Moving From Theory to Practice in the Design of Web-Based Learning From the Perspective of Constructivism

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Abstract

This paper describes the design of a web-based learning module according to a framework drawing on constructivist theories. The aim was to operationalize concepts such as authenticity, collaborative knowledge sharing, sense-making and viewing multiple perspectives as they relate to the design of e-learning opportunities. The prototypical module was designed for practitioners such as teachers and structured around interpreting and responding to a problem. The module consists of a problem model and relies on use of a discussion forum and a shared workspace to support negotiation of interpretation and experience. Also included are 60 streamable video segments presenting multiple perspectives on the problem. Results of the design process provide insight into ways in which constructivist principles and concepts can be translated into practical solutions for the provision of e-learning content. The module illustrates a way in which learning experiences can inform and be informed by practice.

The integration of information and communication technologies into teaching and learning has led numerous researchers and educators to advocate the adoption of new pedagogies and not simply a transposition of traditional face-to-face classroom techniques to an online environment. As Maddux, Johnson, and Willis (2001) explain, use of computers in teaching and learning demands, not that we aim to mimic the same behaviors and procedures that teachers do without the technology, but that we make available new and better ways of educating students. For many educators and researchers, new and better ways are derived from constructivist theories and their related concepts such as knowledge-building, meaning-making, collaboration, and authentic, relevant, and student-centered learning (see Jonassen, 1996; Brown, Collins, & Duguid, 1989; Laferrière, Bracewell, & Breuleux, 2001; Scardamalia & Bereiter, 1996; Jonassen, Peck, Wilson, & Pfeiffer, 1999; Wilkinson, 2002). New and better ways may also involve a goal to "reproduce the technological, social, time, and motivational characteristics of real world situations where what is being learned will be used" (Berryman, 1991, p. 2).

Operationalizing the theories and concepts related to these new forms of learning presents significant challenges in that theories such as constructivism, while they may be discussed and delineated well in the literature, do not automatically translate into clearly defined principles that might guide the design of learning. Exploiting the tools in such a way that they support these theories and the new pedagogies derived from them also presents challenges to the design of online learning. Designing online learning at the postsecondary level places additional constraints on the design process as well. The emergence of the knowledge-based economy which necessitates frequent training and retraining of workers demands that learning be relevant to workplace contexts. The pre- and in-service education of practitioners such as doctors, nurses, teachers, engineers, and

social workers requires as well that learning be relevant to the contexts in which it will be used.

It was in consideration of these issues that a research and development project was undertaken to develop a web-based learning experience that might address some of the challenges related to the design of online learning drawing on constructivist theory. The goal of the project was to design a learning experience that would allow operationalization of concepts and principles related to constructivism. The audience or intended learners chosen for the project was that of practitioners such as nurses, social workers, or teachers. The remainder of this paper describes this project, its conceptual framework, design framework, design results and testing. The following section outlines the framework which informed the design and illustrates the concepts which were considered in relation to constructivism.

Conceptual Framework

The design of the module was informed by constructivist and socio-constructivist theories which are premised on a conception of knowledge as that which is constructed and not reproduced. According to this perspective, the criterion for truth is not correspondence to an objective reality. Instead consensus between subjects serves as the ultimate criterion to judge knowledge. "'Truth' or 'reality' will be accorded only to those constructions on which most people of a social group agree" (Heylighen, 1993, ¶ 8). This conception of learning is premised on the assumption that individuals actively construct their knowledge by fitting existing perceptions, interpretations and understanding with knowledge gleaned through a process of collaborating, sharing and negotiating interpretations, experience and understanding with others. The aim of learning is thus to support what Jonassen (1994) terms collaborative construction of knowledge through social negotiation and to promote what Honebein (1996) refers to as embedding learning in social experience.

Collaborative knowledge construction is favored through "ongoing exchange," and "through engaging, incorporating, and critically exploring the views of others" (Gergen, 1995, p. 34). The multiple perspectives afforded by a collaborative approach can promote reconstruction and reorganization of teachers' existing knowledge and conceptions as a result of being exposed to new interpretations (Murphy & Laferrière, 2003). Meaning-making results from a dialectic process of negotiating contradictions and synthesizing opposing viewpoints (Scardamalia & Bereiter, 1994). Exposure to opposing or multiple viewpoints, sharing and negotiating interpretations, group reflection: these processes and activities result from many-to-many patterns of interaction such as what might be promoted through opportunities for dialogue, conversation or discussion (Murphy & Laferrière, 2003).

Emphasis on collaboration requires a concomitant valuing of the contexts in which learning takes place and in which the results of the learning are to be put to use. As Gergen (1995) argues, "the challenge for the educational process … is to generate the kinds of contexts in which the value and meaning of the constituent dialogues may be linked to the ongoing practical pursuits of persons, communities or nations" (p. 35). It is the "practical context of usage" that becomes the focal point for the learning process. When designing learning for practitioners, the context of the practice becomes therefore

the focal point. Activities are grounded or situated in the very practice in which the learning will be applied. They relate directly to the practice, inform and are informed by it. Recognition of the importance of context in the design of learning requires consideration of the culture or community to which the learners belong. Brown, Collins, and Duguid (1989) refer to activities of a domain as being framed by and having their coherence result from the culture and society in which the activities take place. "Their meaning and purpose are socially constructed through negotiations among present and past members" (Authentic Activity, ¶ 2). The activities can thus be described as coherent, meaningful, purposeful, and authentic activities. The authors' definition of authentic activities is that of the ordinary practices of the culture.

Jonassen (1991, 1994, 1996) provides us with an explanation of how authenticity might be reflected in the design of learning. In order for the activities to be authentic, they must reflect the natural complexity of real-world environments that employ the context in which learning is relevant. Jonassen contrasts such activities with those that are abstracted rather than contextualized and favors adopting approaches in which learners are solving real-world problems or cases. Wilson and Cole (1991) also argue in favor of embedding learning in authentic problem-solving environments in order to provide for authentic versus academic contexts for learning. Honebein (1996) echoes the importance of situating learning in realistic and relevant contexts in social experience. From the perspective of Lave and Wenger (1990) learning should be dilemma rather than content driven. According to these authors, knowledge needs to be presented in an authentic context and is negotiated through the interactions of the learner with others and with their environment. Social interaction and collaboration are therefore critical as learners become involved in a "community of practice."

The socio-constructivist perspective is also reflected in some approaches to the design of learning for practitioners. Lester (1995) advocates professional development models that privilege problem solving, however, he stresses that such models cannot simply rely on "applying a body of expert knowledge to known situations in order to produce rational solutions" (p. 1). Practitioners, argues Lester, encounter in daily practice unknown situations. "Established" or "expert" knowledge is of less use to practitioners faced by these situations. Instead, they must rely on creating unique interpretations and outcomes and on constructing and reconstructing the knowledge and skill needed in order to continually evolve their practice. This model privileges an epistemology that favors personal, contextualized knowledge which informs and is generated by action and which is situated in the context of the individual's practice. From this perspective, problems are conceived as messy, interconnected, and as products of complex, dynamic systems. Lester's perspective echoes that of Schön (1987) who argues that problems of practice do not present themselves to practitioners as problems but as "messy, indeterminate situations" (p. 4) with which the practitioner can only deal "by a kind of improvisation, inventing and testing" (p. 5). He uses the term "indeterminate zones of practice" to characterize the ambiguity and lack of certainty inherent in situations and problems faced by practitioners.

Given this uncertain and ambiguous nature of problems, practitioners can be assisted in evolving or advancing their practice through participation in opportunities in which they can better understand the situation, theorize about it, and begin to identify, construct, and interpret the problems which are faced. This perspective values multiple

viewpoints for it is through the different perspectives that the problems can be interpreted. It is through developing an understanding of how problems may manifest themselves differently depending on the context that practitioners can begin to define the contours of the problem and to reduce the levels of ambiguity. Through viewing multiple perspectives, practitioners can identify what is unique about individual contexts of practice and how that context relates to the problem. As Lester (1995) explains about this approach to learning for practitioners, it involves "a process parallel to and embedded in practice, where the traditional distinction between working and learning is transcended" (p. 51).

In recognition of the nature of problems as defined by Lester (1995) and Schön (1987), what is relevant to the practitioner is therefore not necessarily engagement in a process of what is traditionally referred to as problem-solving but, instead in a process of interpreting and responding to the problem in one's practice. If multiple perspectives and the idiosyncrasy of context is considered of importance, then appreciating how the problem manifests itself in a given context as compared with another represents the first step in any process designed to assist in improving one's practice through a focus on problems. Furthermore, given a perspective on problems that conceptualizes them as ambiguous, changing and highly contextual, we are forced to shift attention away from the notion of problem-solving and towards a notion of responding to a problem. The complexity of problems and of the multiple ways in which they might manifest themselves depending on time, place, circumstances, and individuals involved, requires a more tentative approach to dealing with problems. Such an approach recognizes that, while a definitive solution may not be possible, there are ways of responding to problems that respect and consider the context and circumstances, and that may therefore be more effective in advancing one's practice. We can think of responses as being more tailored to a particular context of practice than might a solution.

Design Framework

The goal of the project was to design an opportunity or experience for learning that would reflect principles and concepts related to socio-constructivism. Achievement of this goal was not accomplished through use of a traditional instructional design process involving analysis of learning needs and goals and the development of a delivery system to meet those needs. Instead the aim was to create an environment that would reflect and support the principles of constructivist learning. Tam (2000) explains the approach to design adopted by constructivists:

> Constructivist designers tend to avoid the breaking down of context into component parts as traditional instructional designers do, but are in favor of environments in which knowledge, skills, and complexity exist naturally. Hence, instead of adopting a linear and 'building-blocks' approach to instructional design, constructivist designers need to develop procedures for situations in which the instructional context plays a dominant part, and the instructional goals evolve as learning progresses. (pp. 54-55)

Thus, the objective was to create a learning experience that favors knowledge construction and meaning-making, is embedded in social experience, and is dilemma or problem driven rather than content driven. The types of activities privileged according to this approach to learning are those that are collaborative, meaningful, purposeful, and authentic. The activities are grounded in the very contexts in which the learning will be applied in such a way that they relate directly to practice, inform, and are informed by it. According to this approach, opportunities are provided for collaboration, sharing and negotiating experiences and interpretations, and for synthesizing and critically exploring multiple viewpoints and perspectives. Negotiating experiences, viewing other perspectives, and knowledge sharing required opportunities for an exchange of experience, knowledge and interpretations between participants. A problem- rather than content-driven approach required a schema or model to guide the problem process. The content of the activities required relevance to the practice of the practitioners. The following section describes how this design framework translated into a learning environment.

Design Results

The learning environment was organized as a module representing the equivalent of approximately 12 hours of classroom instruction and entitled Solving Problems in Collaborative Environments (SPICE). The introduction described the web-based learning module as being "designed for practitioners interested in improving and advancing their practice through collaborative problem interpretation and resolution" (Murphy, 2002, p. 1). The content area chosen for the design was that of the teaching of French as a second language. The problem selected in advance from the research literature by the designer/researcher was that of lack of use of the target language by instructors and students. All activities in the module centered on interpreting and providing responses to this problem. To facilitate this task, the module featured a problem interpretation-response model designed to help participants appreciate and view multiple perspectives on the ways in which the problem might manifest itself depending on the context and circumstances. This model also encouraged users to provide a response to the problem or a tentative solution to the problem suited to their own context. The problem model was intended to provide an approach to problem interpretation and responding that might be applied in everyday practice. The model is produced here below:
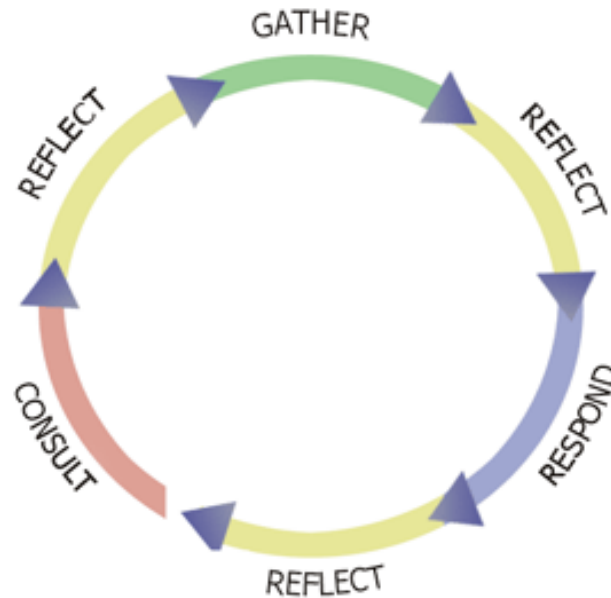
Figure 1. **SPICE approach.**

The model features a total of three steps. The first two steps are that of "Consult" followed by "Gather." These two steps are designed to support a process of construction and reconstruction by which one can better interpret the problem, theorize about it and begin to define its contours and make them less ambiguous. It is only in the last step that participants are actually encouraged to provide a tentative response to the problem. Each of the three steps is followed by a process referred to in the module as that of shared reflection which is described as "a collaborative process of testing your ideas, imparting knowledge, expressing opinions, describing your experiences, building interpretations and asking questions" (Murphy, 2002, p. 1). Consulting is described as follows:

> It is natural when one has a problem, be it professional or even personal, to first consult with others. In the workplace, we often consult with colleagues who we think may have some knowledge or experience of this problem. Being able to hear their perspective can often help us understand the problem better by allowing us to appreciate the different ways in which it manifests itself. In this way, we can see which characteristics of the problem might be common with our situation, context or circumstance and which might be different. (p. 1)

The perspectives referred to in this introduction are provided in video segments of interviews with eight teachers. The choice of interviewees was driven by the goal of providing a wide variety of perspectives on the problem. Thus, individuals were chosen to represent as broad a range of perspectives as was possible and relevant. The eight teachers represented a range of six grades beginning at middle school or junior high. They represented both French immersion and core French programs. All teachers had in common however that they were teaching in urban settings in the city where the interviews were recorded. The interviews of one-hour duration were conducted in a studio by the researcher/designer. Each of the teachers interviewed was asked to identify

how the problem manifested itself in his or her own context and to describe some of the ways in which he or she responded to the problem. The interviews were subsequently edited by the researcher/designer into 60 segments and given a title to summarize the content. All segments were then displayed in a menu with title, interviewees' initials and length of the segment as follows:

Figure 2. **SPICE video menu.**

Participants are invited to view 5 to 10 video segments as part of the consultation step. The viewing is followed by a series of shared reflection activities using a discussion forum. These activities are structured around questions that encourage participants to describe how the perspectives differ or resemble their own. Other discussion activities follow in which participants have an opportunity to compare their experiences with those of interviewees and with those of other participants who post their reaction to the videos. The completion of this stage invites participants to complete a self-assessment of how their thinking on the problem has or has not changed as a result of completing this step in the problem-interpretation process. They are also encouraged to provide a short summary of their understanding of the problem at this point in the process.

Gathering information is the step that follows consultation. This step is described in the module as follows:

> The knowledge of fellow practitioners is valuable and valid. Their years of experience and their reflections on these experiences mean that they can most likely contribute to your own understanding and knowledge of the problem. In addition to this knowledge, there is also a body of theoretical or expert knowledge, which is often tested systematically through research. Such knowledge can also be useful in understanding a problem and responding to it. (Murphy, 2002, p. 1)

For this step in the process, a series of 15 pre-selected online readings are provided related to the problem for which each participant is then invited to post a brief summary. Following the summaries, participants are then invited to discuss how the readings (in full or in summary) do or do not inform or advance their interpretation of the problem. As with the reflection following consultation, participants finish this step by indicating in the discussion forum where their thinking is on the problem at this point in the process.

The final step in the process provides an opportunity for participants to present a response to the problem:

> In some respects, it is not always accurate to talk in terms of solving a problem. We cannot expect that application of a remedy or solution will in all cases make the problem disappear permanently. On the other hand, we can respond to a problem with what we could call tentative solutions. Some of these responses may work with some aspects of the problem at some times under certain contexts but not necessarily always. Our goal however will be to arrive at a response that is appropriate for the problem in the greatest number of instances of it. (Murphy, 2002, p. 1)

A shared workplace tool is used by participants to upload as directions indicate: "a document which you create, such as a short- or long-term action plan … a description of an activity or a lesson plan" (p. 1). Following this activity, participants can view and download the responses. The discussion forum is then used to engage in shared reflection about the various responses and how they might or might not be of use in responding to the problem. The final activity is designed to bring closure to the discussions by inviting participants to summarize their thinking on the problem and to assess how it evolved throughout the problem interpretation and resolution process.

Design Testing

Following completion of the design of the environment within the context of these requirements, one round of testing was conducted with a group of 11 preservice practitioners over a 4-week period. These were practitioners in training enrolled in a 12-week university course in an education faculty who volunteered to participate in the learning experience as part of their course. Prior arrangements were made between the course instructor and the researcher so that the module could be incorporated into the

course as a separate unit to be evaluated by the instructor. Participants completed the learning experience on their own and subsequently submitted to the instructor all work and contributions completed during the experience. There was no moderator or instructor present during completion of the module's activities by participants. The instructor then assessed this work as part of the students' evaluation. Those in the course who did not opt to volunteer to participate completed a different evaluation exercise that counted for an equivalent percentage of the total course evaluation.

The testing process included online monitoring of participation in the experience by the researcher and her assistant, ongoing response to problems or questions which arose during the experience and follow-up, semi-structured interviews with all 11 participants. The purpose of this process was to assess users' perceptions of the overall value of the learning experience in relation to their own goals for learning and to determine how the experience might be better designed to help learners accomplish the related tasks and activities. After applying the feedback to the design, a new iteration of the module was created; however, further user input was not solicited.

The module's testing revealed both positive and negative results with regards to design of the experience. In relation to the learning experience, participants' comments included: "It was a wonderful learning experience," "I found it to be very informative," "It will change how I teach," "It was most definitely a learning experience," "My thinking changed," and "It made me realize that the problem is really complicated. There were a lot of things I didn't realize." Reaction to exposure to the perspectives of others through viewing the videos and reading the texts and the collaborative sharing of experiences and knowledge was positive with comments such as: "It was great to learn from other people's point of view," "There were so many things that were brought up that I had not thought of before," "It took you through different looks at the problem," "I loved reading what others had written. I got some good ideas from what others had written and got a different way of looking at things," "The discussion forum was informative. I learned from my peers," and "The readings were helpful. It was interesting to get different views."

Participants' negative comments about the experience related to technical problems in viewing the videos, uploading files in the work space, and posting and editing comments using the WebCT discussion tools. Other comments pointed to difficulties with the discussion forum and the shared reflections. Some participants remarked that the shared reflection did not result in the level of sharing or interaction that they would have liked. One participant remarked, "In my other courses people respond to each other more". Others noted, "There was more discussion than there were responses. Nobody responded back to anything I had to say" and "Discussion was slow. There wasn't much back and forth." Frustrations were also expressed in relation to the timing of the postings in that while some might have been still commenting on the videos others had gone on and were posting their responses. One participant recommended that the "group needs to be on track together to share ideas." Another commented, "You'd get more interaction if it was done in stages, if people put their postings one at a time so that everyone is at the same point at the same time."

Discussion

The goal of the project was to design a learning experience that draws on principles and concepts related to constructivism. The audience chosen for the design was that of practitioners and specifically in this case, French teachers. The assumption underlying this effort is that practitioners engage in learning in order to advance their practice. A corollary to this assumption is that practitioners advance their practice through making sense of and by constructing meaning from their experiences. From a socio-constructivist perspective, the sharing, exchange, and negotiation of these experiences and their subsequent interpretations afford the learner, in this case, the practitioner, an occasion to critique, compare, and fit existing understandings with those of others. Construction, reconstruction, and reorganization of knowledge and conceptions then follow.

To accomplish this goal and to support the above-mentioned processes, a series of activities was designed. The activities focus and draw on the practice itself and are thus authentic and reflect the complexity of the real-world environments and the contexts in which the knowledge gained through the learning process will be used. The activities are designed to promote reflection on practice through interpretation of and responding to the problem. Discussion is privileged as the prime activity in order to promote negotiation and exchange of experiences and interpretations. The final activity of responding using the shared workspace also supports collaboration and exchange. Knowledge construction and sharing was promoted in the module over knowledge transmission. There was no set content to be delivered in the module. The only expert knowledge provided was what was contained in the readings. Providing access to this material is consistent with the goal of presenting multiple perspectives on the problem.

The absence of the instructor highlights the lateral interaction that is privileged in the experience. It is many-to-many (learner to learner) and not one-to-many (teacher to students) interaction that serves as the pivot of activity. Collaborative knowledge construction is favored over knowledge transmission. The instructor's role in this case might be to assist in the formulation of the initial design of the module and/or in the subsequent evaluation of the learners' participation. Learning is designed to occur, not through delivery of content or expert knowledge from an instructor to students, but thorough the collaborative sense-making that occurs as participants in the experience share in the goal of interpreting and responding to the problem presented to them.

Authenticity was promoted in the module through a choice of a problem prominent in the given practice and through the choice of teachers used in the video segments to discuss the problem from their actual, real-life contexts. Greater authenticity might have been achieved, however, through discussion of a problem generated by the participants themselves. Instead, the module was premised on the assumption that the problem would be of importance to the learners. This assumption may not hold true in all situations or with all learners. In the case of the module, it was not possible to choose the problem once participants were engaged in the learning process because of the use of videos which needed to be prepared prior to delivery of the experience.

Sense-making is encouraged and supported by access to multiple perspectives that allow participants to appreciate the complexity and ambiguity of the problem as it exists in its natural context. Multiple perspectives are presented by the 60 video segments which participants can select from a web-based menu and subsequently stream for immediate viewing on their computer. Multiple perspectives emerge again in the dialectical

interaction between participants who, in discussing the videos and comparing them to their own experiences and prior knowledge, add their own interpretations and perspectives on the problem.

The module was thus designed in keeping with the concepts and principles related to constructivism. To determine the effectiveness of the design, there would need to be some measure of the degree to which the module provided the opportunity for participants to advance their practice. However, the testing was not designed to measure this, nor was it designed to determine if indeed the participants were able to make greater sense of their practice as a result of having made use of the module. A further research project would be required to assess the degree to which the module might actually promote or support sense-making and social construction of knowledge.

Conclusion

The growing interest in new perspectives on learning such as those derived from constructivist theories creates an imperative to investigate alternative approaches to the design of learning. At the same time, the emergence of sophisticated information and communication technologies provides supports for some of these approaches. Combining the tools and the approach facilitated the creation of a learning environment in which use of technology and the choice of activities centered on a problem provided support for the operationalization of concepts and principles related to constructivist learning. The aim in the design of the environment was to support the social and collaborative interactions that must take place in order for participants to share in the goal of identifying and responding to the problem presented to them and originating in their practice. The sharing of their experiences and interpretations of these experiences helps members of the group make sense of the problem in the context of the practice. Thus the learning is informed by and informs the practice.

Operationalizing concepts and principles related to constructivism and socio-constructivism adds meaning and relevance to terms such as sense-making, multiple perspectives, authenticity, collaborative knowledge-building, and negotiation of interpretations and understandings. The design of the SPICE module provides one example of ways in which we can adopt new pedagogies and provide learners with new and better ways of learning. The module illustrates that concepts and principles related to constructivist theory can translate into practice and form a coherent basis for the design of online learning experiences. Future projects might consider adaptation and customization of the module for use with other types of learners.

Acknowledgements

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