Revisiting and Relating Learners' Epistemological Beliefs Models

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Abstract
Better understanding on learners' epistemological beliefs is believed to have significant positive implications on their learning experiences. To date, the postulated models of learner's epistemological beliefs are rich and informative, though varied. Leading studies illustrated that learners' epistemological beliefs can be classified into stages, levels or stances, but the progression of learners' epistemological beliefs has recently been suggested as a system with asynchronies development. This has narrowed down the research scope to focus on domain specific epistemological beliefs, where the educational context of a domain specific knowledge is suggested to have sufficient influence on learners' epistemological beliefs. Instead of identifying the "correct" explanation or model, the purpose of this paper is to revisit the studies and to build a framework to illustrate learner's epistemological beliefs in a more consistent manner. To conclude, it is suggested that the beliefs in the nature of knowing are correlated to the beliefs in the nature of knowledge, and the asynchronies development of learner's epistemological beliefs as a system is associated with domain specific knowledge.

Keywords: Epistemological belief, domain specific knowledge, nature of knowledge, nature of knowing

INTRODUCTION

Throughout the years, continuous research has been carried out to understand learner's epistemological beliefs. The common understanding is that a learning process can be more effective when the learners' epistemological beliefs are well understood. Leading studies have also illustrated that learners' epistemological beliefs can be identified or classified from lower to higher stages, levels, or stances (Perry, 1970; Belenky et al., 1986; Kuhn, 1991; Baxter Malgolda, 1992; King & Kitchener, 1994). Generally, learners with low level of epistemological beliefs are those who believe highly in simple and certain knowledge are highly dependent in learning and tends to rely heavily on another party to justify their knowing. Thus logically, a learner who has high level of epistemological beliefs logically has the ability to justify knowledge and is aware to the knowing and realization of oneself as the knower instead of depending on authority. Such learner also views knowledge as relative, contingent, and evolving.

In recent years, instead of developing from stages to stages, the progression of a learner's epistemological beliefs is suggested as a system with asynchronies development (Schommer, 2004). More research works today are focused on identifying the construct of epistemological beliefs and the growth of a learner's epistemological beliefs within those constructs (Schommer, 1990, Hammer, 1994, Hofer &Pintrich, 1997, Redish et al., 1998, Schommer, 2003; Adam et al., 2007). Besides that, it has also been postulated that the nature of a knowledge domain as well as the teaching and learning process of specific knowledge domain can sufficiently affect a learner's epistemological beliefs development (Hofer, 2000; Elby, 2001; Schommer et al., 2003; Hofer, 2004; Buehl& Alexander, 2006; Muis et al., 2006; Palmer &Marra, 2008).

However, to date, there is still a lack of explanation to describe or relate as to why and how learner's epistemological beliefs behave as stages-liked beliefs, asynchronies beliefs system, or domain specific beliefs. In this paper, instead of identifying the "correct" explanation, the purpose is to revisit premier studies and suggest a framework to illustrate learner's epistemological beliefs in a more consistent manner.

THE IMPORTANCE OF EPISTEMOLOGICAL BELIEFS

The studies of epistemological beliefs were triggered by the curiosity to understand how learners interpreted their educational experiences (Perry, 1970). This led to researches conducted to illuminate the subject matter from different perspectives and for different gender, cognition processes, and classroom learning environment. From educational viewpoints, epistemological beliefs exert sufficient influences on a learner's conceptual understanding and learning strategies. Learners with low level of epistemological beliefs tend to over-simplify and make improper absolute conclusion about knowledge. Such tendency can lead to early foreclose or hinder knowledge relativity and reasoning, resulting in poor academic performance (Schommer, 1990; Lising & Elby, 2005; Stathopoulou & Vosniadou, 2007a; Stathopoulou & Vosniadou, 2007b; Trautwein&Ludtke, 2007). This type of learners is also more inclined to use surface learning, rote learning, memorization of facts, and authority dependency approaches while learning (Hammer, 1994; Elby, 2001; Stathopoulou&Vosniadou, 2007b; Schommer, 2008; Richter &Schmid, 2010;

Bing &Redish, 2012, Habsah Ismail et al., 2012). On the other hand, learners with sophisticated epistemological beliefs or have undergone epistemological beliefs developmental process commonly perform better in conceptual understanding tests and have better grades (Hammer, 1994; Hofer, 2000; Buehl& Alexander, 2006; Stathopoulou&Vosniadou, 2007a; Sahin, 2009). Undeniably, improvements in a learner's epistemological beliefs can enhance his or her conceptual understanding and learning experiences.

Generally, the core construct of epistemological beliefs consists of two core dimensions - the nature of knowledge and the nature of knowing (Hofer &Pintrich, 1997). The authors described the former as the simplicity and certainty of knowledge while the latter as the source of knowledge and justification of knowing. In the lower level of the nature of knowledge dimension, knowledge is viewed as discrete, concrete, knowable facts, and absolute truth that can be obtained; high degree of simplicity and certainty are observed under such circumstances. In higher level, knowledge is viewed as relative, contingent, and contextual; truth is no more absolute, but tentative and evolving. As such, relatively lower degree of simplicity and certainty of knowledge are observed. Meanwhile, the nature of knowing refers to how an individual believes about the source of knowledge and justifies his or her knowing, i.e., whether knowledge is transfer from outside oneself or constructed inside oneself as well as how knowledge is justified from low to high degree of self-reliance and justification. In order to facilitate learners' conceptual understanding and learning experiences through the development of epistemological beliefs, there is a need to understand the development of the dimensions within epistemological beliefs and their intertwined relationships.

RELATIONSHIP BETWEEN NATURE OF KNOWLEDGE AND NATURE OF KNOWING

In this section, the core construct of epistemological beliefs as suggested by Hofer and Pintrich (1997) is used as the cross comparison element to understand how the nature of knowledge beliefs interrelates with the nature of knowing beliefs. The possible interrelationships between constructs under the same dimensions as suggested by Hofer (2004) are still largely untouched.

In 1970, Perry's scheme of intellectual and ethical development became the earliest model; it postulated that learners' epistemological beliefs develop through a nine continuum stage (Perry, 1970). In the basic duality and multiplicity pre-legitimate, learners view themselves as passive learners, that life is in polar terms of right and wrong, and knowledge is solely obtain from authorities. These are subsequently followed by multiplicity subordinate and multiplicity correlate or relativism subordinate. Learners in these two stages begin to discover that the dualistic construct may not be absolute and guidance for knowledge is needed. In the next relativism correlate and commitment foreseen stages, learners view knowledge and value as contextual and relativistic, dismiss dualistic, and thus are oriented towards some sorts of commitment. Learners start to construct initial commitment and implication of commitment in the stages of initial commitment as well as orientation in implications of commitment. Finally, learners views life as an ongoing journey which requires multiple commitments and responsibilities in the ninth stage, namely developing commitment. In this stage, the learners have become active constructors of knowledge and view themselves, their peers, and their lectures as legitimate sources of knowledge.

In 1986, a research was carried out to investigate the epistemological beliefs of women as learners (Belenky et al., 1986). Again, their epistemological beliefs were described in several positions. In the position of silence, the women felt voiceless, powerless, and mindless because of not knowing. In the subsequent position of receiving knowing, knowledge and authority were construed outside oneself and invested in powerful knowing of others from whom one was expected to learn from. At the position of subjective to know, knowing became personal, private, and was based on intuition rather than thought and articulated ideas. This was followed by procedural knowledge where the women demonstrated reasoned reflection and could apply objective yet systematic procedures of analysis. Once they entered the last stage, i.e., constructed knowledge position, they viewed knowledge and truth as contextual and could illustrate an integration of subjective and objective strategies for knowing.

Besides that, Kuhn (1991) also classified individual epistemological beliefs into three categories, namely absolutist, multiplist, and evaluative. Knowledge is certain and absolute for absolutist and highly dependent on experts with high certainty of knowing. In the multiplist category, the reorganization of uncertainty knowledge is activated and knowledge is no longer absolute; expert's view as well as other's and one's own are equally valid, which means the certainty of expert knowing is decreasing. As learner moves into the evaluative category, certainty and absolute knowledge are no longer convincing. Learners are able to justify knowing by comparing and evaluating others views, and experts are no longer viewed as completely certain in knowing.

Realizing that Perry's (1970) scheme of intellectual and ethical development was construct based on a majority of male respondents and Belenky et al.'s (1986) was based on women, Baxter Magolda (1992) conducted another research with equal male and female respondents. Based on the result, Baxter Magolda (1992) suggested an epistemological reflection model consisted of four different stances of knowers - absolute knowers, transitional knowers, independent knowers, and contextual knowers. Absolute knowers view knowledge as certain and authorities as the single source of knowledge. As knowers move to transitional and independent stances, they

discover that knowledge are uncertain, authorities are no longer the single source of knowledge, and that their own opinion as equally valid. As for contextual knowers, they are able to construct evidence and justification for their own knowledge.

In addition, King and Kitchener (1994) also introduced the reflective judgment model that explains individual epistemological beliefs using seven stages. Stage 1, 2, and 3 are categorized as pre-reflective thinking; learners at this stage view knowledge as absolutely certain or temporarily uncertain, and for such knowledge, their concept of justification is low while their dependency on authorities is high. Quasi reflective thinking covers stage 4 and 5; at this stage, the learners no longer view knowledge as certain but as uncertain, contextual, and subjective. Their justification depends no more on authorities, but reasons and evidence as well as the context specific interpretations of evidence. At stage 6 and 7 (reflective thinking), knowledge is constructed by the learners as the conclusion or outcome from their evaluations of evidence and the process of reasonable inquiry. The evaluation of evidence comparison and interpretation of different perspectives opinions, risk of erroneous, and alternative judgment become the major component in their concept of justification.

In the study of Hammer's work about epistemological beliefs in introductory physics, learners' beliefs about structure, content, and learning in physics were examined through interviews (Hammer, 1994) while the respondents were attempting to solve physics problem as well as explain the formula and text passage. Two respondents with different views, Roger and Tony, were identified and discussed. Roger had weak coherent beliefs about the structure of physics, was apparently weak in concepts beliefs about the content of physics, and depended on authority beliefs to learn Physics. On the other hand, Tony had coherent and independent beliefs about Physics structure; he managed to relate the content and learning of physics knowledge as a coherent system, and was able to explicate concepts as the fundamental element within the system. Besides that, he viewed learning as the process of constructing knowledge through justification, and refused to receive the knowledge blindly from authority.

Following that, in a case study conducted by Stathopoulou and Vasniadou (2007b), ten respondents were selected from the study of relationship between physics related epistemological beliefs and physics understanding (Stathopoulou&Vasniadou, 2007a). Five of them obtained high score in the Greek Epistemological Belief Evaluation Instrument for Physics (GEBEP) and the Force and Motion Conceptual Evaluation (FMCE) instruments while the others performed poorly. It was hypothesized that the respondents who scored high in all elements of GEBEP (structure of knowledge, construction and stability of knowledge, attainability of truth, and source of knowledge) and FMCE had higher level of physics epistemological beliefs and in-depth understanding of physics, and thus were more likely to adopt in-depth learning approach in physics learning. Among the respondents, only two respondents had different physics epistemological beliefs and physics conceptual understanding. Their learning approaches were discussed in the case study. The respondent with high GEBEP and FMCE scores, John, had illustrated deep learning approach. His goals were inclined to meaning-making instead of bein performance-oriented; he attempted to integrate ideas from basic and fundamental knowledge, which in turn also reflected his beliefs of low degree of simplicity and certainty in physics knowledge. Besides that, he was meta-conceptually aware of his own beliefs and thus was able to justify his own knowing, illustrating a high degree of self-reliance and justification in the knowing nature of physics. Conversely, Michael scored relatively lower marks in GEBEP and FMCE; he preferred a more superficial learning approach, was performance-oriented, performed rote learning strategy, and demonstrated high degree of beliefs in knowledge simplicity and certainty. In addition, Michael's low degree of self-reliance and justification beliefs had prevented him from being meta-conceptually aware of his own beliefs and physics understanding.

Another case study carried out by Ogan-Bekiroglu and Sengul-Turgut (2011) was done to understand the differences in learners' general epistemological beliefs and physics epistemological beliefs; results reflected the indirect interrelationship between the beliefs of nature of knowledge and nature of knowing. Fifteen participants aged 16 in average were selected and interviewed four times in a semester to assess their general epistemological beliefs (GE) and physics epistemological beliefs (PE) during the beginning and end of the semester. Subsequently, their GE and PE were categorized into four level, namely low (L), medium (M), high (H), and very high (V). Results indicated that, at the beginning of the semester, the students' beliefs in the nature of knowledge for GE were high, but this became low or medium after a semester. In terms of the GE's nature of knowing, their initial beliefs were low or medium since their degree of self-reliance and justification were low; these became medium or high after a semester. Similar trend was observed for their beliefs in PE's nature of knowledge and nature of knowing.

Table 1 shows the cross comparison of epistemological beliefs development according to the core dimensions of epistemological beliefs suggested by Hofer and Pintrich (1997). As the learner's epistemological beliefs developed from lower to higher level, his or her degree of beliefs about simplicity and certainty of knowledge decreased. In such situation, he or she no longer takes knowledge as certain and absolute. However, the beliefs about nature of knowing develop in the reversed order where the degree of self-reliance and justification develops from low to high. Learners hold greater beliefs on self-reliance in constructing knowledge through the justification of

evidences. Thus, it is cumulatively suggested that one's beliefs about source of knowledge and justification of knowing, and his or her beliefs about simplicity and certainty of knowledge are closely intertwined.

Table 1 Cross comparison of epistemological beliefs development

								Epistemological Beliefs (Hofer & Pintrich 1997)	
Perry (1970)	**Belenky et al (1986)**	**Kuhn (1991)**	**Baxter Magolda (1992)**	**King & Kitchener (1994)**	**Hammer (1994)**	**Stathopoulou & Vosniadou (2007)**	**Ogan-Bekiroglu & Sengul-Turgut (2011)**	**Nature of Knowledge**	**Nature of Knowing**
Basic duality	Silence	Absolutist	Absolute knowing	Pre-reflective thinking	Pieces Formulas By authority	Performance orientation	Low	High degree of simplicity and certainty of knowledge	Low degree of self-reliance and justification
Multiplicity pre-legitimate	Received knowledge								
Multiplicity subordinate	Subjective knowledge	Multiplist	Transitional knowing	Quasi-reflective thinking	Weak coherence Apparent concepts Weak concepts	Rote learning Not aware of own beliefs	Medium		
Multiplicity correlate or relativism subordinate									
Relativism correlate	Procedural knowledge	Evaluative	Independent knowing		Coherence Concepts Independent	Meaning-making Integrating ideas Aware of own beliefs	High	Low degree of simplicity and certainty of knowledge	High degree of self-reliance and justification
Commitment foreseen									
Initial Commitment	Constructed knowledge		Contextual knowing	Reflective thinking			Very high		
Orientation in implications of commitment									
Developing commitment									

DISCUSSION

As mentioned before, the study on learners' epistemological beliefs is vital to enhance learners' conceptual understanding and learning experiences. In order to achieve this, the focus has to be placed on understanding the core dimensions of epistemological beliefs. The previous section illustrated the interrelationship between nature of knowledge and nature of knowing, where the former's growth has corresponded directly to the growth of the latter.

However, as mentioned by Schommer (2004), the epistemological beliefs within an individual are a system of multiple beliefs which may or may not develop synchronically. Although Schommer (2004) did not specify the boundaries of the mentioned multiple beliefs, the hypothetical embedded systemic model portrayed the influence and interaction of classroom performance on epistemological beliefs system. Classroom performance and classroom environment are believed to be an element highly associated with domain specific knowledge. In other words, the development of epistemological beliefs is contextually dependent (Entwistle& Peterson, 2004; Muis et al., 2006; Palmer &Marra, 2008). In addition, research also suggested that domain epistemological beliefs, both general and specific, co-existed within an individual (Hofer, 2000; Schommer et al., 2003).

Furthermore, Conley et al. (2004) also suggested that learners' beliefs about source of knowledge (nature of knowing) and certainty of knowledge (nature of knowledge) can significantly improve over time based on their research result. Although the results did not suggest significant improvement on the evolving of knowledge and changes in ideas and theories, i.e., the development of knowledge (nature of knowledge) and justification of knowing (nature of knowing) over time, it did suggest an improvement in both dimensions if the effect of time is removed. They argued that the non-significant improvement of development in knowledge and justification of knowing beliefs are caused by contextual factors.

The suggestion of the corresponding development of the beliefs in nature of knowledge and nature of knowing beliefs is a hypothetical framework that needs further empirical testing. Besides that, the cumulative suggestion and argumentation about the effect of contextually specific factors on the development of learners' epistemological beliefs is also an important element for future research.

CONCLUSION AND IMPLICATION

In this paper, it is suggested that the development of learners' epistemological beliefs are contextually dependent and the development of learners' beliefs about the nature of knowledge and the nature of knowing are closely intertwined. Emphasizing on the importance of learners' epistemological beliefs on learning experience, it is important for educators to embed proper epistemological beliefs within learners. However, the process may be sometimes be constrained by the context of the domain knowledge itself. It is unproductive to blindly compose extreme sophisticated epistemological beliefs during teaching and learning because the weighting of tentative, relativity, and independency of each domain knowledge varies (Elby& Hammer, 2001). Hence, by understanding how the development of epistemological beliefs dimension correlates to each other, educators can take the needed measures to enhance their learners' learning experiences.

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