Students’ Epistemological Beliefs and Students’ Learning Experience

In a Problem-Based Learning Environment

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Problem-Based Learning (PBL) was first introduced as an innovative medical education curriculum at McMaster University in the mid-1960s. The claims about its merits in enhancing students’ problem-solving skills, integration of basic concepts, self-directed learning and higher order thinking skills have helped PBL to gain significant attention in higher education (Hmelo & Ferrai, 1997; Barrows, 1996; Savery & Duffy, 1995). Over the past three decades, PBL has been adopted in schools for a variety of other professional fields, including architecture, business, engineering, forestry, nursing education, law, political science, social work, and education. The instructional principles underlying PBL have been described in a constructivistic framework (Savery & Duffy 1995), which puts emphasis on learners as constructors of their own knowledge and on the social negotiation of meaning. Such an epistemological position brings learners into the spotlight: learners are empowered to determine their own learning issues and to enhance their understanding through interaction with others. Roehler and Cantlon (1997) recognized the differences of the belief systems that social constructivistic classrooms bring into education. When they discussed the role of scaffolding from the position of educators, they saw the changes from a teacher’s delivery of a fixed knowledge base to a student’s active construction of knowledge:

"We believed there was a fixed knowledge base, and a teacher’s responsibility was to give that knowledge. … However, this way of thinking about teaching and learning has changed to a conception that students actively construct their own knowledge and understanding. … Instead of
learning a set of knowledge bases, students develop evolving knowledge based through interactions with others, requiring an active involvement in learning.”

But what are the impacts of the constructivistic belief system embedded in the PBL environments on students’ learning experiences? Few research studies have examined this question. The focus of PBL investigation has been mainly on its effects on students’ learning outcomes and cognition compared with traditional lecture-based instruction (Hmelo, Gotter, & Bransford, 1994; Albanese & Mitchell, 1993; Vernon & Blake, 1993; Norman & Schmidt, 1992). In 1995, Rahimi conducted a qualitative study of students’ experience of medical education, their approach to learning and their reading comprehension, but the results were still analyzed to make comparisons between PBL students and conventional students.

A search of PBL literature related to the question about its epistemological impact on students learning experience brought attention to two research studies. One is Savin-Baden’s study (1995) on staff’s and students’ expectations and experiences of problem-based learning in four different professions and educational environments. The study indicated that the PBL experience involved a conflict with students’ beliefs and values. The findings were discussed in three different ‘stances’: personal, pedagogical, and interactional. In the domain of personal stance, Savin-Baden wrote: “Learning through problem-based learning may challenge students’ current sense of self, and their way of both seeing the world and acting within it.” The other study is Fenwick and Parsons’ (1997) critical investigation of the problems with problem-based learning. They criticized “the ontologically narrow and epistemological inconsistency” in a problem-based
approach. They said that PBL excluded “the perspectives, intentions, and priorities of the individual.”

These studies turned our attention to the interaction between students’ beliefs system and the constructivistic viewpoint embedded in PBL. The research on students’ epistemological beliefs, particularly their influence on students’ motivational beliefs, cognitive and strategic processing in text comprehension and academic performance (Scholenfeld, 1983; Ryan, 1984; Schommer, 1990; Schommer, Crouse, and Rodes, 1992; Schommer, 1993; Kardash and Scholes, 1996; Kardash and Howell, 2000), has shed some light on such an interaction from a motivational framework. How students’ epistemological beliefs influence learning is explained by the mediation of motivational constructs, such as self-efficacy, confidence, and intrinsic motivation in terms of students’ engagement and self-regulation.

In those studies, the dimensions of students’ epistemological beliefs are pre-conceptualized in students’ responses of agreement to the statements in an epistemological questionnaire, except Scholenfeld’s study (1983). It is emergent from the analysis of the verbal data in students’ think-aloud protocol that Scholenfeld derived four categories about students’ belief systems: belief about self, belief about the environment, belief about the topic, and belief about mathematics. With his interpretations of students’ problem-solving behaviors, Scholenfeld established a model to explain “the way that belief systems, interactions with social or experimental environments, and skills at the ‘control’ level in decision-making shape people’s behavior as they solve problems.” The research method proposed in the present study will align more with Scholenfeld’s. The major purpose of the present research is to generate a theoretical model for the ways in
which the interaction between students’ epistemological beliefs and the constructivist framework embedded in the PBL environment occurs in terms of their impacts on the structural patterns of students’ learning experience. Thus, grounded theory, a qualitative research method, is particularly appropriate to fulfill the intent of developing an explanatory theory. Moreover, it is from students’ own perceptions of their epistemological beliefs and their lived experience of PBL that I want to draw explanations. Three research questions guide the initial investigation of this study:

1. What are the essential contents of epistemological beliefs perceived by students themselves?

2. What are the structural patterns of the students’ experience in a problem-based learning environment?

3. What is the interactive model between students’ epistemological beliefs and the constructivistic framework in PBL that can be explained in the structural patterns of the students’ experience in a PBL environment?

As Hofer and Pintrich (1997) pointed out about epistemological beliefs, “there is very little agreement on the actual construct under study” or “the dimensions it encompasses.” Therefore, the answer to the first question may help develop a deeper understanding of the nature of these beliefs. Moreover, the derivation of a hypothesis will be grounded in the analysis of data. Once the relationship between students’ epistemological beliefs and their experience of the PBL classroom is established and examined, future research on the PBL classroom experience can be explored to verify the relationship and to examine closely how such a relationship develops during this particular educational encounter.
Problem-Based Learning: Theoretical foundations and research

PBL is an instructional model emphasizing meaningful learning through solving ill-structured problems. Finkle and Torp (1995) defined problem-based learning as “a curriculum development and instructional system that simultaneously develops both problem solving strategies and disciplinary knowledge bases and skills by placing students in the active role of problem-solver confronted with an ill-structured problem that mirrors real-world problems.” In a PBL environment, problems are used as a stimulus for students to start the learning process. Students reason through the problem and find out what they already knew and what they should know in order to solve the problem. It is through this active and reflective thinking process that students become responsible for their own learning. It is the application of their knowledge to the problem.
that students test and integrate what they learn. In general, the pedagogical structures of PBL highlight the role of problem solving as an initiative for learning, the role of self-directed learner, and collaborative learning.

Underlying those instructional structures are the notions that learning arises in solving ill-structured problems, that students need to actively engage in and monitor their own understanding, and that social negotiation is an important part of collaborative learning. All these notions imply the nature of evolutionary process, individual active construction and integration of multiple perspectives about knowledge. The PBL approach has been claimed to align with the constructive nature of cognition, i.e. knowing is an active, constructive process – an interaction between the individual and the environment (Savey & Duffy, 1995; Jonassen, 1996, Greening, 1998). In other words, the nature of knowledge is individually constructed. The individual cognition defines its own realities through its interactions with the environment. It is this way of seeing the nature of knowledge and knowing underlying its pedagogical structures that labels PBL as a constructivistic learning environment.

It is through the constructivistic viewpoint that the PBL environment establishes the relevance to students’ interest, encourages students’ autonomy, supports self-regulation, and values different perspectives. From this point, PBL seems to fit into the four conditions of motivational framework that Wlodkowski and Ginsberg (1995) proposed from an instructional perspective: (1) ‘establishing inclusion’: in a problem-based learning environment, the relationship between students and teachers is a collaborative one based on mutual respect instead of authoritative respect in which knowledge is passed down from teachers to students; (2) ‘developing attitude’: students
are given power to choose their own learning issues related to their own needs in PBL so that they can develop a favorable disposition toward such learning experience; (3) ‘enhancing meaning’: PBL provides a learning experience that challenges students to incorporate different perspectives and values to pursue understanding of concepts and rules by engaging problem solving; and (4) ‘engendering competence’: students are valued as their own construction of knowledge.

Over all, the value of PBL is seen in its aim to motivate students to participate in the learning process so that students are able to improve their problem-solving skills, integrate basic concepts, and foster self-directed learning and higher order skills. This positive view of PBL has elevated a lot of research studies on PBL investigating five major issues: Does PBL work? What are the impacts of PBL on students’ thinking? What elements in the PBL environment make instruction or learning experience successful or unsuccessful? What is the structural model of the problem-based learning process? What is problem-based learning experience?

Four lines of research are delineated as follows. One is to evaluate the effectiveness of PBL on learning outcomes (Albanese & Mitchell, 1993; Venon and Blake, 1993; Norman & Schmidt, 1992). These studies have shown mixed results. Norman and Schmidt (1993) examined several sets of experimental evidence in medical education, and concluded that there was no evidence that PBL curricula resulted in any improvement in general, content-free problem-solving skills, but it did support some of the general goals of PBL, such as retention of knowledge, transfer of concepts and integration of basic science concepts. Two meta-analysis studies of evaluative research (Albanese & Mitchell, 1993; Vernon and Blake; 1993) also could not reach conclusive
results on the superiority of PBL comparing problem-based learning with the traditional instruction.

Another line of research is to explore the influence of PBL on students’ cognitive process and perceptions (van Til, van der Vleuten and van Berkel, 1997; Rahimi, 1995; Hmelo, Gotterer, and Bransford, 1994; Ryan, 1993). It is the qualitative changes in cognition and learning process that the researchers are interested in. For example, Hmelo, Gotterer and Bransford (1994) compared the reasoning strategies, coherence, learning self-assessments and learning plans of 20 medical students in an elective class in PBL with those of 20 students in the non-PBL group. They found that “PBL students were more likely to use hypothesis-driven reasoning in their explanations than non-PBL students.” Also, problem-based learning had distinct cognitive impacts on self-directed learning, which were revealed in patterns of learning issues and learning plans generated by students.

The other two lines of research examine a relatively extensive context of PBL. One is to describe the design, implementation and evaluative processes of adopting the PBL approach into the classroom. Boud and Feletti’s *The challenge of problem based learning* (1997) includes case studies in different academic fields. The purposes of those studies are usually to share their learned lessons by telling their experience of applying PBL in a specific context, and to identify important factors promoting or impeding success of PBL by analyzing attitudes and opinions of the faculty and the students.

The other is to develop a structural model or discover patterns about problem-based learning. The research methods to uncover the structures and patterns can be either quantitative or qualitative. Van Berkel and Schmidt (1999) used path analysis to test a
hypothesized model of the problem-based learning process incorporating the variables such as amount of prior knowledge, quality of the problems, tutor performance, small-group functioning and time-spent on learning, intrinsic interest in subject matter and commitment. On the other hand, Savin-Baden (2000) looked into the perspectives of those who were involved in problem-based programs and developed a framework of “three interrelated sets of concepts emerged from people’s experience of problem-based learning.” It is through the examination of the nature of the learning experience in the context of different PBL environments that the researcher wants to reveal a holistic view of the interaction of the various components in learning. This intention is best described in her own explanations of why she termed the framework ‘Dimensions of Learner Experience’:

“I have termed this framework ‘Dimensions of Learner Experience’ to encapsulate the idea the learners do not just engage the pedagogical components of themselves in learning. Students do not simply learn the thing they are studying at the time, they also learn about people, contexts, likes and dislikes, and most importantly themselves. Learning is not a linear process whereby students who are engaged in learning are just thinking about that subject, in that context, at that particular time. Learning is about engaging different dimensions of ourselves in the learning process.” (p. 54-55)

Savin-Baden’s viewpoint, along with the mixed results and analyses of the research on PBL, leads me to see that no instructional approach is inherently motivating. The inclusion of all the pedagogical components in a theoretically sound instructional
approach is essential, but it does not guarantee the success of its implementation and the positive effects on learning. Further understanding of the overall picture of the problem-based learning process should be explored by qualitative investigations of the problem-solving process that students engage in. I am intrigued by the repeated notion in motivation literature that individual actions at a particular moment result from an interaction process among the individual’s past learning experience, the individual’s current perceptions of herself and the situational elements, and the individual’s anticipation of future consequences of the choice made in that moment. I have thus become interested in understanding how individual differences in thinking, emotion, and beliefs interact with their learning environments over time and contribute to the mediation between motivation and learning.

**Problem-based learning and motivation**

One of the advantages of the PBL approach commonly perceived is its strength in intrinsic motivation (Barrows and Tamblyn, 1980; Norman and Schmidt, 1992). The underlying assumptions are that students’ curiosity is aroused mainly through the authenticity of the problem and that the motivation is sustained by the relevance to students’ interest through the formation of individual learning goals. Thus, there is no interference of individual differences on motivation to learn. However, literature on motivation has advanced our understanding of learning beyond a cognitive process that integrates new information with individual prior knowledge structures. The most plausible story about learning is that the individual differences in the self-schema, including the sense of self (past, present, and future) and individual perceptions of
physical and mental capabilities, as well as in emotions and in personal epistemological beliefs, all create interactive dynamics with the learning environments. The individual differences in thinking, emotions and beliefs do affect learning. The present research recognizes there will be different gaps between individual epistemological beliefs and the constructivistic framework embedded in the PBL environment, and intends to explore the patterns of students learning experiences to explain how students resolve such gaps.

The definition of motivation in literature varies (Murphy and Alexander, 2000). Motivation is either defined as a conceptual object, such as drive, goals, engagement, will, commitment, interest, effort, and concern, or a process. I am more inclined to accept motivation defined as a process involving different factors, such as goals, self-efficacy, and perceived value, that instigates “the magnitude, persistence, and quality of goal-directed behaviors” (Dweck and Elliott, 1993). It is such an interactive process that I am interested in discovering in the students’ PBL experience to develop a theoretical framework to explain the interaction between the individual epistemological beliefs and the constructivistic viewpoints in PBL.

Epistemological Beliefs in light of Motivational studies

Studies of epistemological beliefs usually begin with Perry’s research (1970) on a developmental scheme of college students’ epistemological beliefs. Examining epistemological beliefs and thinking as a personal belief, Hofer and Pintrich (1997) pulled out three strands of interest in research on epistemological models: (1) How individuals interpret their educational experience, (2) How epistemological assumptions influence thinking and reasoning processes, and (3) How epistemological beliefs as a
system influence comprehension and cognition for academic tasks. The first of these has results on different explanations of how epistemological beliefs develop, i.e. Perry suggested that college students go through nine positions of epistemological beliefs (1970), and King and Kitchner (1994) proposed seven stages of beliefs about knowledge and reality. In order to pursue the second and third interest, the dimensions of epistemological beliefs need to be identified. The different conceptualizations of epistemological beliefs were developed, e.g. Perry’s dualistic and relativist view of the world (1970), and Schommer’s multidimensional epistemological beliefs system of simple knowledge, certain knowledge, quick learning and fixed ability. Moreover, research studies related to those interests examined how epistemological beliefs are related to learning (Kitchner, 1983; Ryan, 1984; Schommer, 1990; Schommer, Crouse, and Rodes, 1992; Schommer, 1993; Kardash and Howell, 2000). The influence of epistemological beliefs on performance was explained in terms of self-regulation learning. For example, Kitchner (1983) proposed a three-level model of cognitive processing to explain complex monitoring when individuals engaged in solving ill-structured problems, the third level of which is epistemic cognition. By reflecting on “the limits of knowing, the certainty of knowing, and criteria of knowing, individuals are influenced by those epistemic beliefs in understanding the problems and in choosing appropriate problem-solving strategies.

Examining the relationship between epistemological beliefs and meta-comprehension, Ryan (1984) found that students with different epistemological beliefs used different standards to judge their reading comprehension. High dualists, who believed knowledge was either right or wrong, used facts as criteria, whereas high
relativists, who believed the validity of knowledge was dependent on context, used whether they would be able to apply the information to new situations to determine their understanding.

On the other hand, since a preliminary study assessed students’ epistemological beliefs, Marlene Schommer has been conducting a series of studies that challenge Perry’s widely accepted standpoint in research that personal epistemology is unidimensional and develops in a fixed progression of stages. Different from Perry’s conception of the epistemological beliefs in the continuum between dualistic (knowledge is right or wrong, true or false) and relativistic (context-oriented standard), Schommer (1990) proposed an epistemological taxonomy of beliefs with five independent dimensions: the structure, certainty, and source of knowledge, and the control and speed of knowledge acquisition. The results of a factor analysis of the responses to a 63-item epistemological questionnaire from college and university students supported her theoretical conception about the multiplicity of dimensions of individual epistemological beliefs. Schommer also studied the effects of the four dominant epistemological beliefs on comprehension among the students in the same set of junior college students. The results suggested that epistemological beliefs have impacts on students’ processing of information and monitoring of their comprehension. The more the students believed in quick, all-or-none learning, the more likely they were to write simple conclusions; the more the students believed in certain knowledge, the more likely they were to write absolute conclusions.

Schommer and her colleagues (1992) replicated the factor structure of an epistemological beliefs system from Schommer’s previous study (1990) and concluded that Schommer’s epistemological questionnaire provided the groundwork for the
development of epistemological assessment. Also, the study did find the association between belief in simple knowledge and selection of the study strategy and suggested that the epistemological beliefs that guide the learner’s selection of study strategies would likely guide the learners to set the standards as to what understanding means.

With focus on understanding the process of reading comprehension, Kardash and Howell (2000) investigated the effects of epistemological beliefs and topic specific beliefs on undergraduates’ cognitive and strategic processing of a dual-positional text. Contrary to their expectation, epistemological beliefs, as one of the reader characteristics, did not interact significantly with the specific types of strategies that participants used. To sum up, the importance of those studies of epistemological beliefs is evident in that the epistemological beliefs have been proven to play a crucial role in the planning and assessment of individual’s comprehension. The assumption that epistemological beliefs may affect both the selections of the learning strategies as well as the criteria for judging and monitoring their comprehension was supported. Also, to understand the nature and the influence of epistemological beliefs on students’ performance is beneficial in designing a learning environment in which the students are regarded as active constructors of knowledge.

Research Methodology

The purpose of the present research is to generate a theoretical framework to describe the interaction between students’ epistemological beliefs and the epistemological view of constructivism embedded in a problem-based learning environment. In order to develop theory “that is grounded in data systematically gathered
and analyzed” (Strauss and Corbin, 1994), the grounded theory methods are used for their strength in the analytic process toward identifying, refining and building the interrelation of concepts derived from the data.

Also, it is essential to recognize the fundamental importance of uncovering the meanings of epistemological beliefs to students and the criticality of understanding of students’ learning experience from their perspectives in this study. In fact, Glaser and Strauss (1967) stated that such a phenomenological inquiry is the basis of the grounded theory. The basic philosophical assumption underlying this inquiry has most often been illustrated by Husserl’s (1962) statements – “we can only know what we experience.”

Fetterman’s (1989) comments on the epistemological basis of an ethnographic study model clearly explains the fundamentals of the phenomenological inquiry:

“This paradigm embraces a multicultural perspective because it accepts multiple realities. People act on their individual perceptions, and those actions have real consequences – thus the subjective reality each individual sees is no less real than an objectively defined and measured reality. Phenomenologically oriented studies are generally inductive; they make few explicit assumptions about sets of relationships.” (p. 5)

The phenomenological inquiry is particularly appropriate to address meanings and perspectives of research participants. Therefore, I will interview students for their descriptions of epistemological beliefs instead of measuring their beliefs with pre-conceptualized questionnaires. In this way, the revelation of the dimensions of the
epistemological beliefs will be derived from students’ own interpretations. In other words, the focus will be the realization of the subject’s perceived consciousness in the objects, i.e. “to get to understand human phenomena as lived and experienced,” which Giorgi (1985) pointed out as the major characteristic of a phenomenological psychological method. In order to return to the things themselves (Husserl, 1970), I, as a researcher, cannot impose the meanings for the students because they are the absolute sources of their own existence. The same principle applies to the understanding of students’ experience in the PBL environment. The experiential phenomenon can be produced only by the students themselves and can be accessed only by their own interpretations.

Thus, this study entails three research questions:

1. What are the essential contents of epistemological beliefs perceived by students themselves?
2. What are the structural patterns of the students’ experience in a problem-based learning environment?
3. What is the interactive model between student’s epistemological beliefs and the constructivistic framework in PBL that can be explained in the structural patterns of the students’ experience in a PBL environment?

**Procedures**

Entry to the field

Through the instructional design community on campus, I will review college-level courses that are under a redesign process in a problem-based learning approach, and
identify an appropriate site for me to recruit participants. Barrow’s six original characteristics for the PBL model (1996) will be used as criteria examining the pedagogical structure of potential courses: learning is student-centered; learning occurs in small student groups; teachers are facilitators; problems form the original focus and stimulus for learning; problems are vehicles for the development of problem solving skills; new information is acquired through self-directed learning. Because problem-based learning is an instructional model (Savery & Duffy, 1995) that can be used to structure the development in the curriculum level or course level, it is worth mentioning that the PBL environment under the present study will be on the course level, not on a curriculum level. The choice lies in the fact that innovation in a curriculum level on campus is limited. Also, the study will constrain its investigation within one course because constructivistic views may be realized differently in different courses. Limiting the study to a single course may energize the study’s vigor in extensive descriptions of the contextual elements in a particular course.

Data sources

It is from students’ own perceptions of their epistemological beliefs and their lived experience of PBL that I want to draw my explanations about the interaction of epistemological beliefs between students and their learning environment. Therefore, two interviews will be administered to students. Before the course starts, students will participate in a 45- to 60-minute open-ended interview, during which four questions will be asked: “Tell me as much as you can from your own perspective, what is truth? What is knowledge? How is knowledge gained? How do you know the right knowledge to use or
apply?” Also, students will be asked about their academic background, such as their major, the year they are in the program, and their career goal, as well as their cultural background.

Also, after the course is over, students will participate in a 60- to 90-minute in-depth interview, during which the following questions will be asked: “Tell me as much as you can, and if possible, give specific examples to illustrate your points: What do you think about this learning experience? How will you describe your learning experience? What is the role of learner? What is the role of the instructor? What has changed about yourself before and after this learning experience?”

The purpose of this subsequent interview is to allow the researcher to hear students’ voices about their learning experience, particularly as it reveals their opinions about the tasks, the activities, the instructor, and the structure of the learning process. Also, the subsequent interview would have students reflect on how they engaged the course, how much work they were involved in, and how much learning they achieved?

Since the focus of this research lies in understanding and meaning, the issues about ensuring the credibility of the research become transferability, faithfulness, and dependability. As a qualitative researcher, the task is to give thick descriptions so that readers are able to make decisions to see whether the results of the inquiry are transferable. The conceptual analysis must be faithfully derived from the data and be checked out against the consistency of different data sources. Moreover, because the meaning of communication depends on knowing the relevant context, and “contexts are consciously designed to evoke multiple meanings” (Dye, 1993), qualitative research must develop thorough and comprehensive descriptions of the context. Thus, documents
such as syllabi and assignments, and classroom observations, will enrich the source of the information about the context.

Students will be also asked to write an essay about what knowledge is and how to learn at the end of the course to see whether the epistemological beliefs evolved and to check the consistency with their descriptions of learning experience in the interview.

**Data Analysis**

The primary method of analysis is a continuous coding process. Analysis will begin with open coding – the data are examined line by line to define actions or events within data. This coding analysis will likely lead to “refining and specifying any borrowed extant concepts” (Strauss and Corbin, 1998). Next is the analysis of axial coding, which is aimed to make conceptual connections between a category and its subcategories. Then, concepts and sub-concepts are further defined by selective coding, “an integrative process of selecting the core category, systematically relating it to other categories, validating those relationships by searching for confirming and disconfirming examples, and filling in categories that needed further refinement and development” (Strauss and Corbin, 1998).

Codes and categories will be sorted, compared, and contrasted until all the data are accounted for in the core categories of the grounded theory paradigm model, and no new codes or categories can be produced, i.e. saturation. As a researcher, I will write analytic and self-reflective memos to document and enrich the analytical process, to make implicit thoughts explicit, and to expand the data corpus. Analytical memos consist of questions and speculation about the data and emerging theory.
Schunk (2000) presents a model of motivated learning which depicts learning as a process of interaction among cognition, various motivational constructs and environmental variables before, during and after the learners engage learning tasks. The model better shows the dynamic nature of the relationship between motivational constructs and learning across time. This study, on the other hand, is designed to examine a relatively static before-and-after interaction. Also, due to lack of looking into the interaction continuously over time, the impacts of the contact of epistemological beliefs between students and the learning environment on students’ learning experience is unidirectional (see Figure 1). The future study (see Figure 2) can explore the multidirectional interactions between those factors in the learning process, and investigate how
these interactions will influence students’ learning processes, especially the problem-solving process, over time.

References


