculum expressed a relatively sophisticated view of the sciences in 
contrast to the humanities/social sciences (sc ii–iii and h/ss ii): “In science they 
present the evidence to back things up, whereas in a humanities course they tend 
to say, ‘Well, this person, they thought this, or this person, they thought that.’”
Also in the second sample, four liberal arts students exhibited more advanced 
science than humanities/social science epistemologies. Further, in all four cases, 
the science epistemological stance exhibited was quite complex (sc ii–iii and 
sc iii). Notably, two of these students had completed extensive courses in sci-
ences and mathematics in preparation for their careers, and a third student was 
rated at high epistemological orientations in both domains, leaving only one 
“typical” liberal arts student with this relative stance.

Three individuals in the second sample were coded as exhibiting equal orien-
tations in the sciences and humanities/social sciences. For example, this student, 
majoring in a foreign language, saw knowledge in both domains as fluid and 
evolving: “It is interesting that they are both changing. People in a science point 
of view are striving to try to prove something. From a humanities point of view 
people are still striving and trying to prove something new to improve that knowl-
gedge of what is there.” In general, the students who expressed equal orientations 
tended to be rated at more complex epistemologies (Orientation ii or above).

The new sample of interviews provides further evidence that postsecondary 
students describe knowledge in the two domains differently. In the second study, 
students were asked directly, “Do you view knowledge differently in the sciences 
and the humanities?” Twenty-one (70 percent) indicated that they did perceive 
a difference, five (17 percent) said no, and four (13 percent) did not directly 
respond to the question. Although our coding of orientations considered more 
than the simple answer to this question, we feel that this result provides direct

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<td>11 (21%)</td>
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support for our grounded theory as students so consistently indicated that they perceived a difference in knowledge in these domains.

Discussion/Implications

Higher education institutions have taken an interest in epistemology as learners’ personal epistemological beliefs are thought to influence, even determine, behavior, especially in educational settings (Tittle, 2001). For instance, epistemological stance has been shown to be related to students’ overall academic performance as measured by grades (Hofer, 2000; Kardash & Howell, 2000), with students holding more complex epistemological beliefs having higher academic achievement. To this end, this study applied a grounded theory of domain-specific epistemologies to a new sample of predominantly liberal arts students. Results indicate that the original grounded theory applies not only to the original sample of science and engineering students but to liberal arts students as well. In both samples, a majority of students described epistemological understandings of knowledge in the humanities/social sciences that were more complex than their understanding of knowledge in the sciences. However, in the first sample of engineering and science majors, in contrast to the second sample of liberal arts students, a larger number of students also exhibited a more complex understanding of knowledge in the sciences than in the humanities/social sciences (21 percent of the old sample versus only 13 percent of the new sample).

Although the samples varied in their distributions of epistemological orientations, we found some surprising, and sometimes disturbing, similarities in the results and feel that these results have implications for the design of individual course- and curricular-level experiences. For example, in both samples there was a sizable proportion of students (thirty-one of eighty-two ratable students) who espoused a simple “knowledge is facts” orientation in one or both domains. Given that both samples were drawn from junior and senior students at respectable universities, we find it somewhat distressing that students are not developing an understanding of knowledge that allows them to acknowledge, let alone evaluate, competing knowledge claims.

We are encouraged, however, by the willingness of many students to give up the security of certain knowledge in order to embark on the journey of exploring an epistemological view that recognizes and accommodates doubt. As William Perry has so eloquently stated, “Maturation did indeed have its joys of discovery and expansion, but its moral significances derived from its challenge by countervailing forces. At every step, the movement required students to ‘face up’ to limits, uncertainties, and the dissolution of established beliefs, while simultaneously it demanded new decisions and the undertaking of new
forms of responsibility” (1999, p. 58). Students often illustrated the process of coming to think more complexly, in one field or both. For example, one senior student who had pursued an interdisciplinary degree in religion, literature, and art, described a change in his thinking regarding the epistemologies of the two domains: “I used to [think of knowledge differently in science and humanities]—very much. Lately, not as much. In some sense, the questions you ask are always going to shape the answers that you get. If you are asking scientific questions, you are going to get scientific answers. But at the same time, see this is where I am saying we could get very philosophical, but I think a lot of thought generally is almost a construct of the human imagination, and therefore taking things like science and mathematics are just as much fictions. . . . And so, they are created by the human imagination.” As evidenced by this quote, the journey toward a more complex epistemology requires courage but can be intellectually exciting in its challenges.

Although we did not attempt to specifically examine the relationship of university instructional or curricular experiences to students’ movement toward a more complex epistemology in this study, previous literature points to the potential relationship of instruction and epistemology (Knefelkamp, 1974) and curricular design and complexity of thinking (Haynes, 2004). Although instruction is likely a key component in how domain-specific personal epistemologies develop, the literature also points to other influences outside the classroom (Egart & Healy, 2004; Perry, 1999; Piper & Buckley, 2004).

In another work, we have proposed a model, shown in Figure 3, for understanding the multiple environments that can affect the development of personal domain-specific and domain-general epistemologies (Palmer & Marra, 2008). This ecological model draws on the work of developmental psychologist Urie Brofenbrenner (1977; Brofenbrenner & Evans, 2000), and we believe it can help both researchers and practitioners understand and react to the implications of the complex relationships among constructs such as society, knowledge domain, and instructional experiences that may have an effect on an individual’s developing personal epistemologies.

The model in Figure 3 represents the individual’s personal epistemology developmental trajectory as being influenced by a nested arrangement of reciprocally related environments. Because the model is intended to be comprehensive, not all elements of the model apply directly to this study (e.g., family). Instead, our discussion focuses on the potential relationship of curricular requirements, discipline, classroom instruction, and students’ epistemological beliefs.

The most proximal environments (microsystems) are the face-to-face interactions of the individual in social settings. A microsystem is any daily activity in which the individual engages in a social role—perhaps most pertinent in
this study, the individual’s role as a student. These elements are denoted by the asterisk-marked circles in Figure 3. The many microsystems combine to create the mesosystem—the various social environments of their daily lives. The more distal environments, the exosystem nested within the macrosystem, influence not only the individual’s personal development but also the environment of the mesosystem. All of these systems change over time, creating a complex model that is a person–process–context–time ecological model.

For our studies, this systems view of the constructs that affect epistemological beliefs provides a framework for understanding our results. Aspects of our data also support the proposed model. For instance, in this ecological approach, the elements of the individual’s microsystem, being more proximal to the individual, will exert a more direct influence on epistemological beliefs than the more distal exosystem or macrosystem. In our studies of domain-specific epistemological beliefs, students occasionally were quite direct in attributing their changing views of knowledge to particular courses or instructional methods. For an English major, one general education course in particular stood out: “One [class] was an experimental course which is now part of the new core called Ideas and Perspectives. When I took it there were twenty-five

**Figure 3** An Ecological Model of Personal Epistemology (Palmer & Marra, 2008).
people in it. I had a humanities instructor and a science instructor. . . . So, they had history components and science components, but looking at the same problems from different angles, you got different perspectives.” This student’s comments support the idea that the more proximal microsystem classroom setting, in particular instructional and assessment practices, may exert a stronger and more direct influence on the individual’s epistemology. This hypothesized relationship as well as our data fit well with the research findings regarding epistemological resources (Hammer & Elby, 2002) that posit that the individual accesses epistemological resources based on the immediate demands of the classroom environment.

The cumulative effect of a series of courses, or a combined set of experiences in a particular knowledge domain, may also have an effect on students’ epistemological perspectives (Hart, Rickards, & Mentkowski, 1995). The influence of domain or discipline is represented in the exosystem in Figure 3. We posit that, as for all elements of the exosystem, the influence of domain is indirect, occurring primarily through the filtering mechanisms of the microsystem of the classroom. This makes intuitive sense, in that, for most students, their introduction to and socialization in a discipline take place initially in classroom settings, guided by instructors.

From our data we see this effect, for example, in the small set of liberal arts students that exhibited a science orientation that was more advanced than their humanities/social science orientation (see Table 2). Three of the four students who showed this relational orientation also had advanced curricular experiences in science. With these few students as exceptions, it seems that the majority of the new sample of students may have had fewer opportunities to develop a complex view of sciences because of their limited or complete lack of exposure to university science content beyond introductory survey courses. One student was quite cognizant of the limitation of her exposure to the nature of science knowledge. She stated, “But maybe that is just because I took sciences in the more lower level. I have to be fair here. Perhaps if you got up to a higher level, it would be a little more engaging, not those eighty-student classrooms and that sort of thing.”

Clearly we cannot draw causal linkages between students’ course and curricular experiences and their epistemological orientations; however, the above quotations do provide evidence of the potential impact of instructional and curricular experiences on epistemological development. Although this type of direct relationship of curriculum to epistemology is not unique in the literature (Marra, Palmer, & Litzinger, 2000; Stephenson & Hunt, 1977), it is relatively infrequent and thus notable.

Although observed patterns of curriculum and epistemological stance could be attributable to self-selection, it is clearly an area that could benefit
from future research. Similarly, the relationship of particular instructional methods to students’ development in domain epistemologies is another potentially fruitful area of inquiry. We believe that even the potential of science (or any other domain) course work having a positive impact on students’ epistemological beliefs is (or should be) an exciting observation for university educators.

However, from our data, it appears that two or three isolated course work experiences in a knowledge domain may expose students to only fragmented knowledge and do little to challenge a simplistic epistemology of the field. The calls for curriculum integration and the questioning of fragmented general education experiences have been around for many years (e.g., Miller 1988; Project on Redefining the Meaning and Purpose of Baccalaureate Degrees, 1985). And yet, the requirements for general education at many institutions continue to be structured specifically in this manner, allowing students to choose courses “cafeteria style” from a list of approved offerings. One result is that students experience a “fragmented and incoherent educational experience” (AAC&U, 2007, p. 19) rather than steady progress in their understanding of knowledge in general or in specific domains. In contrast, general education requirements that support students in selecting a more integrated or sustained set of courses in a domain or a coordinated set of courses that work together rather than as isolated experiences may provide a more fertile “exosystem” for the development of complex epistemological perspectives in students.

Similarly, Fong (2004) argues that true liberal education is not achieved by a general education requirement that aggregates a number of credits in unrelated classes but, rather, by connecting courses into a curriculum that synthesizes ways of knowing and doing. In a widely cited report titled Greater Expectations: A New Vision for Learning as a Nation Goes to College, the Association of American Colleges and Universities (2002) argues that the excellent postsecondary education of the future will help students develop into “integrative thinkers who can see connections in seemingly disparate information and draw on a wide range of knowledge to make decisions” (p. xi). And a more recent AAC&U report (2007) continues to promote this theme, arguing for “integrative learning.” Although it may not be a sufficient condition, a well-developed set of epistemological beliefs is arguably a necessary condition for such thinking.

Liberal or general education is sometimes seen as a “less marketable” part of the curriculum or even obsolete (AAC&U, 2007). However, as previously stated, because of the dynamic nature of today’s job market and the global economy, business leaders are calling for more and improved liberal education—not less. They do not need graduates who have a narrow understanding of one discipline but, rather, an integrated understanding of the complexities of the world and
workplace. Liberal and general education can address these needs—but to do so most liberal and general education curricula need reform (AAC&U, 2007).

This type of curricular reform is not easy. AAC&U (2007) argues that in order to proceed in such revisions, “higher education will also need to break out of the academic categories and silos that were established in the last curriculum revolution, and that still organize the division of labor across most campuses, from community colleges to research universities” (p. 18). While facing many structural challenges, institutions should prioritize the intentional and integrative learning of students if they are to prepare their students for productive lives in a global community (Huber & Hutchings, 2004). Although the university-level curriculum revisions required of general education reform are fraught with difficulties (e.g., departmental “turf” wars based on fears of course cuts or enrollment drops [Guy & Schoepflin, 1996]), we argue that even smaller classroom-level or course-cluster changes that require less overall reform may have a positive impact on developing students’ domain-specific and general epistemological beliefs.

Limitations

This particular study was designed specifically to validate our previous grounded theory with a sample of students who were purposefully chosen from majors outside engineering and the sciences. Our sampling techniques worked well for the validation of the theory but are less appropriate for any generalization across liberal arts students or university students in general. It would therefore be appropriate to continue our line of research with student samples that extend the theory or test its applicability to other populations or situations. For example, research that examines the domain-specific epistemologies of first- and second-year college students would clarify how the theory may or may not apply to younger students. On the opposite extreme, research that examines the domain epistemologies of graduate students or older adults might also offer evidence regarding whether the inconsistencies in domain epistemologies are later resolved or remain inconsistent over time. Longitudinal studies would, of course, offer additional insight into whether these patterns are developmental or merely individual differences.

The two samples discussed in this article were purposefully sampled from different populations of students, those in sciences and those predominantly in liberal arts, so we might expect some variation in the patterns of epistemological orientations for the two groups. However, we also drew these two samples from different regions of the country (East and West) and from different institutional types (research intensive and research extensive). The variation in the sample methods is both a benefit, in that it shows that these differences span different
types of institutions, and a potential liability, because contrasts between the two samples could be attributable to institutional influence rather than the major choice of the individuals interviewed.

Even within these limitations, the similarity of the results for both samples does present a clear challenge to the supposition that students will exhibit a consistent epistemological understanding across knowledge domains (Schommer & Walker, 1995). Researchers who study epistemology may need to examine whether their current measurement tools will detect multiple domain epistemologies for the same individual. Similarly, in the classroom, instructors may need to explore their own conscious or unconscious presentations concerning the nature of knowledge in their discipline.

Educators may also want to consider how best to approach students who are evidencing a more complex epistemology in one knowledge domain compared to another. It may be that educators can use this inconsistency as a teachable moment to help students examine their foundational beliefs about learning.

Conclusions

Educators and policy makers are clearly calling for an approach to higher education that helps students to think in integrated ways and see connections between apparently disparate information sources rather than focused on domain silos (AAC&U, 2002, 2007). Even popular periodicals are echoing the need for these types of educational reforms. A recent Time Magazine article on the future of education describes the need for young people to “be discerning consumers of information and to research, formulate and defend their own view” (Wallis & Steptoe, 2006, p. 54). This study has shown support for a grounded theory of domain-specific epistemological orientations in the social sciences/humanities and sciences. How does this relate to the need to graduate college students who are integrative thinkers?

To think in epistemologically complex ways means that an individual can in fact make judgments grounded in evidence and beliefs regarding conflicting sources of information and understand that truth must be evaluated contextually. Our results indicate that individual students may simultaneously hold differing epistemologies in knowledge domains and, further, that the fragmented nature of students’ general or liberal education experiences may contribute to the lack of epistemologically sophisticated thinking in both the liberal arts and the sciences. Although we believe that epistemological growth does not come solely from individual courses and curricular experiences, research has shown that these experiences can positively affect epistemological beliefs (e.g., Marra et al., 2000).
Our results indicate that the curricula at the two high-quality institutions that provided our student samples do not consistently promote the development of the integrative thinkers called for by higher education leaders. We further suggest that epistemological beliefs and, in general, an exploration of the nature of knowledge can provide a framework for understanding the impact of the curriculum on students' thinking and that curricular and course-level revisions designed to promote epistemological development may also meet the documented needs of our current and future graduates.

References


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