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Significance of Epistemological Beliefs for Teaching and Learning Psychology: A Review

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Abstract

Beliefs about the nature of knowledge, termed “epistemological beliefs”, are relevant to understanding educational strategies of both learners and teachers. Epistemological beliefs arguably have particular relevance in the discipline and profession of psychology, due to an emphasis on integration of knowledge from multiple theoretical perspectives. This article provides an overview of peer-reviewed literature in this area and suggests implications and directions for teaching and learning of psychology, with particular reference to the higher education context.

Key Words: Epistemology, Learning, Professional Education, Psychology, Review, Teaching

Significance of Epistemological Beliefs for Teaching and Learning Psychology: A Review

Beliefs about the nature of knowledge influence learning and teaching (Bendixen & Rule, 2004). These "epistemological beliefs" (EB) can vary across individuals and disciplines (Hofer, 2001; Kaartinen-Koutaniemi & Lindblom-Ylänne, 2008). Despite their importance, to our knowledge, there is no previous published review of EB specific to teaching and learning psychology.

EB are arguably important to both academic and applied psychology. Development of scientific reasoning skills has been recommended as a central goal of psychology education (Cranney et al., 2008; Halonen et al., 2003). Similarly, codes of ethics state that applying psychological knowledge requires awareness of the need for ongoing learning and limitations of existing knowledge (Australian Psychological Society, 2007). A critical perspective regarding new knowledge requires relatively sophisticated EB (Halonen et al., 2003). Therefore, for graduates to apply psychological knowledge ethically, technical skills need to be accompanied by skills for discovering, interpreting, and integrating relevant evidence, which involves well-developed EB.

Other terms for EB and related concepts include "personal epistemologies", "epistemic beliefs", "epistemic cognition", and "epistemological resources", among others (Elby & Hammer, 2001; Murphy, Alexander, Greene, & Hennessey, 2012). The present review uses the term EB, for consistency. Concepts and measurement of EB will be discussed, followed by findings and recommendations regarding learning and teaching.

Concepts

Perry's pioneering research in the 1950s and 1960s (e.g., Perry, 1968) used annual interviews to show that university students' conceptions of the nature of knowledge develop over time. Less experienced tertiary students are more likely to demonstrate *dualist* beliefs, whereby knowledge is viewed as absolute and the teacher's role is to communicate that knowledge. In the next stage, *multiplism*, there is acknowledgement of multiple perspectives, but still the idea that there is a specific, yet undiscovered, truth. Later, *relativism* acknowledges that some viewpoints are better than others. The most sophisticated beliefs, *commitment within relativism*, involve making and evaluating flexibly held commitments to beliefs that incorporate personal values (Brownlee, Boulton-Lewis, & Purdie, 2002; Hofer, 2001). Later EB research, including children's and adults' education, has identified similar developmental stages, termed *realist*, *absolutist*, *multiplist* and *evaluativist* by Kuhn (2005; 2009).

For example, a student with dualist (or absolutist) EB might explain IQ score as "the way you measure intelligence". Differing responses would be expected with multiplist EB, e.g., "one of the ways to measure intelligence"; relativist EB, e.g., "a measure of performance on a standardised test that is believed to reflect the construct of intelligence", or commitment within relativism (evaluativist) EB, e.g., "a measure of performance on a standardised test that is believed to reflect current understanding of the construct of intelligence". (A single response is not sufficient to identify EB; these examples are offered as illustrations only.)

Relatively few students reach the "highest" stages (Entwistle & Peterson, 2004; Kuhn, Cheney, & Weinstock, 2000). Also, students may return to "earlier", less sophisticated EB, particularly during transitions, such as from school to university

(Hofer & Pintrich, 1997; Weinstock, Neuman, & Glassner, 2006). Affect, particularly anxiety, potentially plays a role in this regression (Hofer & Pintrich, 1997) as well as in other aspects of shifts in EB (Bendixen & Rule, 2004).

Perry's higher categories overlap with "constructivist epistemology". Constructivism posits that individuals learn through experience, deriving meanings that are influenced by context and by their previous knowledge and viewpoints (Lea, Stephenson, & Troy, 2003; Muis, 2007). A constructivist approach to learning aligns with EB at the relativism or commitment within relativism stages, due to its emphasis on the importance of students' experiences and perspectives in developing their knowledge. More generally, EB can be viewed as a "psychological approach to the philosophical field of epistemology" (Hofer, 2008, p. 5).

Alternative developmental models to Perry's include Women's Ways of Knowing, the Epistemological Reflection Model, and Reflective Judgment (Hofer, 2001). Despite a lack of consensus on one model (Bendixen & Rule, 2004), longitudinal research supports the usefulness of developmental models. For example, a review of longitudinal research on Reflective Judgment found that most individuals either maintained or progressed EB, with at most 16% displaying regressions (King & Kitchener, 2004). However, regressions are likely to be more frequent if students shift learning contexts (Hofer & Pintrich, 1997).

Developmental models of EB are complemented by models that address other aspects, such as motivation, affect, and dimensionality of beliefs. Regarding dimensions, reviewers have suggested that beliefs about what knowledge is (certainty and simplicity of knowledge) are distinct from beliefs about processes of knowing (source and justification of knowledge; Bendixen & Rule, 2004; Hofer & Pintrich, 1997). For example, beliefs that scientific knowledge is tentative rather than certain,

and complex rather than simple, would generally be viewed as more sophisticated EB (although see Elby & Hammer, 2001, for critique of "consensus" views of EB sophistication). Similarly, viewing the source of knowledge as "experts" would be considered less sophisticated than viewing the source as an array of evidence potentially varying in quality, support for or against a proposition, and replicability. Structure of EB and boundaries with other constructs continue to be debated (Chinn, Buckland, & Samarapungavan, 2011), but reviews have consistently supported utility of EB for understanding and improving teaching and learning, due to associations between EB and both learning and motivation (Bendixen & Rule, 2004; Greene, Muis, & Pieschl, 2010; Hofer, 2001; Hofer & Pintrich, 1997; King & Kitchener, 2004; Schommer-Aikins, 2004). Potential cultural differences in EB have also been explored (Braten, Gil, Stromso, & Vidal-Abarca, 2009; Khine, 2008).

Measurement

EB measures vary with different models (e.g., see reviews by Braten et al., 2009; Buehl, 2008; Hofer, 2006; Limón, 2006). Many studies have used the Schommer Epistemological Questionnaire (EQ; Schommer, 1990) or have adapted it (Jehng, Johnson, & Anderson, 1993; Kardash & Wood, 2000; Schraw, Bendixen, & Dunkle, 2002). EQ factors of Simple Knowledge, Certain Knowledge, Innate Ability, and Quick Learning have fair internal consistency (e.g., Cronbach alphas between .54 to .76, Schommer-Aikins, 2004). Unfortunately, concerns about the theoretical basis, poor replicability of factors, and reliability of the EQ and related measures limit their usefulness (DeBacker, Crowson, Beesley, Thoma, & Hestevold, 2008). More recent written measures include the Connotative Aspects of EB (Stahl & Bromme, 2007) and the Topic Specific EB Questionnaire (Braten et al., 2009).

Perry (1968) used interviews. A widely used format is the semi-structured Reflective Judgment Interview (King & Kitchener, 2004). The student is questioned about several controversial topics (e.g., the accuracy of news reporting). Questions include the student's beliefs, their certainty about those beliefs, and how people including experts may disagree on this topic. Internal consistency is high (median Cronbach's alphas around .80; King & Kitchener, 2004). A written adaptation of the Reflective Judgment Interview also has acceptable pre-post test reliability (Valanides & Angeli, 2005). There is to date no consensus on EB measurement and it is recommended to consider relevance for the intended purpose, as well as psychometric properties when selecting measures.

Domain Specificity: EB in Psychology versus Other Disciplines

EB may be domain- or discipline-specific (Hofer, 2001; Kaartinen-Koutaniemi & Lindblom-Ylänne, 2008), although domain-general EB may co-exist (Muis, Bendixen, & Haerle, 2006). Domain-specificity has been examined by comparing students of different disciplines and by comparing students' EB regarding knowledge domains. Paulsen and Wells (1998) assessed EB among 290 university students majoring in disciplines that were hard-soft ("hard" emphasising one specific paradigm; Biglan, 1973a) or pure-applied ("applied" emphasising applying subject matter to practical problems). Psychology is "soft" and "pure" (Biglan, 1973a, 1973b). As predicted, students from "soft" and "pure" disciplines had significantly more sophisticated EB than did students from "hard" or "applied" disciplines. For example, social sciences and humanities (soft and pure) students were less likely to have naïve beliefs in simple or certain knowledge than were engineering (hard and applied) or business (soft and applied) students. Karseth and Solbrekke (2006) interviewed Norwegians studying law or psychology. They found that law students

were more likely to view their task as learning a single, "correct" legal method, whereas psychology students emphasised the importance of understanding multiple theoretical perspectives.

Longitudinal German research measured EB in final year high school (*N*=2,854) and second year university (*N*=1,495; Trautwein & Lüdtke, 2007). EB predicted students' choice of discipline (self-selection hypothesis of EB-discipline associations) and changed in different ways depending on the discipline the student studied (socialisation hypothesis; Trautwein & Lüdtke, 2007). Specifically, high school certainty beliefs were highest among students who chose business at university and lowest among students who chose social science. By second year university, certainty beliefs declined further in social science and humanities students, but increased in engineering students.

Examining individuals' discipline-specific EB, Hofer (2000) found that psychology students' EB about science and psychology differed. They believed that in psychology, knowledge was less certain, truth was less attainable, personal experience was more important as a source of knowledge, and knowledge from experts was less important compared with science. Similarly, Estes, Chandler, Horvath, and Backus (2003) found that undergraduate students who had studied psychology believed that psychological phenomena were less knowable through scientific methods than were biological phenomena, and that psychological phenomena could be understood via common sense and personal experience. These data imply increased readiness to develop sophisticated EB regarding psychology than some other topics, although alternative explanations such as lack of understanding of scientific methods in psychology are also possible. More sophisticated EB regarding psychology than other fields have been found among students from a range of disciplines, with the most

pronounced difference found among students at higher year levels (unpublished data from Wood, Kitchener & Jensen, cited by King & Kitchener, 2004).

Students' EB change with time in psychology programs. Focus groups conducted with beginning, second and third year psychology students in the United Kingdom (UK) showed that beginning students viewed psychology as being open-ended and creative (suggesting relativist and constructivist epistemologies), but also as constituting a body of knowledge (suggesting a dualist epistemology; Wallwork, Mahoney, & Mason, 2006). Second and third-year students referred to the discipline's complexity, with this being viewed more positively by third years. This implied greater acceptance of relativism by advanced students.

Despite changes over time, Kaartinen-Koutaniemi and Lindblom-Ylänne (2008) found that EB still varied between masters students of psychology, pharmacy or theology in Finland (N=52). Psychology students placed more emphasis on research methods and quantitative analysis in evaluating knowledge, whereas theology students were more likely to value intuition. Emphasis on scientific method and its applicability to understanding psychological phenomena was more evident among these psychology Masters students than the undergraduate students in Estes et al.'s (2003) study. Thus, experience in psychology fosters appreciation that psychological phenomena are knowable by scientific methods.

Lonka and Lindblom-Ylänne (1996) assessed EB in first- and fifth-year psychology and medicine students. Among psychology students, fifth-years reported lower mean scores than first-years on a factor that combined high interest in applied knowledge with low interest in theoretical knowledge. In contrast, these factor scores increased in advanced medical students, even though both programs qualified students for professional practice. Knight and Mattick (2006) found that EB of UK medical

students changed in complex ways that varied among different areas of knowledge and practice. They concluded that development of professional identity should be considered in conjunction with EB. This may also pertain to psychology students who are in professional streams of study.

In summary, studies within and across disciplines suggest that students are likely to have more sophisticated EB regarding psychology than many other disciplines. Why might psychology foster sophisticated EB? Psychology focuses on critical thinking, through emphasis on research methods and integrating knowledge from multiple theoretical perspectives (Reddy, Hammond, Lewandowska, Trapp, & Marques, 2011). Psychology students are encouraged to develop scepticism to understand and justify sources of evidence and know how to distinguish between different strength evidence. Psychology also emphasises writing more than some other disciplines, which requires students to compare and integrate competing knowledge. This may encourage constructivist approaches.

If sophisticated EB are fostered by studying psychology, how might this benefit students? One way is via associations between EB and students' learning approaches and the other is via associations between EB and academic achievement.

Relationship with Learning Approaches

EB may influence learning through a link with learning approaches (Entwistle & Peterson, 2004; Hofer & Pintrich, 1997). "Surface" learning focuses on outcome goals such as obtaining a qualification, whereas a "deep" approach involves intrinsic motivation and abstract meaning. A third "strategic" approach involves striving to achieve highly while organising one's time efficiently (Cassidy & Eachus, 2000). Naive EB have been associated with surface learning approaches whereas sophisticated beliefs have been associated with deeper approaches (Schreiber &

Shinn, 2003). Entwistle and Peterson (2004) noted that students who viewed learning as being about transforming or constructing knowledge focused on understanding and displayed intrinsic academic orientation and a self-regulated approach to learning. Students who viewed learning as being about memorising fact-based fragments of knowledge were more likely to use surface-level rehearsal and memorising strategies. More generally, Muis (2007) reviewed ways that EB relate to self-regulated learning.

A longitudinal study of Dutch social science, economics, law and arts students found that surface learning frequency was stable from the first to third semester of study, whereas deep learning strategies increased (Vermetten, Vermunt, & Lodewijks, 1999). Students who viewed knowledge as something for "intake" were less likely to report deep learning, whereas students who viewed knowledge as "constructive" were more likely to. Phan (2008) also found that EB affected students' deep versus surface learning approaches, but that learning approaches did not affect students' later EB.

Lonka and Lindblom-Ylänne (1996) found that surface learning was significantly lower and constructivist epistemology significantly higher among psychology than medical students, and among fifth- than first-year students. However, there was no interaction between discipline and year level. Regardless of discipline, students endorsing constructivist epistemology reported using surface strategies less often and deep strategies more often than did dualist students.

Relationship with Academic Achievement

Sophisticated EB have been associated with better performance on both experimental tasks and course grades. Schommer (1990) asked undergraduate psychology students to write conclusions for and demonstrate mastery of passages from psychology or nutrition. Higher certainty of knowledge beliefs were associated with absolute (oversimplified) conclusions, whereas completion of more university

courses was associated with more tentative conclusions, reflecting more sophisticated EB. Higher quick learning beliefs were also associated with oversimplified conclusions and poorer mastery on the psychology passage as well as overestimation of understanding. There was no influence on nutrition passage mastery, but floor and ceiling effects appeared to be a problem with that passage. Similarly, Schommer-Aikins and Easter (2006) found that business students who believed in quick learning had worse reading comprehension and poorer course grades, whereas other EB did not correlate with academic outcomes. However, Hofer and Pintrich (1997) criticised "quick learning" on methodological and conceptual grounds as beliefs about learning rather than beliefs about knowledge.

Trautwein and Lüdtke (2007) found that higher certainty of knowledge beliefs in final year high school students were associated with lower grades, after controlling for cognitive ability and socioeconomic status. Similarly, Phan (2008) found that both EB and learning approaches predicted academic performance of university mathematics students, and that learning approaches mediated effects of EB on academic performance. University physics students who showed higher gains in conceptual knowledge during first year described their learning in ways that implied more sophisticated EB (May & Etkina, 2002).

Among students in introductory educational psychology, 90% of whom were studying to become teachers, more sophisticated EB were associated with higher course grade and this relationship was mediated by both achievement goals and learning strategies (Muis & Franco, 2009). Consistent with findings from non-psychology students, Hofer (2000) found that certainty and simplicity of knowledge beliefs among 326 psychology undergraduates significantly negatively correlated with psychology grade (r =-.31) and overall grade point average (r =-.22). Thus, in

psychology and other disciplines, more sophisticated EB are associated with higher academic achievement.

Teaching

Students prefer teaching approaches to be aligned with their present EB, yet learning is enhanced when students' existing conceptions are challenged (Entwistle & Peterson, 2004). Student-centred approaches to learning and teaching naturally align with a constructivist epistemology (Lea et al., 2003). However, student-centred approaches are more often claimed than realised in practice (Lea et al., 2003).

Lonka and Ahola (1995) found that "activating" classes in psychology, intended to be student-centred and, therefore, involving constructivist epistemology, were associated with improved student understanding, study skills, academic results and final year thesis grades compared with "traditional" teacher-centred classes. Similarly, UK psychology students viewed student-centred learning as being more motivating and effective than teacher-centred learning, but also expressed the need for sufficient support rather than being left to learn by themselves (Lea et al., 2003).

Focus groups conducted with beginning, second and third year UK psychology students showed a shift in third-year students who emphasised the importance of personally experiencing the discipline's complexity (Wallwork et al., 2006). The authors suggested that aiding psychology students' development of independent learning and critical thinking might require educators to avoid providing increasing structure and support, because this may maintain information acquisition (dualist) models of learning. Furthermore, they stated that students who view psychological knowledge as requiring information acquisition may feel unsupported and threatened by teaching strategies that encourage independent activities and consideration of multiple perspectives.

EB may also affect assessment. Lea and Street (1998) noted that academic writing may be viewed differently by educators and students as well as by different individuals. They suggested an "academic literacies" approach that acknowledges epistemological variability among writing contexts. Interviews revealed that academics' ideas about "good" writing were based in the meaning of knowledge, often discipline-specific. However, academics were often unable to identify explicitly what would improve poor student writing from an epistemological basis and instead more frequently described surface features such as structure and form. More attention by teachers to the epistemological basis of their expectations would help them communicate clearer expectations and give students feedback on core rather than surface issues. Madigan, Johnson, and Linton (1995) noted the epistemological nature of psychology's key writing guide, the Publication Manual of the American Psychological Association (APA). They argued that more than teach students to write like psychologists, the Manual teaches them to "reason empirically about human behaviour" (p. 434) and to embrace the discipline's intellectual values; that is, to think like psychologists. Interestingly, critiques of Madigan et al.'s paper included the suggestion that the epistemology implied by the APA Manual is not shared by all psychologists (Josselson & Lieblich, 1996).

Assessment may also affect students' beliefs and approaches. Among first- and second-year university students studying research methods in health, social work or counselling, higher use of strategic learning was related to both higher academic achievement and perceived proficiency at course completion (Cassidy & Eachus, 2000). Deep learning did not correlate with achievement or perceived proficiency. The authors suggested that this might reflect that performance rather than learning is emphasised and rewarded in higher education. Certainly French psychology students

reported perceiving universities to provide strongest encouragement and incentives for strategic goals, even though both educators and students more strongly endorsed deep learning goals (Darnon, Dompnier, Delmas, Pulfrey, & Butera, 2009). Knowledge of EB may help psychology educators to use assessment to facilitate deep as well as strategic learning.

Explicit versus Implicit Teaching

The extent to which it is beneficial to explicitly teach students about EB, compared with using strategies that implicitly foster more sophisticated beliefs, is unclear. Explicit teaching regarding EB involves strategies such as students completing and then discussing an EB measure, as used in some educational psychology courses (Hofer, 2001). Explicit EB instructional studies have been concentrated in education. For example, EB of pre-service early childhood teachers increased in sophistication when both explicit and implicit teaching of EB was included in their university program (Brownlee, Petriwsky, Thorpe, Stacey, & Gibson, 2011). Explicit instruction regarding EB during teacher training was endorsed in a comprehensive review of teachers' EB (Schraw & Olafson, 2003). These reviewers suggested that explicit instruction may help teachers to develop pedagogically helpful EB and to use classroom practices that are consistent with these EB (Schraw & Olafson, 2003).

Hammer and Elby (2002) demonstrated that teaching strategies can implicitly encourage students to use epistemological resources that will aid learning. Examples given include encouraging student debate, using design and construction activities, and using bridging analogies. They cited work by Harel and Papert (1991, cited in Hammer & Elby, 2002), showing that students demonstrated more sophisticated

epistemological resources when asked to design and construct physical or virtual objects than in traditional classroom tasks.

Kienhues, Bromme, and Stahl (2008) randomly assigned second year German university students to an instructional condition presenting a unitary viewpoint that was not expected to change EB, or one presenting contrasting viewpoints that was expected to develop more sophisticated beliefs. Neither condition included explicit EB instruction. Approximately 55% of the sample was psychology students. Results were mixed. Some students with naïve beliefs who received refutational instruction developed more sophisticated beliefs. However, some students with more sophisticated EB showed more naïve beliefs following either type of instruction. Regression to the mean might partly explain this but it also suggests potential for some types of teaching to affect EB development adversely. Overall, this study demonstrated that EB could be changed by the instructional context, consistent with Hammer and Elby's (2002) suggestions.

A review of EB in mathematics found that instructional strategies could change children's and adults' beliefs about mathematics in ways that improved understanding and performance (Muis, 2004). Similarly, in an intervention study with graduate students studying introductory statistics for social sciences, Muis and Duffy (2012) found that a class assigned to a semester of constructivist teaching strategies including teacher modelling of critical thinking, use of multiple approaches to solving problems, and making connections to prior knowledge, developed more sophisticated EB, used more constructivist learning strategies, and achieved higher course grades, compared to a control class. Muis (2004) speculated that including explicit instruction about EB as well as using teaching and learning strategies that support implicit EB

development might protect students from "regressing" in EB if they receive such an intervention and then change instructional contexts.

Recommendations for Psychology Education

Based on evidence above regarding advantages of sophisticated EB for psychology students and potential for fostering helpful EB, we recommend that all psychology teachers acquire knowledge of educational implications of EB. Evidence seems clear that using learning and teaching strategies that *implicitly* promote sophisticated EB will benefit psychology students. A number of authors have provided relevant suggestions for teaching practice (e.g., Bendixen & Rule, 2004; King & Kitchener, 2004; Muis, 2007). Strategies such as encouraging students to structure knowledge themselves via optimally supportive learning environments (Wallwork et al., 2006), reviewing historical development of an area (Hofer, 2001), attending to individual student variability and potential anxiety about constructivist approaches (Lea et al., 2003), and giving assessment feedback that emphasises core understanding rather than surface issues (Lea & Street, 1998) are demonstrated or likely to be helpful in psychology.

It is unclear whether *explicitly* teaching psychology students about EB would add benefit. If taught explicitly, it is recommended that the concept be revisited, so that students have an opportunity to review development of their beliefs over time (Brownlee et al., 2011). A recent report recommended explicit teaching of epistemology from first year psychology onwards (Cranney et al., 2008). Optimal times for explicit instruction might include transition periods such as first year psychology, "capstone" courses, and entry to Honours or postgraduate training, because students are believed to be vulnerable to returning to less sophisticated EB at such transitions (Hofer, 2001; Weinstock et al., 2006). Explicit teaching may help

protect students from regressing in EB when changing learning contexts and would also help to develop psychology educators.

Recommendations for Research

Future research should continue to strive for clarity in concepts and measurement. Important intervention questions regarding psychology education include (a) optimal ways to foster sophisticated EB among students, (b) mechanisms by which this occurs, and (c) whether it adds benefit to explicitly teach students about EB.

References

Australian Psychological Society. (2007). *Code of ethics*. Melbourne, Australia: Author.

Bendixen, L. D., & Rule, D. C. (2004). An integrative approach to personal epistemology: A guiding model. *Educational Psychologist, 39*, 69-80. doi: 10.1207/s15326985ep3901_7

Biglan, A. (1973a). The characteristics of subject matter in different academic areas. *Journal of Applied Psychology, 57*, 195-203. doi: 10.1037/h0034701

Biglan, A. (1973b). Relationships between subject matter characteristics and the structure and output of university departments. *Journal of Applied Psychology, 57*, 204-213. doi: 10.1037/h0034699

Braten, I., Gil, L., Stromso, H. I., & Vidal-Abarca, E. (2009). Personal epistemology across cultures: Exploring Norwegian and Spanish university students' epistemic beliefs about climate change. *Social Psychology of Education, 12*, 529-560. doi: 10.1007/s11218-009-9097-z

Brownlee, J., Boulton-Lewis, G., & Purdie, N. (2002). Core beliefs about knowing and peripheral beliefs about learning: developing an holistic conceptualisation of epistemological beliefs. *Australian Journal of Educational & Developmental Psychology, 2*, 1-16.

Brownlee, J., Petriwsky, A., Thorpe, K., Stacey, P., & Gibson, M. (2011). Changing personal epistemologies in early childhood pre-service teachers using an integrated teaching program. *Higher Education Research and Development, 30*, 477-490. doi: 10.1080/07294360.2010.518952

Buehl, M. M. (2008). Assessing the multidimensionality of students' epistemic beliefs across diverse cultures. In M. S. Khine (Ed.), *Knowing, knowledge and beliefs: Epistemological studies across diverse cultures* (pp. 65-112). Dordrecht, The Netherlands: Springer.

Cassidy, S., & Eachus, P. (2000). Learning style, academic belief systems, self-report student proficiency and academic achievement in higher education. *Educational Psychology, 20*, 307-322. doi: 10.1080/713663740

Chinn, C. A., Buckland, L. A., & Samarapungavan, A. L. A. (2011). Expanding the dimensions of epistemic cognition: Arguments from philosophy and psychology. *Educational Psychologist, 46*, 141-167. doi: 10.1080/00461520.2011.587722

Cranney, J., Provost, S., Katsikitis, M., Martin, F., White, F., & Cohen, L. (2008). Designing a Diverse, Future-oriented Vision for Undergraduate Psychology in Australia: Final Investigation Report. Sydney, Australia: University of New South Wales.

Darnon, C., Dompnier, B., Delmas, F., Pulfrey, C., & Butera, F. (2009). Achievement goal promotion at university: Social desirability and social utility of mastery and performance goals. *Journal of Personality and Social Psychology, 96*, 119-134. doi: 10.1037/a0012824

DeBacker, T. K., Crowson, H. M., Beesley, A. D., Thoma, S. J., & Hestevold, N. L. (2008). The challenge of measuring epistemic beliefs: An analysis of three self-report instruments. *The Journal of Experimental Education, 76*, 281-312. doi: 10.3200/JEXE.76.3.281-314

Elby, A., & Hammer, D. (2001). On the substance of a sophisticated epistemology. *Science Education, 85*, 554-567. doi: 10.1002/sce.1023

Entwistle, N. J., & Peterson, E. R. (2004). Conceptions of learning and knowledge in higher education: Relationships with study behaviour and influences of learning environments. *International Journal of Educational Research, 41*, 407-428. doi: 10.1016/j.ijer.2005.08.009

Estes, D., Chandler, M., Horvath, K. J., & Backus, D. W. (2003). American and British college students' epistemological beliefs about research on psychological and biological development. *Journal of Applied Developmental Psychology, 23*, 625-642. doi: 10.1016/S0193-3973(03)00002-9

Greene, J. A., Muis, K. R., & Pieschl, S. (2010). The role of epistemic beliefs in students' self-regulated learning with computer-based learning environments: Conceptual and methodological issues. *Educational Psychologist, 45*, 245-257. doi: 10.1080/00461520.2010.515932

Halonen, J. S., Bosack, T., Clay, S., McCarthy, M., Dunn, D. S., Hill IV, G. W., . . . Weaver, K. A. (2003). A rubric for learning, teaching, and assessing scientific inquiry in psychology. *Teaching of Psychology, 30*, 196-208. doi: 10.1207/S15328023TOP3003_01

Hammer, D., & Elby, A. (2002). On the form of a personal epistemology. In B. K. Hofer & P. R. Pintrich (Eds.), *Personal epistemology: The psychology of beliefs about knowledge and knowing* (pp. 169-190). Mahwah, NJ Erlbaum.

Hofer, B. K. (2000). Dimensionality and disciplinary differences in personal epistemology. *Contemporary Educational Psychology, 25*, 378-405. doi: 10.1006/ceps.1999.1026

Hofer, B. K. (2001). Personal epistemology research: Implications for learning and teaching. *Educational Psychology Review, 13*, 353-383. doi: 10.1023/A:1011965830686

Hofer, B. K. (2006). Domain specificity of personal epistemology: Resolved questions, persistent issues, new models. *International Journal of Educational Research, 45*, 85-95. doi: 10.1016/j.ijer.2006.08.006

Hofer, B. K. (2008). Personal epistemology and culture. In M. S. Khine (Ed.), *Knowing, knowledge and beliefs: Epistemological studies across diverse cultures* (pp. 3-22). Dordrecht, The Netherlands: Springer.

Hofer, B. K., & Pintrich, P. R. (1997). The development of epistemological theories: Beliefs about knowledge and knowing and their relation to learning. *Review of Educational Research, 67*, 88-140. doi: 10.3102/00346543067001088

Jehng, J.-C. J., Johnson, S. D., & Anderson, R. C. (1993). Schooling and students′ epistemological beliefs about learning. *Contemporary Educational Psychology, 18*, 23-35. doi: 10.1006/ceps.1993.1004

Josselson, R., & Lieblich, A. (1996). Fettering the mind in the name of "science". *American Psychologist, 51*, 651-656. doi: 10.1037//0003-066X.51.6.651

Kaartinen-Koutaniemi, M., & Lindblom-Ylänne, S. (2008). Personal epistemology of psychology, theology and pharmacy students: a comparative study. *Studies in Higher Education, 33*, 179 - 191. doi: 10.1080/03075070801916088

Kardash, C. M., & Wood, P. (2000). *An individual item factoring of epistemological beliefs as measured by self-reporting surveys.* Paper presented at the American Educational Research Association, New Orleans, LA.

Karseth, B., & Solbrekke, T. D. (2006). Characteristics of graduate professional education: expectations and experiences in psychology and law. *London Review of Education, 4*, 149-167. doi: 10.1080/14748460600855252

Khine, M. S. (Ed.). (2008). *Knowing, knowledge, and beliefs: Epistemological studies across diverse cultures*. Dordrecht, The Netherlands: Springer.

Kienhues, D., Bromme, R., & Stahl, E. (2008). Changing epistemological beliefs: The unexpected impact of a short-term intervention. *British Journal of Educational Psychology, 78*, 545-565. doi: 10.1348/000709907x268589

King, P. M., & Kitchener, K. S. (2004). Reflective judgment: Theory and research on the development of epistemic assumptions through adulthood. *Educational Psychologist, 39*, 5-18. doi: 10.1207/s15326985ep3901_2

Knight, L. V., & Mattick, K. (2006). 'When I first came here, I thought medicine was black and white': Making sense of medical students' ways of knowing. *Social Science & Medicine, 63*, 1084-1096. doi: 10.1016/j.socscimed.2006.01.017

Kuhn, D. (2005). *Education for thinking*. Cambridge, Mass: Harvard University Press.

Kuhn, D. (2009). The importance of learning about knowing: Creating a foundation for development of intellectual values. *Child Development Perspectives, 3*, 112-117. doi: 10.1111/j.1750-8606.2009.00089.x

Kuhn, D., Cheney, R., & Weinstock, M. (2000). The development of epistemological understanding. *Cognitive Development, 15*, 309-328. doi: 10.1016/S0885-2014(00)00030-7

Lea, M. R., & Street, B. V. (1998). Student writing in higher education: An academic literacies approach. *Studies in Higher Education, 23*, 157-172.

Lea, S. J., Stephenson, D., & Troy, J. (2003). Higher education students' attitudes to student-centred learning: beyond 'educational bulimia'? *Studies in Higher Education, 28*, 321-334. doi: 10.1080/03075070309293

Limón, M. (2006). The domain generality-specificity of epistemological beliefs: A theoretical problem, a methodological problem or both? *International Journal of Educational Research, 45*, 7-27. doi: 10.1016/j.ijer.2006.08.002

Lonka, K., & Ahola, K. (1995). Activating instruction: How to foster study and thinking skills in higher education. *European Journal of Psychology of Education, 10*, 351-368.

Lonka, K., & Lindblom-Ylänne, S. (1996). Epistemologies, conceptions of learning, and study practices in medicine and psychology. *Higher Education, 31*, 5-24. doi: 10.1007/BF00129105

Madigan, R., Johnson, S., & Linton, P. (1995). The language of psychology: APA style as epistemology. *American Psychologist, 50*, 428-436. doi: 10.1037/0003-066X.50.6.428

May, D. B., & Etkina, E. (2002). College physics students' epistemological self-reflection and its relationship to conceptual learning. *American Journal of Physics, 70*, 1249-1258. doi: 10.1119/1.1503377

Muis, K. R. (2004). Personal epistemology and mathematics: A critical review and synthesis of research. *Review of Educational Research, 74*, 317-377. doi: 10.3102/00346543074003317

Muis, K. R. (2007). The role of epistemic beliefs in self-regulated learning. *Educational Psychologist, 42*, 173-190.

Muis, K. R., Bendixen, L. D., & Haerle, F. C. (2006). Domain-generality and domain-specificity in personal epistemology research: Philosophical and empirical reflections in the development of a theoretical framework. *Educational Psychology Review, 18*, 3-54. doi: 10.1007/s10648-006-9003-6

Muis, K. R., & Duffy, M. C. (2012). Epistemic climate and epistemic change: Instruction designed to change students' beliefs and learning strategies and improve achievement. *Journal of Educational Psychology*. doi: 10.1037/a0029690

Muis, K. R., & Franco, G. M. (2009). Epistemic beliefs: Setting the standards for self-regulated learning. *Contemporary Educational Psychology, 34*, 306-318. doi: http://dx.doi.org/10.1016/j.cedpsych.2009.06.005

Murphy, P. K., Alexander, P., Greene, J., & Hennessey, M. (2012). Examining epistemic frames in conceptual change research: implications for learning and instruction. *Asia Pacific Education Review, 13*, 475-486. doi: 10.1007/s12564-011-9199-0

Paulsen, M. B., & Wells, C. T. (1998). Domain differences in the epistemological beliefs of college students. *Research in Higher Education, 39*, 365-384. doi: 10.1023/A:1018785219220

Perry, W. G. (1968). *Forms of intellectual and ethical development in the college years: a scheme*. Cambridge, Mass: Bureau of Study Counsel, Harvard University.

Phan, H. P. (2008). Predicting change in epistemological beliefs, reflective thinking and learning styles: A longitudinal study. *British Journal of Educational Psychology, 78*, 75-93. doi: 10.1348/000709907X204354

Reddy, P., Hammond, J., Lewandowska, A., Trapp, A., & Marques, J. F. (2011). Innovation in the teaching of psychology in higher education in the EU Retrieved 3 February, 2012, from http://www.europlat.org/downloads/2011_February_Innovation.Report.pdf

Schommer-Aikins, M. (2004). Explaining the epistemological belief system: Introducing the embedded systemic model and coordinated research approach. *Educational Psychologist, 39*, 19-29. doi: 10.1207/s15326985ep3901_3

Schommer-Aikins, M., & Easter, M. (2006). Ways of Knowing and Epistemological Beliefs: Combined effect on academic performance. *Educational Psychology, 26*, 411-423. doi: 10.1080/01443410500341304

Schommer, M. (1990). Effects of beliefs about the nature of knowledge on comprehension. *Journal of Educational Psychology, 82*, 498-504. doi: 10.1037/0022-0663.82.3.498

Schraw, G., Bendixen, L. D., & Dunkle, M. E. (2002). Development and validation of the Epistemic Belief Inventory (EBI). In B. K. Hofer & P. R. Pintrich (Eds.), *Personal epistemology: The psychology of beliefs about knowledge and knowing* (pp. 261–275). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Schraw, G., & Olafson, L. (2003). Teachers' epistemological world views and educational practices. *Journal of Cognitive Education and Psychology, 3*, 178-235. doi: 10.1891/194589503787383109

Schreiber, J. B., & Shinn, D. (2003). Epistemological beliefs of community college students and their learning processes. *Community College Journal of Research and Practice, 27*, 699-709. doi: 10.1080/10668920390211084

Stahl, E., & Bromme, R. (2007). The CAEB: An instrument for measuring connotative aspects of epistemological beliefs. *Learning and Instruction, 17*, 773-785. doi: 10.1016/j.learninstruc.2007.09.016

Trautwein, U., & Lüdtke, O. (2007). Epistemological beliefs, school achievement, and college major: A large-scale longitudinal study on the impact of certainty beliefs. *Contemporary Educational Psychology, 32*, 348-366. doi: 10.1016/j.cedpsych.2005.11.003

Valanides, N., & Angeli, C. (2005). Effects of instruction on changes in epistemological beliefs. *Contemporary Educational Psychology, 30*, 314-330. doi: 10.1016/j.cedpsych.2005.01.001

Vermetten, Y. J., Vermunt, J. D., & Lodewijks, H. G. (1999). A longitudinal perspective on learning strategies in higher education - different view-points towards development. *British Journal of Educational Psychology, 69,* 221-242. doi: 10.1348/000709999157699

Wallwork, J., Mahoney, B., & Mason, S. (2006). Doing a Psychology degree: An investigation of student understanding about the learning and teaching of psychology. Worcester, UK: University of Worcester.

Weinstock, M. P., Neuman, Y., & Glassner, A. (2006). Identification of informal reasoning fallacies as a function of epistemological level, grade level, and cognitive ability. *Journal of Educational Psychology, 98*, 327-341. doi: 10.1037/0022-0663.89.2.327