Professional Development Learning Environments (PDLEs) Embedded in a Collaborative Online Learning Environment (COLE): Moving towards a new conception of online professional learning

Roland vanOostveen
roland.vanoostveen@uoit.ca
Associate Professor
Faculty of Education, University of Ontario Institute of Technology
2000 Simcoe St. N., Oshawa, ON Canada L1H 7K4
Fax: 905.721.1707
orcid.org/0000-0001-8767-2894

François Desjardins
Associate Professor (Retired)
Faculty of Education, University of Ontario Institute of Technology
2000 Simcoe St. N., Oshawa, ON Canada L1H 7K4

Shawn Bullock
Associate Professor
Faculty of Education, Simon Fraser University
8888 University Dr., Burnaby BC Canada V5A 1S6

Professional Development Learning Environments (PDLEs) in a Collaborative Online Learning Environment (COLE): Moving towards a new conception of online professional learning

Abstract

Teaching, and education in general, remain firmly rooted in the practices of the past and continue to resist the implementation of strategies and theories arising from educational research. Consequently, significant reforms have been slow to take hold in educational systems around the world. Much of the reluctance can be attributed to a widely-held misconception of the nature of learning. This project attempts to address this misconception through the development of Professional Development Learning Environments (PDLEs are a series of learning tasks and a video-based case study) embedded in an online learning environment that requires the collaboration of users to solve problems. To use a Problem-Based-Learning (PBL) approach in an online context requires a major paradigm shift as well as using tools that were not designed specifically for such a student-driven, process-centred pedagogical paradigm. This becomes a problem when online resources and systems are used for supporting in-service teacher in their pursuit of furthering their education. Although the current theories of learning and teaching may present the philosophical content of such courses, the online strategies used often conflict with the theory. To study the formal implementation of PBL as a social-constructivist pedagogical approach, into an online learning environment to provide the tools for e-learning that would be closer in design to the current thinking on the very nature of learning, the PDLEs were modified to become small reusable video clips with a structure designed to facilitate PBL and focus learners' attention on higher order thinking skills rather than specifically on content. These modified PDLEs are referred to as Problem-Based Learning Objects (PBLOs). The PBLOs were embedded into a prototype of a *Collaborative Online Learning Environment* (COLE) which was developed simultaneously. The entire system was pilot tested with small groups. Preliminary results show that although many technical difficulties remain to be solved, using the environment does show evidence of some effect on beliefs about personal theories of learning, causing shifts from technical issues to those surrounding processes of learning. Our preliminary research has called attention to the potential ability of PBLO/COLE to disrupt conventional, transmission-based conceptions of online learning as content delivery. At the same time, however, our preliminary work has also indicated that learners who are not used to the collaborative opportunities provided within PBLO/COLE may still hold traditional orientations to teaching and learning as a "gold standard" to which all other options are compared. A purposeful direction for our future research will entail working with learners in PBLO/COLE over a sustained period so that they may engage in an online experience grounded in principles of socio-constructivism.

1.0 Introduction

The problems associated with the initial education and on-going learning of professionals, such as teachers, are magnified in the absence of adequate technological resources. Traditional mechanisms used for professional development by way of government directives, guidelines, advisory bulletins, "train-the-trainer" sessions for centrally assigned consultants (Fullan 1992, 1993, 2005; Olson 1990), workshops and seminars are unlikely to encourage large scale change within the profession. Fullan (1992, 1993) argued that the failure of these approaches can largely be attributed to the fact that no account is taken of the individual teacher's previous experiences, personal theories and values. Although many case studies acknowledge the uniqueness of individual educational environments, there is seemingly little general appreciation that teaching is a complex, fluid and uncertain enterprise.

Despite profound, rapid changes in society such as the advent of high-speed access to the Internet and the inclusion of smart phones into most aspects of life, real reforms to the focus of education or the methods used by teachers have been slow to take hold in educational systems around the world (Barone, 2005; Fullan, 2005; Fullan & Miles, 1992). Speaking from decades of experience with educational reform, Sarason (2002) concluded that reform was unlikely given the current architecture of the school system in North America, particularly given that the ways we work, live and play have all gone through important transformations in the past generation. Employers, governments and institutions have all realized that the needs of society with respect to education systems have also changed. For example, in a short document titled "Employability Skills 2000+", The Conference Board of Canada (2006) outlined the types of competencies that should be expected of graduates of Canadian school systems. The desired abilities are: 1) academic skills such as communication, thinking, and learning, 2) personal management skills that include "a positive attitude toward change", and finally, 3) teamwork skills. The new emphasis on both communication within teams and thinking/problem solving indicate that the critical skills required of citizens are profoundly different than just a few decades ago. Earlier, Goldman-Segall (1998) suggested that school should be transformed into places where rich, ill-defined, real-world problems can be examined using emerging technologies as a way of re-instilling motivation for learning. In addition, the rapidly expanding realm of e-learning provides examples of online courses moving from a content-centered approach towards "socialization as information objects" (Siemens 2009, p. 1). On the other hand, in spite of recent technological advances, the complex abilities related to the many faceted aspects of the mastery of technology remain one of the important barriers for users in the context of online learning (Martin, 2006; Pettenati, Cigognini, Mangione & Guerin, 2009).

The need for changing our assumptions about how we learn and share knowledge remains largely unanswered. Wenger (1999) suggests that much of the reluctance can be attributed to a widely-held misconception of the nature of learning. He states that "institutional learning is largely based on the assumptions that learning is an individual process". On the contrary, constructivist learning theorists argue that, if knowledge is constructed by the learner (Papert, 1980; Piaget, 1977; von Glasersfeld, 1995), as opposed to something that is delivered, and if it evolves through a series of conjectures while being systematically subjected to attempts at refutation, our concepts of learning and teaching must also change (Popper, 1963).

Wenger (1999) argues that learning is a normal life activity and that, since humans are essentially social beings, learning is a social activity or "learning as social participation". From this perspective, Wenger concluded that present institutionalized teaching and training, based on the notion of individual process and separate from the rest of our social activities is in danger of becoming completely irrelevant. If a constructivist view of knowledge is then considered in combination with the importance of language, culture and interpersonal communication in the development of higher psychological processes (Vygotsky, 1986) and the concepts of collaboration and of

collective intelligence (Levy, 1994), it becomes rather apparent that the current dominant practices of online distance education are inconsistent with this view as they are constructed around the notions of objective content delivery and individual study and knowledge acquisition.

Halpern & Hakel (2003) assert that "it would be difficult to design an educational model that is more at odds with the findings of current research about human cognition than the one being used today at most colleges and universities" (p.38). Although various authors (Johnson, Wisniewski, Kuhlemeyer, Isaacs & Krzykowski, 2012; Lloyd, Byrne & McCoy, 2012; Tagg, 2012) have noted the factors contributing to resistance of faculty and students to changing the current paradigm, and since "the most significant influence on the evolution of virtual learning will not be the technical development of more powerful devices, but the professional development of wise designers, educators and learners" (Dede, Brown-L'Bahy, Ketelhut & Whitehouse, 2004, p. 558), the authors of this paper designed this pilot study to determine if it was possible to build a virtual platform within which learning would not be defined as the accumulation of information but rather on collaborative meaning making by those participating in the process.

The questions driving our work were:

1. How might PBL be employed in online contexts by embedding various elements in Professional Development Learning Environments (PDLE)?
    a. What variables arise from the exploration of the efficacy of the various structures making up PBLOs?
    b. What usability issues arise with respect to the COLE and the embedded PBLOs?
2. Does this study also clearly explain how to measure such changes in cognition of student (i.e. teachers) using concept mapping and Repertory Grids?
    a. What are the effects of PBLO use on self-initiation and independent thinking abilities of learners/users?
    b. What are the effects of the COLE on user attitudes to online learning, problem based learning and group work within an online environment?

2.0 Theoretical framework

McPherson and Nunes (2004) suggest that traditional views of teaching and learning tend to serve as basic models on which online learning environments have been built. A cursory examination of the tools and technologies that have been the most successful in education, at least in terms of adoption rates by teachers and instructors, support this idea. Typically, Professional Development Learning Environments (PDLEs) that are most popular are those that deliver content most efficiently to the individual learners, systems that allow the management of this content, and systems that allow the automated use of quizzes and tests. In other word, traditional PDLEs replicate the traditional, transmission approach to teaching and learning (Mouza, 2003).

In contrast to this, Problem-Based Learning (PBL) is one approach that is both consistent with a constructivist and collaborative epistemological perspective and has been successfully used in teacher education (McPhee, 2002). Although PBL was initially developed for medical education in the late 1960s, it has been demonstrated to be quite appropriate for most professional training because it can start with real-life situations from which the learners, in our case teachers involved in professional development or pre-service teacher candidates, are asked to work collaboratively to find and solve authentic, ill-defined problems (Savin-Baden, 2007). Today, although many aspects of this approach are emerging as potentially useful to online learning (Kenny, Bullen & Loftus, 2006), particularly in the areas of supporting and managing the activity, much work remains to be done before such as approach can be adopted on a broader scale.

One specific area of interest has been the design and use of video cases as a principal medium to present realistic situations to specifically initiate a problem-based learning activity in online learning for the professional development of teachers. Online environments that aim to bring real-world problems to classrooms hold the promise of enabling teachers to restructure their thinking about the nature of knowledge and consequently consider changing their teaching practices. By modifying and transferring theoretical constructs about learning, developed in face-to-face environments, to an online environment, this study aims to determine whether the concept of PBL can be initiated online with the use of video cases encapsulated into a specifically designed Learning Object (LO) and whether the use of such would present certain barriers in terms of required IT skills of learners.

In order to create the virtual platform which would provide affordances for collaborative meaning making experiences, the authors reflected upon a number of theoretical considerations. These aspects are discussed in the following section.

2.1 Design of the PDLE: to PBLO and COLE

The study described here centres on the use of Problem-based Learning Objects (PBLOs) created to support teacher professional learning (PL). The model of design and assessment was based on several concepts that are addressed within the constructed PBLOs: social constructivism, establishment of a community of learners, video case studies, learning objects, constructivist environments, and problem- based learning (PBL).

Term	Definition
PDLE (Professional Development Learning Environment)	Virtual learning spaces which may include asynchronous text-based interactions, mediated interactions, immersive virtual simulations, etc.(Dede, Ketelhut, Whitehouse, Breit & McCloskey, 2009)
PL (Professional Learning)	Inclusive of interactive learning strategies and technologies that emphasize continuous growth by those involved in professions such as law, medicine and education (Couros, 2015; Western Governors University, 2014)
PBL (Problem-Based Learning)	A pedagogical orientation within which learners interrogate a real-world event or context through the creation of an open-ended problem(s) or question(s) that drive the exploration of the situation. Understanding is derived by collaborative discourse and reflection (Fogarty, 1997; Hillman, 2003; Kenny, Bullen & Loftus, 2006; Savin-Baden, 2007)
Learning Objects	Small reusable digital capsules that are based on a single learning objective or topic (Shaw, 2003).
PBLO (Problem-Based Learning Object)	Small reusable digital multimedia capsules which satisfy a minimum set of characteristics in order to be qualified as objects. PBLOs are used to instigate thinking and discussion (process-centred). They are learner-driven, as the learners build their own context appropriate solutions to the created problems (vanOostveen, Desjardins, Bullock, DiGiuseppe & Robertson, 2010).
COLE (Collaborative Online Learning Environment)	A Moodle-based virtual environment designed to foster collaborative learning activities, provides

	communication tools such as video chatting, time management tools for scheduling and information tools such as an embedded wiki, while also providing the research team with the possibilities of recording all activities occurring within it (Desjardins & vanOostveen, 2008a)

Table 1: Definitions of Terms Used throughout the study

2.2 Considerations posed for PDLE Redefinition

2.2.1 Social Constructivism

In general, constructivists believe that each person builds an individual perspective of reality based on his or her experiences and frames of reference, and that learning will occur if students are given opportunities to construct personal meanings out of their experiences, particularly when discussed with their peers (Piaget, 1972, von Glasersfeld, 1995; Vygotsky, 1978). New conceptions or understandings should be intelligible, plausible, and fruitful (Posner, Strike, Hewson, & Gertzog, 1982). While PBLOs can be used for reflection by individual teachers working independently, their strength is evident in socially defined spaces where individual perceptions are communicated and debated with others in collaborative processes of conjecture and refutation (Popper, 1963). In this project, teachers will be able to engage in social constructivist practices with PBLOs that can be used to build new understandings in ways that are contextually appropriate for their students. Project researchers will determine the effects of constructivist structures within the PBLOs on teacher professional growth.

2.2.2 Community of Learners

The scientific academic community relies on the process of peer review to ensure that a certain standard of rigour and quality is maintained (Wenger, 2000). The community of practitioners, like any other, has certain conditions and standards that determine the strength of warrants for knowledge claims. Longino (1994) identifies four conditions that a community of practitioners must meet if consensus is to count as knowledge rather than mere opinion.

- There must be publicly recognized forums for criticism.
- There must be uptake of criticism - the community needs to do more than merely tolerate dissent; it must act on it.
- There must be publicly recognized standards for evaluation of theory and practice.
- There must be equality of intellectual authority - what is included or excluded must result from critical dialogue rather than the exercise of political or economic power.

In this study, all project participants were required to participate in an online community of learners under such conditions. Simultaneously, researchers explored the structures needed to support the development of these communities within the online environment within which PBLOs will be embedded.

2.2.3 Video Case Studies

Recently, case studies have been used in business and legal schools as an effective teaching tool (Harvard Business Publishing, 2009), and have also begun to appear in math, science and technology education programs. The use of case studies in these programs has been varied and include:

- studies that focus on identifying teacher learning outcomes such as, higher-order reasoning, reflective thinking, decision-making, strategic inquiry and collaboration,
- studies that examine variables influencing the success rate of case-based professional development activities such as the role of discussion and teacher experience, and

- studies that report on the construction and implementation of new technologies that support case- based learning" (Yoon, Pedretti, Bencze, Hewitt, Perris & vanOostveen, 2002).

Typically, these case studies are text-based, although there is increasing interest in the use of multi- media (or video-based) cases in support of pre-service teacher education in the literature (Cannings & Talley, 2002; Hewitt, Pedretti, Bencze, Vaillancourt & Yoon, 2003; Kurz, Batarelo & Middleton, 2009; Pedretti, Bencze, Hewitt, Romkey & Jivraj, 2008). However, there is still little evidence to support the use of video cases in in-service teacher professional development (Bencze, Hewitt & Pedretti, 2001; Copeland & Decker, 1996; Louden, Wallace & Groves, 2001; VandenBerg, 2001). Consequently, it is one of the intentions of this project to investigate the usage of this method within the structure of the PBLOs and within an online environment.

3.0 PBLO Structure

PBLOs do not contain, nor are they predicated on, a preconceived notion of the learner's knowledge of or the skills that the learner brings to bear on problems which are presented. Instead PBLOs consist of video-cases that have been embedded into a specific 4-page structure which incorporates:

- video clips,
- transcripts of the video,
- contextual information regarding the clips,
- theoretical information that can be applied to the content of the video clips, and
- 2 separate series of questions on pages 1 and 4 of the object (see Figure 1).

The questions require the user initially to analyse the clips and then later to synthesize the information that has been gathered by the users. The analysis/synthesis structure is an attempt to employ Piagetian principles of inductive and deductive reasoning along with hypothesis creation, defence and refutation (Popper, 1963) within a PBL context so that the video cases are not simply presentations of ideas to be absorbed. The questions embedded in the video case structure are designed to provoke discussion amongst the learners and the formulation of hypotheses that could be described as Popperian 3rdWorld thought objects, such as models and theories (Popper, 1972).

Learning Objects are digital, reusable content software applications that are intended to address specific curriculum topics (Hedberg, 2008; Rey-Lopez et al., 2008). This traditional definition has been expanded to include larger environments that were designed for similar purposes. Learning objects can be found in a wide variety of shapes and sizes. Consequently, learning objects can be classified on a grid created by the intersection of two domains. As shown in Figure 2, one of these domains concerns control of the learning enterprise, the second is oriented around the process/content dichotomy.

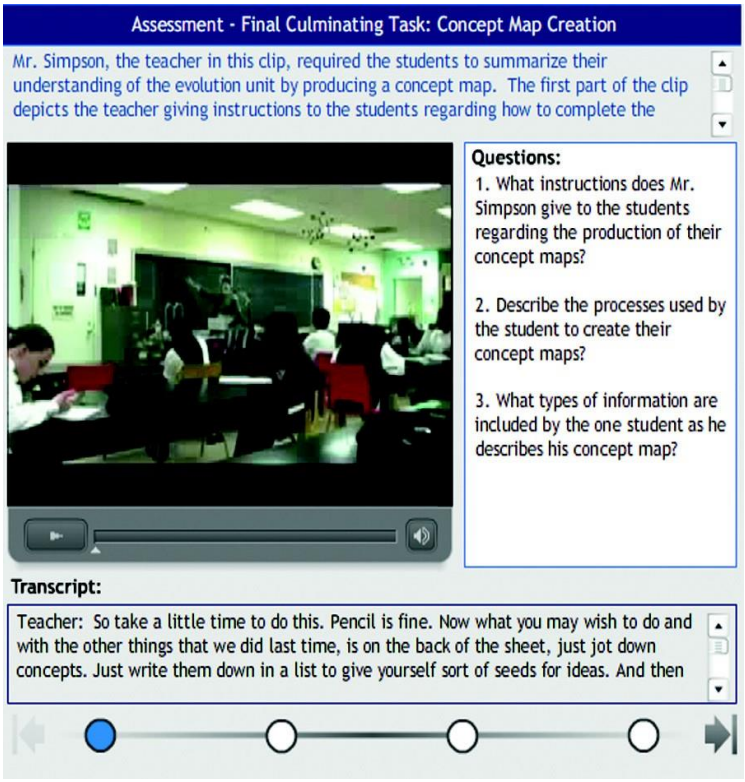


Figure 1: Page 1 of an assessment PBLO in the Argumentation video case.

3.1 Learning Objects and Constructivist Environments

Problem Based Learning Objects (PBLO) differ from traditional characterizations of learning objects because they do not actually contain content that is tied to curriculum outcomes. They are specifically designed to motivate or to initiate a process rather than to deliver actual curriculum content. The content provided in PBLOs is used more to instigate thinking and discussion (process-centred) than to provide so-called knowledge intended to be acquired by users. As such, they are learner-driven, as the learners build their own context appropriate solutions to the posed problems. Consequently, PBLOs are *not* content delivery systems, nor do they offer simulation environments as proposed by Papert (1980). Since PBLOs also do not collect learner information to then tailor the training to the user, they do not fall in an adaptive technology category where intelligent tutoring systems (Wenger, 1987) have been prominent. PBLOs, in their present iteration, contain a problem consistent with the problem based learning (PBL) approach commonly used in medical schools, such McMaster Medical School, and engineering faculties, such as McMaster University, Coventry University and Imperial College, today (Savin-Baden, 2007). PBLOs do not contain the solution nor do they propose a method. These are left to the learners to construct. PBLOs can be best placed in the upper right quadrant of the grid (see Figure 2) as they are both student (or learner) directed in their use and the overall orientation of the objects is one of process, as the intent of their use is not specifically to concentrate on the specific problems or the solutions but to focus on the consensually derived understandings arising from the interaction with the objects and the other members of the environment.

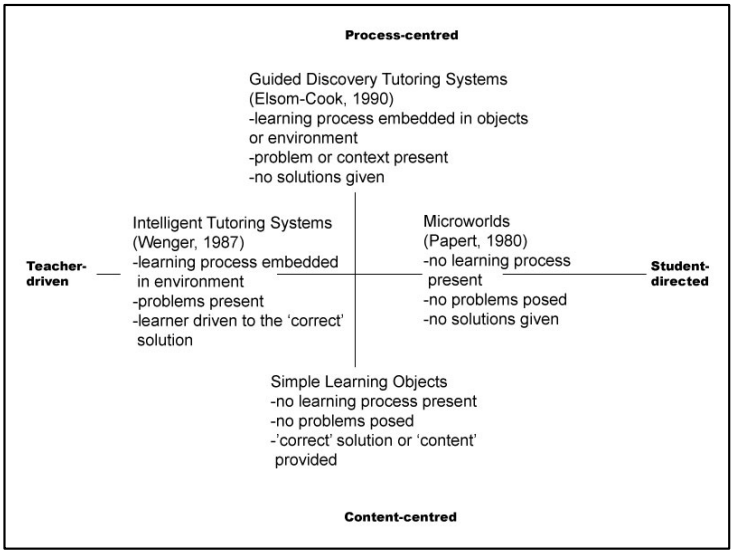


Figure 2: Classification of Learning Objects as a function of control levels and content/process orientation

3.2 Problem-based Learning (PBL)

Problems, in a PBL environment, provide a context within which to learn. Simultaneously, they provide motivation, as the learners already know why they are learning, i.e., to search for solutions to the problems. Problems can be viewed as objectives that cannot be achieved directly as there is some type of obstacle, or multiple obstacles, which must be overcome (Watts, 1991). To operationalize a definition of this concept (see Figure 3), the problem (P), is first characterized as the difference between the desired situation (SD) and the current situation (SC). Then, the level of difficulty that can be expected to resolve the differential between the desired and current situations can be determined, in an inverse relationship with, the amounts of relevant knowledge (K) and resources accessible (R) by the learner or problem solver. Thus, if the learner has a great deal of knowledge and/or resources and knows how to apply these to the differential, the problem should be rather simple to solve. Finally, the "Role" refers to the situatedness or contextual factors related to the potential problem solver since the role determines the background and type of perspective brought to bear on the problem.

$$P \sim \left(\frac{O(S_D - S_C)}{K+R} \right) \text{Role}$$

P = Problem
O = Obstacle
SD = Desired Situation
SC = Current Situation
K = Knowledge (Current & Required)
R = Resources (Current & Required)
Role = Perspective, Position, Orientation

Figure 3: Proposed model of a first level analysis of "Problem" (Desjardins & vanOostveen 2008b).

Problems can be categorized into a variety of levels of complexity depending on how much contextual

information is given to the learners. Watts (1991) provides a brief taxonomy of context/situation types upon which students can build their own problems.

- 'Given' problems contain statements of both the goal and some suggested strategies to be used to solve the problem
- 'Goal' problems have the goal stated but no strategies are suggested.
- 'Own' problems include neither the goal nor the strategies. Problems of this type consist primarily of a statement of context and the learners are required to identify the problem or problems embedded in the context. (Watts 1991, p. 8)

In learning contexts such as those employed in the PBLOs, learners will collaboratively identify, access and use resources to solve problems of all 3 types described above. The model of problem-based learning used in PBLOs also fits the categorization structure of 'Problem-based learning for professional action', as proposed by Savin-Baden (2007). This model has, as its overarching concept, the notion of 'know-how'. Action is seen here as the defining principle of the curriculum whereby learning is both around what it will enable students to be able to do, and around mechanisms that are perceived to enable students to become competent to practice" (Savin-Baden, 2007, p.27). Since PBLOs combine a rich mix of theoretical elements, video exemplars and reflective questions, they are used to encourage pre-service and in-service teachers to critique the techniques and activities displayed in the video and to allow the teachers to determine the place of those techniques and activities in their own practices.

PBLOs need to be included within an infrastructure that provides opportunities for users to communicate their responses to the video clips and questions, interact and collaborate as they share their insights and perceptions, and gradually build consensual knowledge. A Collaborative Online Learning Environment (COLE) has been developed in which the PBLOs have been embedded. This Moodle-based environment designed to foster collaborative learning activities, provides communication tools such as video chatting, time management tools for scheduling and information tools such as an embedded wiki, while also providing the research team with the possibilities of recording all activities occurring within it (Desjardins & vanOostveen, 2008a).

4.0 Design of COLE

Regardless of whether we consider that technological evolution is shaped by the user's demands as expressed by market trends or that social changes are brought on by the diffusion of new technologies, the effects of one on the other is undeniable (Pinch 1996; Pinch & Bijker, 1987; Williams & Edge 1996). To carry out some manual tasks, humans have created tools that, in turn, have changed the way these tasks get accomplished. Eventually there is a change in the way we think about these tasks and the tools, and then, humans alter the tool, then the tasks themselves and eventually the expectations. This loop has so far, been endless and, in recent times, rapid and accelerating, except in education.

There are many reasons why such changes are not quite as rapid in education. For teachers, the assumptions about teaching and learning have driven them to develop or at least to choose and therefore encourage the development of technological tools that reflect these assumptions. Since learning has traditionally been considered an individual process of acquiring knowledge as an object; the tendency right from the introduction of the first micro-computers to the latest course management systems has been to prefer using tools that reflect traditional ideas of teaching and learning. Teachers initially opted for drill and practice software, CDROMs full of encyclopedic information, then as technology evolved, they chose to support the development of web-based

content management systems (CMS) to organize sets of learning objects specifically designed to teach pre-determined content to the student (Jonassen, Peck & Wilson, 1999). Unfortunately, the use and development of these new tools, has not altered the general view of teaching and learning. The loop is incomplete and the attitudes about learning have not changed.

These unchanged attitudes about learning are reflected in online distance education as it remains entrenched in an objectivist perspective: technology is still used to deliver information to individual students, much as it is done in a large lecture hall. This tendency becomes particularly problematic when this perspective is used to select and develop tools used in professional development of teachers. Despite the new social constructivist ideas that may be included in many of the courses offered to future teachers, the way they experience these courses remains a familiar, unchanged but increasingly irrelevant experience. As Sarason (1996) noted, teachers are unlikely to adopt radically new pedagogies unless they experience pedagogical approaches that challenge traditional notions of teaching and learning in their professional education.

Changing the online learning experience for teachers in a professional development context might alter personal theories about learning. To achieve such a change in experience for teachers, a different online learning environment needed to be developed, one that would become a microworld (Papert, 1980). Microworlds are "experimental learning environments in which learners can navigate, manipulate, or create objects and test their effects on one another" (Jonassen & Carr, 2000, p.178). Thus, the technological environment design for online courses, rather than only the course content, should reflect the notions that first, knowledge is something that exists in the mind of the learner (vonGlasersfeld, 1995) and that learning is an activity that occurs in everyday life of social beings as they collaborate, exchange and generally communicate (Wenger, 1999). Such an environment should facilitate some constructivist aspects of learning while limiting the use of traditional teaching strategies by intentionally excluding other affordances.

The intention of designing the Collaborative Online Learning Environment (COLE), was to intentionally move from a content centred – teacher driven design to a process centred – learner driven approach. This means that a social constructivist position had to be adopted, with a strong intention to foster collaborative knowledge construction. Consequently, the vocabulary and the meanings would have to be negotiated amongst the learners thus creating a 'collective intelligence' (Levy, 1994) that would require much communication as well as the rethinking of personal assumptions. Old ideas would have to be presented, defended by some and sometimes refuted by others. This process of inductive – deductive reasoning combined with the Popperian idea of refutation (Popper, 1963) is only possible in a collaborative setting.

If knowledge is deemed to be constructed by the learner, learning environments cannot foster actual learning by simply delivering content or information. Knowledge is constructed through perceptual experiences and reflection about these experiences (Piaget, 1977; Popper, 1963; von Glasersfeld, 1995). To achieve this, COLE would have to create an environment where the learner would become the producer of knowledge, much like the scientist (or educational scientist in this case) observes, analyses, thinks and writes his/her version of explanations of the phenomenon and then exposes these conjectures to others for discussion and potential refutation.

With the two basic principles, that is: 1) moving from content-centred to process-centred approaches, and 2) having the learner become the producer of knowledge, learners must work with collaborative effort, and the proposed online learning environment would have to offer the tools and functions to both allow this, as well as provide limitations to almost prevent direct exclusive delivery of information and the individual, non-negotiated production, or reproduction, of predetermined information.

With an objective to create a Collaborative Online Learning Environment that would respect these basic principles, it is further intended that the use of this environment by teachers involved in professional development, will foster a change in attitudes or at least in representations, of what teaching could be and of what learning is. It is also understood that as in any study program, an instructor would be involved. In this case, the instructor would play a specific role, that of a facilitator in accordance with the specific social-constructivist perspective adopted (Savin-Baden, 2007)

4.1 The architecture

The first step in designing the online environment was an interplay between the functions required to support the collective knowledge construction process and the difficult decisions of the features to be explicitly excluded. Second, the interface was designed to specifically organize these functions by the types of interactions afforded by the technology (Desjardins, Lacasse & Belair, 2001; Desjardins, 2005), as shown in Figure 4. To do this, a prototype was created using the open source “Moodle" as a basic platform with several existing plug-ins having been selected and implemented.

The student-teacher, or user, initially meets the Web-based interface that is as simple as possible. The idea was simply that if too much time is required to learn how to “navigate” the interface, it is too complicated. This interface, if is to be a “learning environment” must first and foremost be a workspace. Around this workspace are the tools and resources, grouped under:

- Communication tools
- Information access & management tools
- Information production and processing tools
- Time management tools

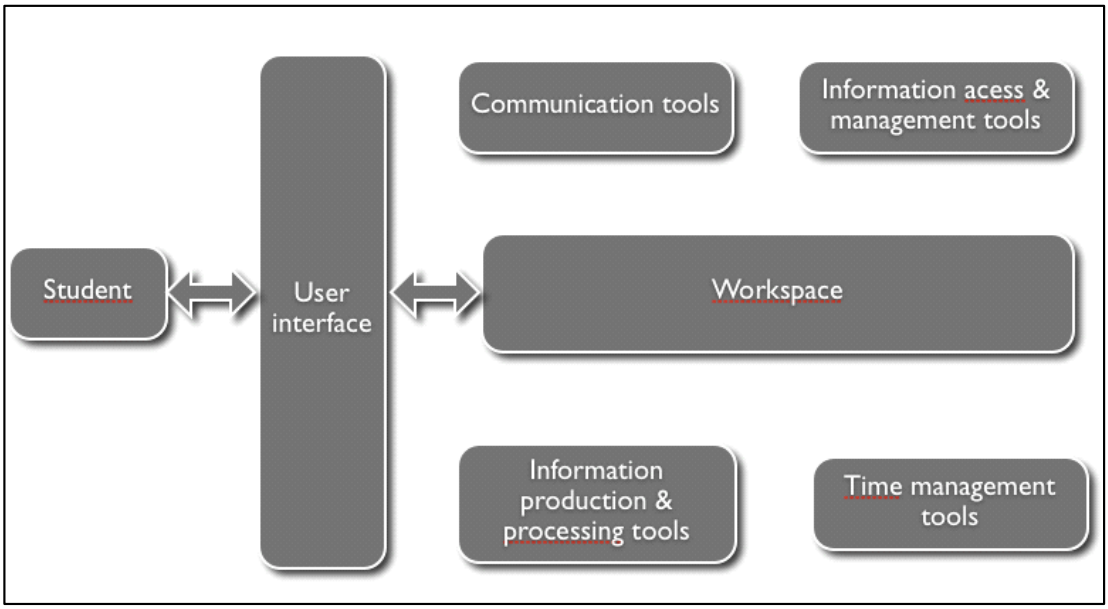


Figure 4: The basic architecture of COLE interface.

Communication tools include such affordances as asynchronous elements such as e-mail and synchronous multimedia made possible by technologies like peer-to-peer videoconferencing or video chat, as seen in Figure 5. The decision to have only one chat room was among several of the limitations built into the system. This was intended to not only allow free discussions amongst the learners, but also to allow the discussions to be open to the other learners in the cohort, to foster the negotiation of construction of the concepts.

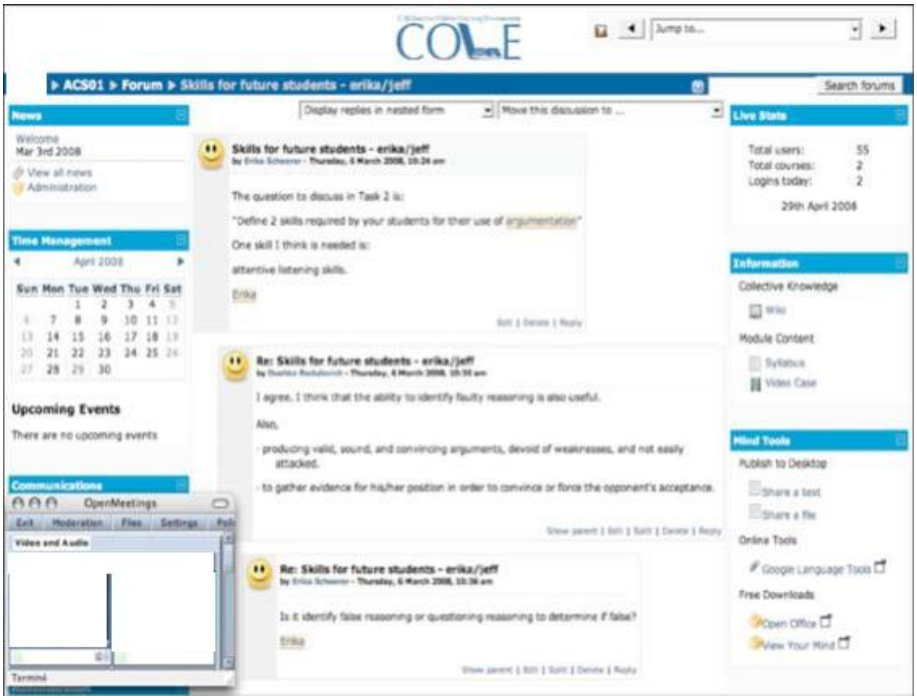


Figure 5: Sample screen capture of COLE showing a partial discussion from the forum and an OpenMeeting videoconferencing window open.

Information access & management tools are specifically chosen to achieve two basic goals. First, the most evident, these resources are to serve as a portal to access online information and documents, much along the same lines as present Web search engines. Second, it is in this area that any information or documents produced by the learner community will be stored. One of the main systems in this section is the "wiki" that allows users to collaboratively edit and negotiate the creation of a web page, in a similar manner to Wikipedia (http://wikipedia.org). There is only one wiki for each "course" or "theme". The wiki is initially empty and all content is to be created by the learners. Students can create articles about specific concepts but the built-in limitation of it not being possible to have multiple distinct articles with the same title "forces" different contributors to discuss and eventually agree on each specific definition stored and referred to in the wiki. Unlike the well-known "Wikipedia", experts are not expected to validate the content and therefore, it is explicitly up to the learner community to self-monitor and to negotiate the meanings to each term or concept. Here, the facilitator can participate in these discussions, but should not act as an expert but rather as one who would ask questions.

Information production and processing tools include the more standard word processing, spreadsheet, database and concept mapping tools, but with the specificity that all of them create files that are shared and in some instances, technology permitting, can be shared live online. Because online students tend to have some issues with managing their time when it comes to juggling work schedules, family life and studies (Volery & Lord, 2000), a dynamic set of tools such as an agenda and a calendar are made available with automated reminders as to

self-set or group set deadlines.

Finally, in addition to these four basic sections, two small frames at the top of the environment, provide current information. First, a small "News" window represents the only place where the instructor can make some announcements or give small bits of information to the entire cohort of students. Second, on the left at the top, a "statistics" window will provide simple information, automatically generated by the system, on such things as the total time spent on the site, number of other participants online, number of connections in the recent past, etc. This information is made available to the individual to help in planning and establishing work schedules. Although the working prototype meets most of the requirements expressed in the initial project, the user interface is still constantly revised and adjusted as comments arise from users as well as from new technological developments emanating from within the open source community of Moodle.

5.0 Professional learning

It has proven difficult to define "teacher professional development" partially due to a broad-based assumption that teachers already know what professional development is. The web sites of various teacher educational institutions seem to define teacher professional development as a matter of enrolling, attending and participating in pre-service teacher education programs or in additional qualification courses (Ontario Institute for Studies in Education of the University of Toronto, 2003; The Faculty of Education at York University, 2003).

For the sake of this report, the primary characteristics for authentic teacher professional development were drawn from a small number of sources. Authentic teacher professional development would seem to imply an improvement, or perhaps a maturing in the arts and sciences that define teaching. According to the Ontario College of Teachers (1999), the characteristics of authentic teacher professional development can be gleaned from the established Standards of Practice:

- Commitment to Students and Student Learning - The standard focusses on a commitment on the part of teachers to their students in the areas of learning, behaviour, individual growth and the promotion of life-long learning.
- Professional Knowledge - Teachers are expected to know the curriculum, subject content, students and teaching practices.
- Teaching Practice - Teachers are to use their professional knowledge to promote student learning using appropriate practices of teaching, reflection, assessment and evaluation.
- Leadership and Community - Teachers are called upon to create and support learning communities in the classrooms, schools and in their profession by collaborating with other stakeholders.
- Ongoing Professional Learning - Teachers are expected to acknowledge the relationship between teacher learning and student learning, and to support that relationship by actively engaging in professional growth (personal, social and educational) and improve their practice.

An additional list of similar principles is suggested by Little (as cited in Burnaford, 1999).

- Offers meaningful intellectual, social, and emotional engagement with ideas, materials, and colleagues.
- Takes explicit account of the contexts of teaching and the experience of teachers.
- Offers support for informed dissent.
- Places classroom practice in the larger contexts of school practice.
- Prepares teachers (as well as students and parents) to employ the techniques and perspectives of inquiry.
- Involves governance that ensures a balance between the interests of individuals and the interests of the institution.

In a report about a teacher development project conducted in New Zealand, Bell and Gilbert (1994) suggest:

> Teacher development can be seen as having two aspects. One is the input of new theoretical ideas and new teaching suggestions. This tends to be present in current teacher development programmes and is usually done in more formal situations, for example, seminars and lectures. The second is trying out, evaluation, and practice of these new theoretical and teaching ideas over an extended period of time in a collaborative situation where the teachers are able to receive support and feedback, and where they are able to reflect critically. In our experience, this second aspect tends to be underplayed in many in-service programmes and tends to use more informal modes such as telephone conversations, conversations in the staffroom, sharing anecdotes and visiting each others classrooms (Bell & Gilbert 1994, p. 494).

Carr and Kemmis (1986) and Sagor (1992) examine the essential characteristics of authentic professional development comparing the teaching profession with other professions. Sagor (1992) indicates that most other professionals interact with each other as well as their clients daily and that these "interactions with other professionals stimulate and push these people to new levels of performance in both the art and the craft of their profession" (p. 2). He goes on to suggest that teachers, due to the structure of the school day and other pressures, rarely interact with each other except perhaps at staff meetings, and these meetings are rarely held to talk about advancing the teaching profession. He also argues that the knowledge base for teaching is not as defined and certain as that found in other professions such as law and medicine. In addition, generalized solutions to the problems of teaching, which tend to be very context sensitive, are difficult to determine. Experiential learning seems to be very important and if the experiences cannot be discussed on a regular basis then the problems will probably not be understood and will not be solved. These experiences need to be reflected upon, shared with other teachers and tested through a process that allows teachers to shape their experiences in ways that suit their contexts (vanOostveen, 2005).

A second component that Sagor (1992) identifies as part of the teaching profession deals with contributions to the knowledge base. While he holds that the teaching profession is informed by a knowledge base, Sagor contends that teachers do not interact with and contribute to the development of this knowledge base. Teachers' work is not generally published in the academic literature. Rather, publishing in educational research journals tends to be the domain of educational researchers, professors and others in academic circles but not in the classroom. Carr and Kemmis (1986, p. 8) contend that "theory and research play a much less significant part in teaching than they do in other professions." Regardless of how teachers view theory, they must not only access the existing body of knowledge but also to take advantage of the available opportunities to add to that knowledge. Teachers therefore need to interact with their academic colleagues in such a way that both groups are mutually supportive of each other's efforts, or as Carr and Kemmis (1986) suggest: "the attitudes and practices of teachers must become more firmly grounded in educational theory and research" (p. 9).

The final component that Sagor (1992) identifies as part of the definition of the teaching profession entails the 'separation of quality control.' According to Sagor, most professions involve self- assessment as measured against a standard established within the profession itself. This does not seem to be the case with teachers. Much of the assessment that occurs within teaching is in the hands of the administration (principals and other designates) and, with the changes a former government instituted in Ontario, it increasingly lies in the political arena. Currently, the situation remains relatively static. While the current government of 2009 has indicated a willingness to discuss some of these issues, this has not been supported with the type of changes in legislation which are needed (vanOostveen, 2005). In contrast, authentic professional teacher education should allow teachers to regain control of the teaching environment enabling them to make decisions, within the context of the learning community in which they work, that they consider are appropriate for their local classrooms and schools.

Carr & Kemmis (1986) agree that teachers are severely limited in the autonomy that they possess. “Teachers operate within hierarchically arranged institutions and the part they play in making decisions about such things as overall educational policy, the selection and training of new members, accountability procedures, and the general structure of the organizations in which they work is negligible” (p. 39). In order to make teaching a more professional activity, teachers must take advantage of existing opportunities to participate much more widely in the decision-making process.

The challenge becomes one of attempting to engage teachers in authentic teacher professional development which reflects the characteristics noted above. Perhaps the most effective way of achieving this would be to have teachers meet in small groups where they could interact with each other and the established knowledge base, discussing what theory would be most appropriate to their given situations. They need to be given opportunities to construct plans, to try some strategies out in their classroom, reflect on those experiences and then come back to the group and critique what happened. The teachers should take their reflections, the criticisms and ideas of their colleagues, and make new plans that they can take back into their classrooms for another cycle of action. The methodology described, action research, has become significant within educational communities for intervention, development and change.

It is not sufficient for teachers to rely upon their own instincts as they progress through an action research program. It is the contention of these authors that they need to have access to issues and concerns that impinge on their practice but of which they may not be aware. One way to do this may entail the establishment of a learning community of teachers complete with a facilitator who will be able to intervene, as necessary, to provide this ‘outside’ perspective and to provide additional resources (vanOostveen, 2005).

PBLOs embedded in COLE were designed as a means of addressing the conditions required to accommodate a form of action research set within an online environment, allowing for a greater range of access than the traditional face-to-face format, while still providing opportunities to teachers to participate in communities of learning while accessing the literature and building their own understandings of theory and its relationship to their practice.

5.1 Online learning: change in stance and incorporation of constructivist principles

A host of complexities must be addressed when moving teacher professional development into an online environment. Not only does the system need to meet the constraints required for learning in general, it must go beyond these by providing for the affordances that will allow for high levels of interaction between learners and with the course or system designers. Wagner (2001) defines interaction as a “reciprocal event that requires at least two objects and two actions. Interactions occur when these objects and events mutually influence one another” (p. 8). With the incorporation of problem-based learning and constructivist principles, PBLOs when embedded into COLE speaks to many of these characteristics as described by Anderson (2008) in his model of online learning.

Bransford, Brown and Cocking (1999) suggest that effective learning environments are described by the four attributes of being community-centred, knowledge-centred, learner-centred and assessment- centred. Each of these attributes will be discussed with respect to the characteristics shown by PBLOs embedded in COLE.

Learning with PBLOs is community-centred in that supports and challenges are provided to the learners within communities that are structured within the environment, for example, learners work collaboratively with other learners completing tasks, discussing reactions to the video cases, and when negotiating understandings to be

entered the wiki. As teachers participate in discussions with others they will be engaging in problem-based learning, endeavouring to determine the relationship of their new-found knowledge to their classroom practice. After attempts to implement ideas derived while in the online environment, teachers will be encouraged to bring their experiences from the classroom back to the online community for sharing and critique. In doing so, the community will be actively participating in action research, albeit a very different type of action research undertaken while in a face-to-face setting.

Learning within the COLE environment is knowledge-centred and is situated within specific disciplines and fields. Teacher participants will be given opportunities to experience discourse and the knowledge structures that undergird discipline thinking. For instance, PBLOs have been developed regarding the exploration of using argumentation skills in Grade 12 biology classes or a contemplation of critical literacy in an elementary language class. Each of the video cases encased in the PBLOs is situated within specific contexts and fields. The tasks and questions which are part of the PBLOs are designed to instigate discourse. Participants will also be asked, as part of the tasks, to reflect upon their own thinking, as suggested by Bransford, Brown & Cocking (1999). In this way, learners will be able to develop deeper understandings of the issues involved in the contexts addressed in the PBLOs.

Learner-centredness deals with meeting the needs of individual learners within the context of the community. An important initial step in focusing on the learner is to determine prior knowledge. The initial tasks of concept mapping and definition building, undertaken by student teachers in the argumentation PBLO were designed for this specific purpose, as well as to establish a baseline to be used to measure growth throughout the video case. Recent increases in the bandwidth and open-source software for communication have led to increased opportunities in this area. The use of affordances such as wikis, and potentially other social networking tools, within the online environment will provide even more possibilities in the future.

PBLOs are also assessment-centred in the sense that the major embedded forms of assessments are based on formative assessments that will be carried out through peer and self-assessments. These are primarily done within the context of wiki entries, revision of concept maps, and definition negotiation.

According to Anderson (2008), interaction is a critical element in the online education process. A computer-based learning environment requires an interface design that considers functionalities issues and issues of Human-Computer-Human Interactions (HCHI). Using a model set out by Desjardins, Lacasse & Bélair (2001), four types of interactions can be identified within COLE, allowing issues to be addressed and tools chosen for each.

User/computer interaction: The users must be able to understand and use the available functions and tools with ease. This implies that the user-interface must be very clear, simple to use and any navigation must be kept to a minimum. In a learner-driven context, the interface cannot predict what the user will want to use and when, therefore these functions are to be accessible always. To support the principles of a learner-driven, process-centred approach, the greater part of the interface is dedicated to a workspace for the user. The functions are then displayed around the workspace, organized according to the three remaining types of interaction.

Interacting with others: A section of the COLE interface called “Communications” includes computer- mediated communication tools, both asynchronous and synchronous, such as a basic mail service, a text-based live chat and a peer-to-peer videoconferencing system allowing a maximum of four users per virtual meeting space. Some limitations are imposed to foster collaboration. For example, there is only one chat room for any given course to foster open communication amongst all members of the same cohort. Limiting the videoconferencing to four

participants per meeting space is set to provide a forum where small groups or teams collaborating on a specific task can hold meeting in as close to a face-to-face fashion as possible.

Interacting with information: The resources in this section are selected and adapted both to facilitate access to information in general and, most importantly, to produce, share and co-construct information in a collaborative manner. For instance, this section contains the actual course outline or syllabus and this is also where instances of problems are found as PBLOs. As concepts and ideas emerge from the learners while interacting with the PBLOs, a wiki becomes the central location where the learners define these and this is also where this knowledge is negotiated. Since the wiki is shared amongst all participants in a course, the language is collectively developed and understood, as in most socially constructivist learning activities. Although there are other tools available to generate and share texts in the environment, this one represents the principal negotiated repository of the collective knowledge.

Using information processing tools: This section of COLE offers text editors, spreadsheets and concept mapping tools for use by the learners to help them in the process of generating new information.

PBLOs, set within an online system such as COLE, seem to provide learners with a unique environment with many of the characteristics required for online learning.

6.0 Methodology, Findings and Discussion

The present case study examines the design, implementation and pilot use of what will be defined as a Problem-Based Learning Object (PBLO) with 34 pre-service teachers in a science education curriculum methods course. The student teacher volunteers accessed the PBLO, embedded in a modified online learning environment, focused on the development of argumentation skills in a high school biology classroom, for a total of 2 hours over 2 days in the spring of 2008.

A pilot test was conducted over the space of approximately 2 hours (1 hour for each of two class periods in the Spring of 2008). The students were paired up and each of the partners was placed in separate, but adjacent, classrooms. The physical distance between the students required that they use the communication affordances available within COLE rather than leaning over and just speaking to the partner. All students were pre-service teachers enrolled in a General Science Curriculum course at a small Canadian public university. The pilot consisted of a PBLO (a set of tasks corresponding to a video-based case study focused on the use of argumentation within a Grade 12 Biology course in an urban high school in Ontario). The argumentation topic for the case study was chosen by a class-room teacher and the principal investigator as an example of a pedagogical technique used to explore critical thinking skill development for secondary school students. The development of argumentation skills in the science classroom can help students to identify the characteristics of arguments and then to apply the developed knowledge (Newton, Driver & Osborne 1999). The video case itself consists of 26 separate video clips organized into 5 separate themes which illustrate pedagogical considerations, such as, assessment, learning styles, teaching styles, interactions and an exploration of argumentation. While the full range of video clips was available to the teacher candidates there was insufficient time for viewing more than one or two clips during the pilot testing period.

6.1 Survey and Recordings during trial session (including debriefing sessions)

6.1.1 What were we looking for?

In the intervening time between the two pilot sessions with PBLO/COLE the students were asked to complete an online survey which asked a series of questions designed to measure attitudes towards online learning and to collect some basic demographic information such as age, gender, and experience with online environments. During the in-class use of the COLE, several pairs of pre-service teachers were video recorded as they were collaborating with their colleagues through the affordances provided in the environment. After the case study viewing a brief full-class debriefing session was held and video recorded for each of the course sections.

6.1.2 What did we find?

The pre-service teachers' responses to the survey questions provided some interesting background information regarding their experience with digital technology and predispositions to online learning environments. A superficial analysis of the data has been performed and will be reported here. Statistical significance and conclusions based on any of the results should not be assumed. 75.8% of the 34 participants were female. 67.6% of the students were between the ages of 18 and 27, as might be expected in a pre-service teacher education program where most the students had recently graduated from an initial science undergraduate program. These students also typically had work experiences (outside education) of less than 6 years. Of the students who were older than this, 5 had more than 15 years of work experience outside of education.

The students were asked to estimate their weekly use of various types of software, ranging from word processors to video conferencing (see Table 1). Word processors and e-mail applications (both client or web-based applications) were most frequently used by these students. Other applications that are typically local-machine based, such as spreadsheets, databases, personal calendars and concept mapping tools, were infrequently used. Social networking sites, such as Facebook, are well used (more than 2 hrs./week) by more than 50% of the students. Text messaging/chats were also frequently used by the students. Some of most interesting results, involved the use of video-conferencing (VC) and wikis. These applications were not used or infrequently used (<1 hr./week) by more than 50% of study participants. The infrequent use may, at least partially, explain the relative unfamiliarity to these applications expressed by students in the debriefing sessions below.

The students were asked about their familiarity with online courses and problem-based/collaborative approaches to learning. 70.6% of the students had experienced 1 or fewer online courses. Consequently, most of the students were unprepared for what they would experience with the PBLOs and COLE. The students' relative inexperience with online learning environments may be of benefit from the perspective that these students may not have to overcome negative expectations based on previous online experiences with these types of systems. Conversely, the students' relative inexperience may also be detrimental since their expectations for online learning environments may be unrealistic. Each of these types of reactions are reflected in the statements recorded in the debriefing sessions below. In response to the problem-based/collaborative learning question, 64.7% of the students indicated that they prefer "a problem presented and have to create the solution in small groups." The responses probably have no significance outside the pilot study; they may be more indicative of the pedagogical stance taken within the course that these students were in during the pilot study.

Application Type	<1	2-5	6-10	>10
WordProcessor (i.e., MS Word, WordPerfect)	0	11	12	11
Spreadsheet (i.e., MS Excel, Quattro Pro)	27	4	1	2
E-mail	1	12	7	14
Discussion Forums	12	11	8	3
Blogs	28	4	1	1
Social software (i.e., FaceBook)	14	9	4	7
Concept mapping (i.e., Smart Ideas, Inspiration)	27	7	0	0
Text messaging/Chat (i.e., Messenger)	8	9	9	8
VOIP/videoconferencing (i.e., Skype, iChat)	26	3	3	2
Wikis (i.e., Wikipedia)	21	9	0	4
Agenda/Personal calendar	18	9	2	5
Database (i.e., FoxBase, FileMakerPro)	24	4	4	2

Table 2: Self-reported use of software by pre-service teachers (hours per week).

The final question asked participants to indicate how comfortable they were taking responsibility for their learning. Specifically, students were asked if they preferred courses where: 1) readings are assigned, 2) some texts are assigned or 3) themes are proposed and sources suggested. The results were striking: 47.1% of the students indicated that they preferred readings assigned, but 38.2% of the students chose the response with sources suggested. In this case, the results may say more about how students have experienced learning in the past and consequently may not be aware that there are alternatives.

Participants had the opportunity to unpack some of their underlying beliefs about learning in an online environment during a debriefing session that was held in the week following the pilot sessions. Issues surrounding the technical aspects of COLE dominated the initial questions and comments. For example, the participants spoke of the problem with the slow response time for the text-based chat system. Despite this difficulty, many indicated a preference for this particular form of communication. Students mentioned using similar tools, such as MSN instant messaging, in their own personal study situations.

Students went on to comment on the potential utility of peer-to-peer videoconferencing. Many commented on the ease of its use and quality, despite some of the known technical problems. One individual commented that such a system would create unrealistic expectations, as he believed that too many users in remote areas would have insufficient bandwidth to accommodate such tools. Overall, most students agreed that text chat is a very important aspect of the environment that could promote collaboration and that, if possible, they would use a built-in chat tool.

Despite initial technical problems related to access, the wiki tool attracted some attention. As the discussion progressed, student expressed more elaborate opinions regarding the potential of this tool. For example, one participant remarked that if she had known how to use the wiki, “it would have been cool, I think it has lots of potential.” This remark led to a discussion about the required collaboration built into COLE. One participant stated: “Having to argue or discuss, I personally like it, but I know a lot of people don’t so I’m not sure.” Several comments made by the participants about their experiences within the teacher education program generally confirmed this statement. Some students even referred to the teachers they met in schools, stating that most just want the information and do not wish to spend time discussing.

One participant commented on the specific constructivist perspective inherent in COLE:

> "I think it's good because you're actually creating it and it's like right in front of you, like when you're doing it, it's not, you're just listening, it's like you're doing it. That's what I like about it." (Participant 1)

This comment generated a lot of support within the group suggesting that many participants enjoyed taking responsibility for their own learning. Another individual noted that the use of video cases added a good sense of realism. For example, she found it easier to comment on a video clip than on a written description. However other participants believed that the video clips were too "choppy", referring to the sometimes-rapid shifts between video shots found within the clips. The students felt the shifts did not portray the unified story. We believe that participants were treating the video cases as content modules instead of PBLOs.

The following extracts were derived from the debriefing sessions: Extract 1
S1: Same exact experience online as in the classroom?
S2: But if you integrate the chat and the forum you can match the experience. I can talk to R... whether its here or whether I'm on a computer and he's on a computer.
S3: It's never going to be identical. It's just like two classes, it's like your class and ours. The dynamics are going to be different with everything but you can try to get them as close to the same experience as possible. You need to give them the same knowledge and as close to the same experience as possible. The former set of quotations identities that the multimedia communications package is important.

Although these participants recognize that there are some limitations, synchronous communications are critical to the concept of collaboration. In this extract, remnants of the traditional representation of teaching and learning remain, thus illustrating clearly the basic difficulties that need to be overcome:

Extract 2
S4: If you construct it and you on the other end won't necessarily construct the same one right. You are actually able to show me by constructing that question that you have taken the knowledge and everything that we have done over the course and you are able to apply it.
S3: Not necessarily. I think you are making an assumption. If I have to come up with… construct a calculus question I can tell you right now, honestly it will be the simplest question you could ever have. It will be page one of the textbook. Here you go.
S4: How is that any different from asking in science to construct a question and solve an independent investigation? How is that any different where you find a similar mathematical situation where you ask the question and you are actually helping drive your own learning through the same situation? How is that any different? Why separate the ideas of math from science?

Extract 2 reveals the difficulty that participants had reconciling their experiences of negotiating meanings and collaborating to construct definitions in COLE with traditional modes of assessment. The existence of this tension between prior assumptions about learning and recent experiences in COLE reveals that the conceptual change process is at least partially underway. The concept mapping activity, discussed in the next section, sheds some light on the conceptual change process.

6.3 Concept Mapping

6.3.1 What were we looking for?

The first task in the PBLO required the students to produce concept maps regarding their conceptions of argumentation and online learning. Concept maps were collected from the students before they

watched the video clips and again after the pilot test.

Concept maps were used in the study as a means of avoiding the often-time-consuming tasks of creating and scoring open-ended response surveys (Jackson & Trochim, 2002). Concept maps are graphical representations of the content and organization of individual's thoughts, constructed using pencil and paper, or as in this case study, an electronic application (Novak & Canas, 2008). Daley (2004) suggests that concept maps are useful in qualitative research since they help the researcher to "see participants' meaning, as well as, the connection that participants discuss across concepts or bodies of knowledge" (p.1). Concepts are usually drawn as words enclosed in boxes or circles and are arranged in ways that allow closely related concepts to be found relatively close to each other. These closely related ideas are then connected to each other using lines and arrows. Descriptions placed on the lines indicate the nature of inter-relationships between the concepts. In this study, two sets of concept maps were created (pre- and post-intervention) as a means of identifying cognitive changes which occurred in the thought structures of the subjects as depicted because of the student's use of the PBLO's within COLE environment. The initial set of concept maps created by the teacher candidates reflect the prior assumptions that each teacher candidate held regarding the terms ("argumentation" in one concept map and "online environments" in another) and therefore establish a baseline of knowledge as understood by everyone. The second concept maps display the changes in participant thought processes following engaging in the use of PBLOs within COLE environment (Kinchin & Hay, 2000).

The concept maps created in this study were analysed using a two-stage model developed by Kinchin & Hay (2000), Hay & Kinchin (2006, 2008) and Hay, Wells & Kinchin (2008). The two stages are characterized by the initial determination of concept map typology (chain, spoke or net) and subsequently identifying the quality of change that has occurred between the two concept maps (pre- and post-intervention) created by the participants using simple criteria (non-learning, rote learning and meaningful learning) (Hay, 2007; Hay et al., 2008).

The first step in analyzing the concept maps created by the participants was taken by applying the typology characteristics to each individual concept map. Concept maps have been classified into three types, depending on their organizational arrangement and characteristics (see Figure 6).

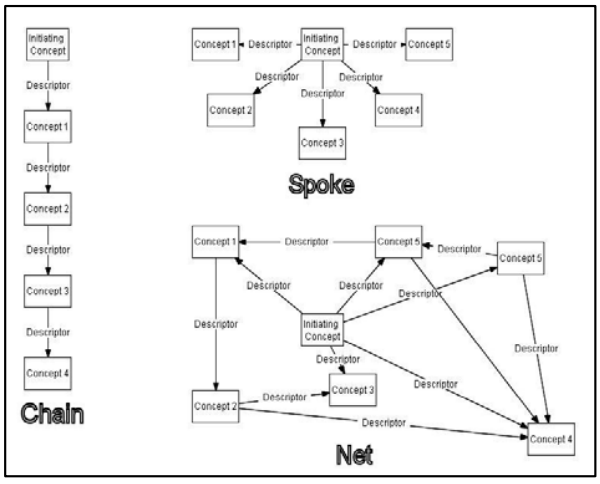


Figure 6: The three main concept map structures.

Spoke concept maps have concepts radiating from the central structure and indicate that the concepts are related in a simple association with no indication of interactions between the concepts. Chains consist of a hierarchy of terms that are related to each in a sequential fashion without any interactions with concepts, outside of the chain

of direct links. Nets display complex interactions as there are elements of chain and spoke concept maps found within the net with links between various concepts, not solely with the central (initiating term) nor with terms within a specific chain. The specific characteristics of each concept map type are found in Table 2.

The second step in the analysis process was to determine the quality of change which had occurred in the thinking of the participants as indicated in the changes to the structure and content of the second set of concept maps when compared to the first. To prepare the second set of concept maps, the participants were given the same instructions as they had for the initial set of maps, that is to create a concept map for each of the terms "argumentation" and "online learning". The participants were asked not to refer to the first set of concept maps as the researchers were interested in the addition/deletion of concepts following the intervention, as well as the reorganization which occurred. The second set of concept maps was identified using the typology criteria as was the first set.

	Concept Map Type		
	Spoke	Chain	Net
Hierarchy	One level only	Many levels, but often incorrect	Several justifiable
Processes	Simple association with no understanding of processes or interactions	Shown as a temporal sequence with no complex interactions or feedback	Described as complex interactions at different conceptual levels
Complexity	So little integration that concepts can be added without consequences for 'map integrity'	Map integrity cannot cope with additions, particularly near the beginning of the sequence	Map integrity is high. Adding one or more concepts has minor consequences as 'other routes' through the map are available.
Conceptual development	Shows little or no 'world view'. Addition or loss of a link has little effect on the overview.	Integrated into a narrow 'world view', suggesting an isolated conceptual understanding. Loss of a link can lose meaning of the whole chain.	Can support reorganization to emphasize different components to appreciate a 'larger world view' or to compensate for a 'missing' link

Table 3: Concept map typology characteristics. Modified from Kinchin & Hay (2000).

The two sets of concept maps were then matched according to participant and the initial term (argumentation or online learning) given. Each of the first concept maps within each pair was compared to the second, looking for the addition and/or deletion of terms and the reorganization and linking of terms which was changed from the first concept map. Changes of typology between the two concept maps were noted for some individuals (see Table 3).

6.3.2 What did we find?

In both cases, most students did not change their manner of representing and organising the concepts in the maps. The only exceptions to this were two students who changed from an initial spoke type concept map to a network approach after working through the "Argument" PBLO, (see Table 3). A similar result was obtained in the case of the students working through the "online learning" PBLO, with only two exceptions, one going from spoke to

network and one doing the reverse, going from network to spoke.

Judgements regarding the quality of changes which occurred beyond the changes in typology were made between the pairs of concept maps. This was done again by the three members of the research team using the following criteria, as developed by Hay & Kinchin (2008):

- Non-learning. Was defined by an absence of cognitive change. Non-learning was therefore measured by the lack of new concepts in the second map and by an absence of new links in the extant prior knowledge structure.
- Rote Learning. Was defined in two ways. First by the addition of new knowledge. Second by absence of links between the newly acquired concepts and those parts of the prior knowledge repeated in the second map.
- Meaningful Learning. Was defined by a non-trivial change in the knowledge structure. Thus, evidence of meaningful learning comprised the emergence of new links in parts of the prior knowledge structure developed in the course of learning and/or the meaningful linkage of new concepts to parts of the pre-existing understanding (Hay & Kinchin, 2008, p. 173).

Here most of the students who produced a network style of concept map, were deemed to have met the criteria of Meaningful Learning, whereas the spoke concept maps were judged to indicate more rote learning according to the Hay & Kinchin (2008) typology.

Argumentation, *N*=23	Post			
		Spoke	Chain	Network
Pre	Spoke	13	-	2
	Chain	-	-	-
	Network	-	-	8
Online learning, *N*=25	Post			
		Spoke	Chain	Network
Pre	Spoke	10	-	1
	Chain	-	-	-
	Network	1	-	13

Table 4: Concept map categorization and comparison between Pre- and Post-

A binomial test was performed but, as expected, showed no statistically significant difference. We are thus forced to reject any hypotheses suggesting that using PBLOs would foster any measurable change in how students would represent the resulting constructed knowledge in concept maps. On the other hand, we can also conclude that the Collaborative Online Learning Environment, as well as the PBLO's basic design, did not present any effect on the learners' abilities to deal with the issues presented in this technological environment. Although no real content was presented by the PBLOs, and although this intervention was the first time that students were introduced to both COLE and the PBLOs, students did not seem to require particular IT competencies to navigate and manipulate the Collaborative Online Learning Environment. Thus, the environment did not appear to have any negative effects on the potential learning that was set as an objective for the PBLOs.

Although not statistically significant, it is also to be noted that most of the changes that did occur in this small sample, were on the positive side. In the case of the Argumentation concept maps, 2 of the 13 students who started with a spoke concept map changed their concept map to a more network configuration in the second iteration where none did the reverse. In the case of the Online Learning concept maps, two students did change, one in each direction.

6.4 Focus group after session (with Repertory Grids)

6.4.1 What were we looking for?

A few days following the pilot session, a focus group of eight students was convened. The students in the focus group were asked to participate in a discussion devised to identify a series of constructs and elements related to the construction and use of online environments. Most of the discussion revolved around the question that was posed to the group: What would you say are the most important factors to be considered when planning a university level course to be delivered online? This question was used for the elicitation of the characteristics of the topic, or elements, and then the students were asked to determine how they would measure the extent to which they had considered the identified elements, as a means of generating the required constructs. The constructs and the elements were used by the students to produce independent repertory grids. The focus group session was video recorded and subsequently transcribed.

To gain some insight into both the predispositions that teachers bring to bear on their conceptions of teaching and to determine if there had been any shift in the predispositions of the teachers during the lifetime of the project, the Repertory Grid technique was employed. A focus group of 8 participating teacher candidates was drawn out of the pool of students participating in the pilot study. The set of grid responses was completed during the focus group meeting in November 2007, a few days following the sessions where the PBLO/COLE was used. Repertory Grids are drawn from the Personal Construct Theory (PCT) of George Kelly (Bencze, 2000; Feixas & Alvarez, 2000). The Grid is designed to:

> capture the dimensions and structure of personal meaning. Its aim is to describe the ways in which people give meaning to their experience in their own terms. It is not so much a test in the conventional sense of the word as a structured interview designed to make those constructs with which persons organise their world more explicit. The way in which we get to know and interpret our milieu, our understanding of ourselves and others, is guided by an implicit theory which is the result of conclusions drawn from our experiences. The repertory grid, in its many forms, is a method used to explore the structure and content of these implicit theories/personal meanings through which we perceive and act in our day-to-day existence (Feixas & Alvarez, 2000).

The description which follows is adapted from Bencze (1995). The technique used in this study is a graphical and numerical, computer generated (web-based) grid, which can be accessed at http://grid.eilab.ca (Gaines & Shaw, 2003). It allows the user to illustrate relationships that exist in the user's mind between elements and constructs. The elements are defined as characteristics or instances of the topic, in this case COLE. The elements are produced as a list of characteristics of COLE, which was created by the participants using a brainstorming process. The constructs are the two contrasting poles of a continuum (e.g., hinders community <–> promotes community) which are used by the teacher to make sense of the elements. Constructs are considered to be idiosyncratic. The teacher determines the location (1 - 9) between the two extremes of the 'construct' using a numbered scale. For instance, using the 1-9 scale, the teacher might suggest that the element 'communication' should be rated as an 8 on the construct 'hinders community <-> promotes community'. By doing this the teacher is describing, in explicit terms, his/her beliefs and understandings that communication is an important element when attempting to promote community (Bencze, 1995, 2000).

While several mechanisms can be used to elicit the constructs and elements from the teachers in the development phase of repertory grid analysis, the technique chosen was to use a manual method of elicitation that involved each of the teachers using a pen and a paper form. As a group, the students were asked to consider a series of questions which were designed to elicit the elements and constructs. The questions used included: What would

you say are the most important factors to be considered when planning a university level course to be delivered online? Which of these is most likely to impact the success of such courses? During the discussion based on the questions, the teachers were asked to make a list of characteristics of COLE (elements). This initial list was shortened to 8 by the entire group. 2 additional elements could be added by the individual teacher. The group then brainstormed and agreed upon a set of 10 constructs. These constructs were written into the grid on the paper, one pole of the construct on each end of the 9-point scale. The teachers were asked to rate each of the elements against the constructs by placing the number associated with the ‘element’ into the appropriate place on the 1-9-point scale between each of the constructs.

The teachers were then asked to explain why they rated the strategy as they did. The explanations were recorded and were available for analysis along with the paper grids (Bencze, 1995). The paper grid results were transferred into WebGrid by the research team. The resulting grids and the analyses of the grids were stored on a laptop computer. Reading the grids involves taking note of the numbers in each ‘cell' or grid square: numbers below 5 indicate an association with the pole on the left hand of the construct; numbers above 5 indicate an association with the right pole of the construct. The number 5 would indicate that the person completing the grid felt that the element was equally associated with both poles of the ‘construct'.

Using the FOCUS option in WebGrid, it is possible to analyze the responses in greater detail. In the example illustrated in Figure 7, Brian (a pseudonym) gave ‘cost' a rating of 7 on the ‘experimental <–> non-experimental' construct. This indicates that Brian thought that the costs associated with using COLE allowed for it to be used in an experimental fashion. This element, ‘cost', was also given a rating of 6 on the ‘individual <-> corporate (group)' continuum. In other words, there is a high correlation between the two ‘constructs' for this specific ‘element'. This is indicated by the point where the lines, extended to the right from the ‘constructs', intersect with the grid which is printed on the top of the complex of lines. The intersection point is approximately 92.5%, indicating the strong relationship that exists between these two ‘constructs'. A similar analysis can be seen for the ‘elements' as well. Here, again referring to the example given in Figure 7, a strong relationship (approximately 90%) is indicated between authenticity and technology. This may be interpreted as a belief that the technologies used in COLE allow it to display an authentic portrayal of the classroom (for the argumentation PBLO).

Taking all the associations represented in a repertory grid into account, a representation of a person's value system (at the time of the elicitation) with respect to the concepts alluded to in the ‘elements' and ‘constructs' (characteristics of COLE and how these characteristics help the teacher candidates interpret the characteristics) may be constructed. However, it is important to be aware that these interpretations are tentative and must be corroborated with evidence collected by other means.

While the overall reliability and validity of individual Repertory Grids remains an issue (Gaines & Shaw, 2003), the tool did provide some insight into individuals' personal constructs. In addition, Repertory Grids may provide access to changes in teacher attitudes towards the issues about the construction and use of sophisticated online technologies to support teacher professional learning.

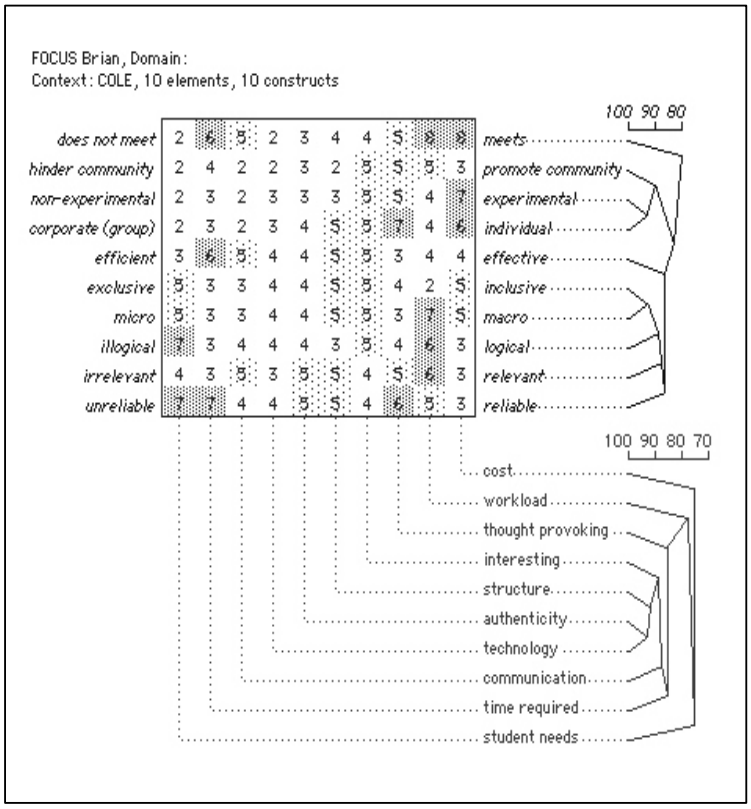


Figure 7: Brian's repertory grid depicting his thinking about his use of COLE during the pilot study.

Unfortunately, while the analysis of the resulting grids was straight forward, the interpretation of these same grids was inconclusive as there were no consistent strong correlations between individual student responses. Consequently, we decided to return to the video recording of the focus group session to determine if any insights could be derived from the responses of the students with respect to the element and construct elicitation process.

To do this, the text transcript of the focus group session was fed into a word cloud application. This type of application creates a "visual depiction of words. The more frequent the word appears within the text being analyzed the larger the word becomes. A word cloud plots word frequency by the size of the word" (Ramsden & Bate, 2008, p. 1). The largest words as indicated by the word cloud, were subsequently sought in the transcript document. Instances of student use of these specific terms within the transcript were noted and compiled. These instances were analyzed using a grounded theory approach (Glaser & Strauss, 1967; Strauss & Corbin, 1990) and themes could arise from the instances in which the terms were used (Lincoln & Guba, 1985, p. 41).

6.4.2 What did we find?

The most frequently appearing words, as identified in the word cloud (see Figure 8), found in the focus group session, in order of size, included: 'going', 'course', 'technology', 'think', 'got', 'needs', 'one', 'want', 'student', 'online', 'different' and 'planning'. Several of these words,

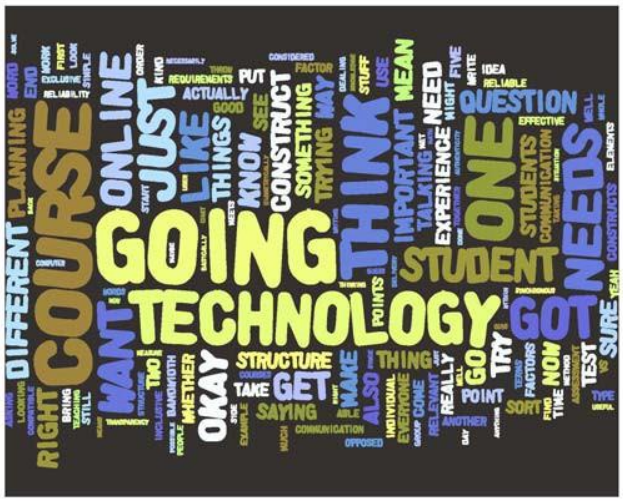


Figure 8: Word cloud produced based on repertory grid focus group transcript.

such as ‘going’, ‘got’, ‘think’, ‘student’, ‘one’, ‘want’, and ‘different’ were used frequently by the students in the group as a manner of speaking.

No significance could be found arising from their use during the discussion, with respect to the questions under consideration for the elicitation of either elements or constructs. The term ‘course’ was used frequently but it was impossible to distinguish themes that were specifically related to this term as it was usually used in the same context as ‘technology’, ‘online’ or ‘planning’, consequently the term will not be reported here separately. Similarly, ‘needs’ was typically used within the context of student needs which needed to be addressed. There was not sufficient diversity to identify any specific theme with this term. Excerpts from the discussion will be reported, rather than every occasion when the students used each of the terms, to portray the theme which emerged.

When discussing the ‘technology’ in online courses, the students seemed to focus on the idea that the technology should recede or disappear so that student work within the online environment or ‘course’.

> Some students might really want to take this course but they are being held back due to the technology. (Participant 2)
>
> It [the technology] needs to be very simply laid out so that you can focus on the course and not try to get through the technology. (Participant 3)
>
> The technology [needs to be simple] so that you can focus your ideas on the course. The technology you're just using it as a tool. (Participant 4)
>
> It should be an applicable technology and as a tool not be a hindrance to the ... It shouldn’t overshadow the actual content of the course. It should complement it and assist. (Participant 5)
>
> It shouldn’t take away from the content of the course. It should complement it, rather than you know, just

> because you can doesn't mean that you should have that kind of technology in there unless it complements the course. (Participant 6)

These excerpts recall Jonassen's (1996) concept of learning with technology or using technology as mind tools. Mind tools are digital technologies which support learning such that "learners and technologies should be intellectual partners in the learning process, when the cognitive responsibility for performing is distributed to the part of the partnership that performs it the best" (Jonassen, Peck, Wilson 1999, p.12). In this case, the digital space within which the online course exists should provide the tools for communication, file production and processing so that the students can concentrate on thinking and developing skills as required by the activities set within the course. If the technology intrudes into the student's thinking processes, because of poor choice, design or execution, then the technology is not sufficiently transparent.

While considering the impact of teaching in an 'online' course structure, the students had some difficulties in describing what an online course would look like, even though they had experienced COLE.

> Are you going to [conduct an online course] with reading? Are you going to do it with recorded lectures? Are you going to do it with discussions online? So what's the delivery method that's going to be used to deliver the course, I guess is what I'm saying? (Participant 7)

> I also think that bandwidth considerations that do exist should also be factored in because they are going to limit the delivery method. If you want to [view] an online video live and you don't have the bandwidth that's not going to work very well so you sort of have to factor those in. (Participant 8)

> I'm going to plan this online course but if the appropriate educational experience is not possible through an on- line course, should I even deliver it? Is it the right way to do it? (Participant 9)

> If I put two people in a room and one took it online and one took it face-to-face, shouldn't they have been able to construct similar types of knowledge in the same types of courses? (Participant 10)

> I think, the point is if they want to cheat [while engaged in traditional testing], they are going to find a way, no matter what, whether they are sitting with MSN open and they are still doing the online course at the same time and talking. The point is at some point you've got to rely on people's integrity. (Participant 11)

Focus group participants continued to think about online courses as efficient delivery methods for content to students who were at a distance to the instructor. These ideas are particularly striking when the final comment in this group read. The student acknowledges that there are some inherent issues with traditional testing methodology when placed in an online setting. It is acknowledged that if the structure of the online experience is not changed then instructors must rely on the ethical integrity of the learners. The teacher candidates have not realized that their definition of learning is a matter of presenting information to learners and then asking the learners to reiterate that information in a formal testing situation.

The discussion regarding 'planning' in an online environment followed a similar path to the discussion about online courses. The students attempted to reconcile notions of traditional face-to-face courses while using online settings.

> I guess the other thing is, what are the requirements, if I was going to teach this course, not online, what would my requirements be? And do those change when I turn to an on-line course, in terms of planning? (Participant 12)

> If I'm planning a course and I was going to do it in a classroom, and what would I do and what are the

> requirements I would have of my students? Should those requirements really change if I'm going to an on-line situation or do I still want the students to get the same amount of stuff, the same experience out of it as if they were in the classroom. (Participant 13)
>
> Maybe when you are planning that is what you need to consider is some of those bigger [assessment activities], be it culminating tasks or be it authentic assessment or whatever it is to be done in order to evaluate appropriately for that type of course. (Participant 14)

It is clear from the comments that part of the difficulty students was having was related to their relative inexperience with the online setting and with teaching in general. They assumed that an online course would have a similar structure and experience to a face-to-face course and that each class in a face-to-face environment is different so that even if, as the second comment implies, the instructor wanted to provide the same experience to the learners, this is impossible to do. The short period of time available to them through the pilot study was not sufficient to orient them to alternative experiences.

Through the repertory grid focus group session discussion, the participating teaching candidates could identify elements, such as student needs, technology, structure, communication, authenticity, and constructs, such as relevance, efficiency, reliability, promotion of community, and inclusivity. They wrestled with the notions of online courses and the impact that a change of environment would have on the nature of learning. However, the teacher candidates were not able to reach the conclusion that the structure of online environments need to be radically different from face-to-face classrooms to meet the needs of the learners and do justice to notion of using technology as mind tools.

7.0 Conclusions

It is important to consider that this paper presents the results of a very short pilot study intended more to explore than to conclude. As initially expected, the pilot study was by no means long enough to foster the kinds of changes that would be desired. Nonetheless, it demonstrated that the developed tools are useable by students, and it would suggest that further investigation with larger samples over a longer period is warranted.

Overall, the initial reactions centred on two fronts, one being the technical issues and the second on more pedagogical aspects surrounding the COLE. On the technical question, the servers used for the main part of COLE were insufficient to handle the number of students, even in this limited experiment. Most of the delays experienced either in loading of certain elements or the lag in the online Chat, was due to a technical issue with servers that can easily be addressed in future trials.

The wiki was also problematic because it did not manage the entries as it should have. This also was an easy fix after the trial. Despite these difficulties, the concept was understood by the participants and sufficient interest and understanding as to its purpose was shown to suggest that the wiki tool should remain central to COLE.

Although COLE is designed to foster collaboration and for collective knowledge construction to occur, it should be noted that the task design, the presentation of the problems and the actual participation of the learner in the learning community is what drives the learning process. We caution against adopting a traditional framework for understanding COLE, as it might lead us to simply adding more features to the environment, as though an increase in tools would equate to increasing its potential as a learning tool. At worst, COLE could devolve into a transmission-based teaching tool like other well-known course management systems. At best, we see the potential of COLE to facilitate the kind of collaborative learning that we believe is central for a 21st-century citizenry.

The prototype of this COLE was constructed in a relatively short time using the Moodle platform and many open source plugins were used. The central idea was to attempt to produce an online learning environment that would be solidly based in learner-driven process-centered paradigm with a clearly social-constructivist perspective. The prototype, presently used in trials, has been shown to offer good potential to support a problem based learning approach as users, in a very short time, have shown some awareness of difference and of change. What remains to be examined, thus outstanding as the principal focus of this research, is the question: Can the use of PBL set in a Collaborative Online Learning Environment, deeply rooted in a social constructivist perspective, have any effect on teacher's individual representation of "learning" and maybe "pedagogy"?

The time available to use the PBLO within the pilot testing sessions was extremely short and consequently the responses were minimal. It remains to be seen if the four-page structure described here will be effective in allowing in-service teachers to examine and reflect on issues of importance to their professional career and their practice. Although five additional PBLOs were recorded in response to requests that arose within this project, only two of these have been implemented within the COLE environment. The remaining three have yet to be fully edited and restructured into PBLOs before they can be used. While there is potential to have these PBLOs used within professional learning programs, there have not yet been opportunities to do so.

Savin-Baden (2007) provides a vision for the integration of problem-based learning and online learning environments. She labels systems which integrate these concepts as 'computer-mediated collaborative problem-based learning (CMCPBL)' environments (p. 23). According to Savin-Baden, these CMCPBL environments should be focused on a 'team-oriented knowledge building discourse,' rather than concentrating on teacher-directed, content-centred methods and they should exemplify the three characteristics of this type of discourse:

- focus on problem scenarios and depth of understanding
- open knowledge building that focuses on collective knowledge so that inquiry is driven by a quest of understanding
- an inclusion of all participants in the broader knowledge community, this learning involves students, teachers, administrators, researchers, curriculum designers and assessors (Scardemalia & Bereiter 1994).

PBLOs embedded within the context of COLE was designed to embody a process centred, learner- driven approach (Desjardins & vanOostveen, 2009). The PBLOs serve to orient the learner to specific contexts and situations within which problems can be found through discourse with others within the learning community. Overall the PBLO/COLE environment seems to be a direct answer to the CMCPBL call to action.

Our preliminary research has called attention to the potential ability of PBLO/COLE to disrupt conventional, transmission-based conceptions of online learning as content delivery. At the same time, however, our preliminary work has also indicated that learners who are not used to the collaborative opportunities provided within PBLO/COLE may still hold traditional orientations to teaching and learning as a "gold standard" to which all other options are compared. A purposeful direction for our future research will entail not only presenting PBLO/COLE as an answer to the CMCPBL call to action, but also to working with learners in PBLO/COLE over a sustained period so that they may engage in an online experience grounded in principles of socio-constructivism.

8.0 References

Anderson, T. (2008). Towards a theory of online learning. In Anderson, T. (Ed.). *Theory and practice of online learning* (2nd ed.). Edmonton: Athabasca University Press.

Barone, C. (2005). The New Academy. In Oblinger, D.G. & Oblinger, J.L. (Eds.), *Educating the Net Generation*. Retrieved January 1, 2010 from http://net.educause.edu/ir/library/pdf/pub7101n.pdf

Bell & Gilbert (1994). Teacher development as professional, personal, and social development. *Teaching and Teacher Education* 10(5), 483-497.

Bencze, J.L. (1995). *Towards a more authentic and feasible science curriculum for secondary schools*. Unpublished PhD Thesis, University of Toronto.

Bencze, L. (2000). *Repertory grid technique for eliciting individual's conceptions*. Unpublished.

Bencze, L., Hewitt, J. & Pedretti, E. (2001). Multi-media case methods in pre-service science education: Enabling an apprenticeship for praxis. *Research in Science Education* 31(2), 191-209.

Bijker, W., (1987). The social construction of facts and artifacts: Or how the sociology of science and the sociology of technology might benefit each other. In Bijker, W., Hughes, T. & Pinch, T. (Eds.). *The social construction of technological systems: New directions in the sociology and history of technology*, Cambridge, MA: MIT Press, 17-50.

Bransford, J., Brown, A., & Cocking, R. (1999). *How people learn: Brain, mind experience and school*. Washington, DC: National Research Council. Retrieved January 2, 2010 from http://books.nap.edu/openbook.php?record_id=9853&page=23

Burnaford, G. (1999). *Teacher action research as professional development in schools: four paths to change. School wide inquiry: a self-study of an "outside" teacher researcher*. Opinion Paper presented at the Annual Meeting of the American Educational Research Association, Montreal, PQ., April.

Carr, W. & Kemmis, S. (1986). *Becoming critical: Education, knowledge and action research*. Lewes: Falmer Press.

Cannings, T.R. & Talley, S. (2002). Multimedia and online video case studies for preservice teacher preparation. *Education and Information Technologies*, 7(4), 359-367.

Conference Board of Canada, (2006) *Employability Skills 2000+*. Retrieved Sep. 15, 2008 from http://www.conferenceboard.ca/education/.

Copeland, W.D. & Decker, D.L. (1996). Video cases and the development of meaning making in preservice teachers. *Teaching & Teacher Education* 12(5), 467-481.

Couros, G. (2015). Professional development and professional learning #miamidevice. *The Principal of Change: Stories of learning and leading.* Retrieved from https://georgecouros.ca/blog/archives/5791

Daley, B.J. (2004). Using concept maps in qualitative research. In Canas, A.J., Novak, J.D. & Gonzalez, F.M. (Eds.), Concept maps: Theory, methodology, technology. *Proceedings of the First International Conference on Concept Mapping*, Pamplona, Spain.

Dede, C., Brown-L'Bahy, T., Ketelhut, D., & Whitehouse, P. (2004). Distance Learning (Virtual Learning). *The*

Internet Encyclopedia, Hoboken, New Jersey: John Wiley & Sons, Inc., 558, 2004.

Dede, C., Ketelhut, D.J., Whitehouse, P., Breit, L. & McCloskey, E.M. (2009). A research agenda for online teacher professional development. *Journal of Teacher Education*, 60(1): 8-19.

Desjardins, F. J., (2005) La représentation par les enseignants, quant à leurs profils de compétences relatives à l'ordinateur : vers une théorie des TIC en éducation , *La revue canadienne de l'apprentissage et de la technologie*, Vol. 31 (1) 27-49.

Desjardins, F. J., Lacasse, R. & Bélair, L. M., (2001). Toward a definition of four orders of competency for the use of information and communication technology (ICT) in *Education, Computers and Advanced Technology in Education: Proceedings of the Fourth IASTED International Conference*, Calgary : ACTA Press, pp. 213-217.

Desjardins, F.J. & vanOostveen, R. (2008a). Collaborative Online Learning Environment: Towards a process driven approach and collective knowledge building. Proceedings of *the Ed-Media Conference on Education Multimedia, Hypermedia & Telecommunications*, Vienna, Austria, June 30 - July 4, 2008, CDROM.

Desjardins, F.J. & vanOostveen, R. (2008b). Implementing PBL online as a collaborative learning strategy for teachers: The COLE. A presentation at *The Eleventh IASTED International Conference on Computers and Advanced Technology in Education*, September 29 – October 1, 2008, Crete, Greece.

Desjardins, F.J. & vanOostveen, R. (2009). *Research focus for EILab*. Retrieved January 29, 2010 from http://eilab.ca/spip/spip.php?rubrique3.

Feixas, G. & Alvarez, J.M.C. (2000). *A manual for the repertory grid.* Retrieved June 1, 2003 from http://www.terapiacognitiva.net/record/pag/contents.htm.

Fogarty, R. (1997). Problem Based Learning and Other Curriculum Models for the Multiple Intelligences Classroom. Australia: Hawker Brownlow Education.

Fullan, M. (Ed.) (1992). *Successful school improvement: The implementation perspective and beyond*. Buckingham: Open University.

Fullan, M. (1993). *Change forces: Probing the depth of educational reform*. Lewes: Falmer.

Fullan, M. (2005). Leadership & sustainability: System thinkers in action. Corwin Press: Thousand Oaks.

Fullan, M. & Miles, M.B. (1992). Getting reform right: what works and what doesn't. *Phi Delta Kappan*, 73(10), 744-52.

Gaines, B.R. & Shaw, M.L.G. (2003). *Repertory Grids: WebGrid III*. Retrieved April 5, 2003 from http://gigi.cpsc.ucalgary.ca/WebGrid/.

Goldman-Segall, R. (1998). *Points of viewing children's thinking*. Mahwah, NJ: Lawrence Erlbaum Associates.

Halpern, D.F. & Hakel, M.D. (2003). "Applying the Science of Learning to the University and Beyond: Teaching for Long-Term Retention and Transfer," *Change: The Magazine of Higher Learning*, (July-August, 2003): 37-38.

Harvard Business Publishing (2002). *Harvard Business Publishing Brief Cases*. Retrieved January 1, 2010 from http://hbsp.harvard.edu/llist/brief-cases.

Hay, D.B. (2007). Using concept maps to measure deep, surface and non-learning outcomes. *Studies in Higher Education*, 32(1), 39-57.

Hay, D.B. & Kinchin, I.M. (2006). Using concept maps to reveal conceptual typologies. *Education + Training*, 48 (2/3), 127-142.

Hay, D. & Kinchin, I. (2008). Using concept mapping to measure learning quality. *Education + Training*, 50(2), 167-182.

Hay, D.B., Wells, H. & Kinchin, I.M. (2008). Quantitative and qualitative measures of student learning at university level. *Higher Education*, 56, 221-239.

Hedberg, J. (2008). Framing learning activities for the effective use of ICT. In Yelland, N.J., Neal, G. & Dakich, E. (Eds.). *Rethinking education with ICT: New directions for effective practices*, Rotterdam: Sense, 31-44.

Hewitt, J., Pedretti, E., Bencze, L., Vaillancourt, B.D. & S. Yoon (2003). New applications for multimedia cases: Promoting reflective practice in preservice teacher education. *Journal of Technology and Teacher Education* 11(4), 483-500.

Hillman, W. (2003). Learning How to Learn : Problem Based Learning. Australian Journal of Teacher Education, 28(2).

Jackson, K.M. & Trochim, W.M.K. (2002). Concept mapping as an alternative approach for the analysis of open-ended survey responses. *Organizational Research Methods*, 5(4), 307-337.

Johnson, T., Wisniewski, M. A., Kuhlemeyer, G., Isaacs, G., & Krzykowski, J. (2012). Technology adoption in higher education: Overcoming anxiety through faculty bootcamp. *Journal of Asynchronous Learning Networks*, 16(2), 63-72.

Jonassen, D.H. (1996). *Computers in the classroom: mintools for critical thinking*. New Jersey: Prentice-Hall.

Jonassen, D.H. & Carr, (2000). Mindtools: Affording multiple knolwedge representations for learning. In Lajoie, S.P. (2000). *Computers as cognitive tools: No more walls - Vol. II*, New Jersey: Lawrence Elbaum Associates.

Jonassen, D.H., Peck, K.L. & Wilson, B.G. (1999). *Learning with technology: A constructivist perspective*. New Jersey: Prentice-Hall.

Kenny, R., Bullen, M., Loftus, J. (2006). A pilot study of problem formulation and resolution in an online problem-based learning course. *The International Review of Research in Open and Distance Learning*, 7(3).

Kinchin, I.M. & Hay, D.B. (2000). How a qualitative approach to concept map analysis can be used to aid learning by illustrating patterns of conceptual development. *Educational Research*, 42(1), 43- 57.

Kurz, T.L., Batarelo, I. & Middleton, J.A. (2009). Examining elementary preservice teachers' perspectives concerning curriculum themes for video case integration. *Educational Technology Research and Development* 57, 461-485.

Levy, P. (1994). *L'intelligence collective: Pour une anthropologie du cyberespace*, Paris: La Découverte, 246 pages.

Lloyd, S. A., Byrne, M. M., & McCoy, T. S. (2012). Faculty-perceived barriers of online education. *Journal of online learning and teaching*, 8(1), 1.

Longino, H. (1994). The fate of knowledge in the social theories of science. In Schmitt, F.T. (Ed.), *Socializing Epistemology: The Social Dimensions of Knowledge*. Lanham, MD: Rowman & Littlefield.

Louden, W., Wallace, J. & Groves, R. (2001). Spinning a web (case) around professional standards: Capturing the complexity of science teaching. *Research in Science Education* 31: 227–244.

Martin, A. (2006). Literacies for the digital age: Preview of Part 1. In A. Martin & D. Madigan (Eds.), *Digital literacies for learning*, (pp. 3-25). London, UK: Facet Publishing.

McPhee, A.D. (2002). Problem-based learning in initial teacher education: Taking the agenda forward. *Journal of Educational Enquiry*, 3(1), 60-77.

McPherson, M., Nunes, M. B. (2004). *Developing Innovation in Online Learning: an Action Research Framework*, London, UK: Routledge.

Mouza, C. (2003). Learning to teach with new technology: Implications for professional development. 35 (2): 272-289.

Newton, P., Driver, R. & Osborne, J., (1999) The place of argumentation in the pedagogy of school science. *International Journal of Science Education* 21(5): 553–576.

Novak, J.D. & Canas, A.J. (2008). The theory underlying concept maps and how to construct and use them. *Technical Report IHMC CmapTools 2006-01 Rev 01-2008*. Florida Institute for Human and Machine Cognition. Retreived on October 2, 2009 from http://cmap.ihmc.us/Publications/ResearchPapers/TheoryUnderlyingConceptMaps.pdf

Olson, J.K. (1990). Teachers' conceptions of their subject and laboratory work in science. In Hagarty- Hazel, E. (Ed.) *The student laboratory and the science curriculum*. London: Routledge.

Ontario College of Teachers (1999). *Standards of practice for the teaching profession*. Toronto: Council of the Ontario College of Teachers.

Ontario Institute for Studies in Education of the University of Toronto (2003). Retrieved August 20, 2004 from http://ro.oise.utoronto.ca/BulPage90.htm.

Papert, S. (1980). *Mindstorms: Children, Computers and Powerful Ideas*. New York: Basic Books. Pedretti, E.G.,

Bencze, L., Hewitt, J., Romkey, L. & Jivraj, A. (2008). Promoting issues-based STSE perspectives in science teacher education: problems of identity and ideology. *Science & Education* 17: 941-960.

Pettenati, M.C., Cigognini, M.E., Mangione, G.R., & Guerin, E. (2009). Personal knowledge management skills for lifelong-learners 2.0. In *Social Software and Developing Community Ontology*. IGI Global Publishing. Information Science Reference. Retrieved from http://www.igi- global.com/reference/details.asp?ID=33011.

Piaget, J. (1972). *Psychology and epistemology: Towards a theory of knowledge*. Harmondsworth: Penguin.

Piaget, J. (1977). *La construction du réel chez l'enfant* (sixième édition). Paris : Delachaux et Niestlé.

Pedretti, E., Bencze, L, Hewitt, J., Perris, K. & vanOostveen, R. (2006). Improving elementary preservice science teachers' self-efficacy beliefs through the use of cases and case- methods. *Journal of Science Teacher Education*, 17(1)

Pinch,T. (1996). The social construction of technology: A review. In *Technological change: Methods and themes in the history of technology*, edited by Robert Fox, Australia: Harwood Academic Publishers. 17-35.

Popper, K. (1963). *Conjectures and Refutations: The Growth of Scientific Knowledge*. New York: Routledge.

Popper, K. (1972). *Objective knowledge: An evolutionary approach*. Toronto: Oxford University Press.

Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: Toward a theory of conceptual change. *Science Education*, 66(2), 211-227.

Ramsden, A. & Bate, A. (2008). Using Word Clouds in Teaching and Learning. Retrieved January 26, 2010 from http://opus.bath.ac.uk/474/1/using%2520word%2520clouds%2520in%2520teaching%2520and%2520learning.pdf

Rey-Lopez, M., Brusilovsky, P., Meccawy, M., Diaz-Redondo, R., Fernadez-Vilas & Ashman, H. (2008). Resolving the Problem of Intelligent Learning Content in Learning Management Systems. *International Journal on E-Learning* 7(3), 363-381.

Sagor, R. (1992). *How to conduct collaborative action research*. Alexandria, Virginia: Association for Supervision and Curriculum Development.

Sarason, S.B. (2002). *Educational reform: A self-scrutinizing memoir*. New York: Teachers College Press.

Savin-Baden, M. (2007). Challenging models and perspectives of problem-based learning. In *Management of change: Implementation of problem-based and project-based learning in engineering*, edited by de Graaff, E. & Kolmos, A., Rotterdam: Sense Publishing.

Scardemalia, M. & Bereiter, C. (1994). Computer support for knowledge-building communities. *The Journal of the Learning Sciences*, 3(3), 256-283.

Shaw, Michael (October 2003), "(Contextual and Mutated) Learning Objects in the Context of Design, Learning and (Re)Use", Teaching and Learning with Technology. Retrieved from http://www.shawmultimedia.com/edtech_oct_03.html

Siemens, G. (2009). *Socialization as information objects*. Retrieved August 20, 2004from http://www.connectivism.ca/?p=127.

Tagg, J. (2012). Why does the faculty resist change? Change: The Magazine of Higher Learning, 44(1), 6-15.

The Faculty of Education at York University (2003). Retrieved August 20, 2004 from http://www.edu.yorku.ca.

VandenBerg, E. (2001). An exploration of the use of multimedia cases as a reflective tool in teacher education. *Research in Science Education* 31: 245–265.

vanOostveen, R. (2005). *Using action research for teacher professional development: Research in science and technology education*. Unpublished PhD Thesis. Toronto: The Ontario Institute for Studies in Education, The University of Toronto.

vanOostveen, R., Desjardins, F., Bullock, S., DiGiuseppe, M. & Robertson, L. (2010). Towards a reconceptualization of online teacher professional learning: Problem-based learning objects (PBLOs). In J. Herrington & C. Montgomerie (Eds.), Proceedings of ED-MEDIA 2010--World Conference on Educational Multimedia, Hypermedia & Telecommunications (pp. 1579-1588). Toronto, Canada: Association for the Advancement of Computing in Education (AACE). Retrieved December 20, 2017 from https://www.learntechlib.org/p/34849/.

Volery, T. & Lord, D. (2000), Critical success factors in online education, The International *Journal of Educational Management*, 14 (5), pp. 216-223

Von Glasersfeld, E. (1995). *Radical constructivism: A way of knowing and learning*. London; RoutledgeFalmer.

Vygotsky, L. (1978). *Mind in society*. London: Harvard University Press.

Vygotsky, L., (1986) *Thought and Language*, Cambridge, Massachusetts: The MIT Press, 352 pages.

Watts, M. (1991). *The science of problem-solving.* London: Cassell.

Wagner, E.D. (1994). In support of a functional definition of interaction. *The American Journal of Distance Education*, 8(2), 6-26.

Wenger, E. (1987). *Artificial Intelligence and Tutoring Systems: computational and cognitive approaches to the communication of knowledge.* San Francisco: Morgan Kaufmann.

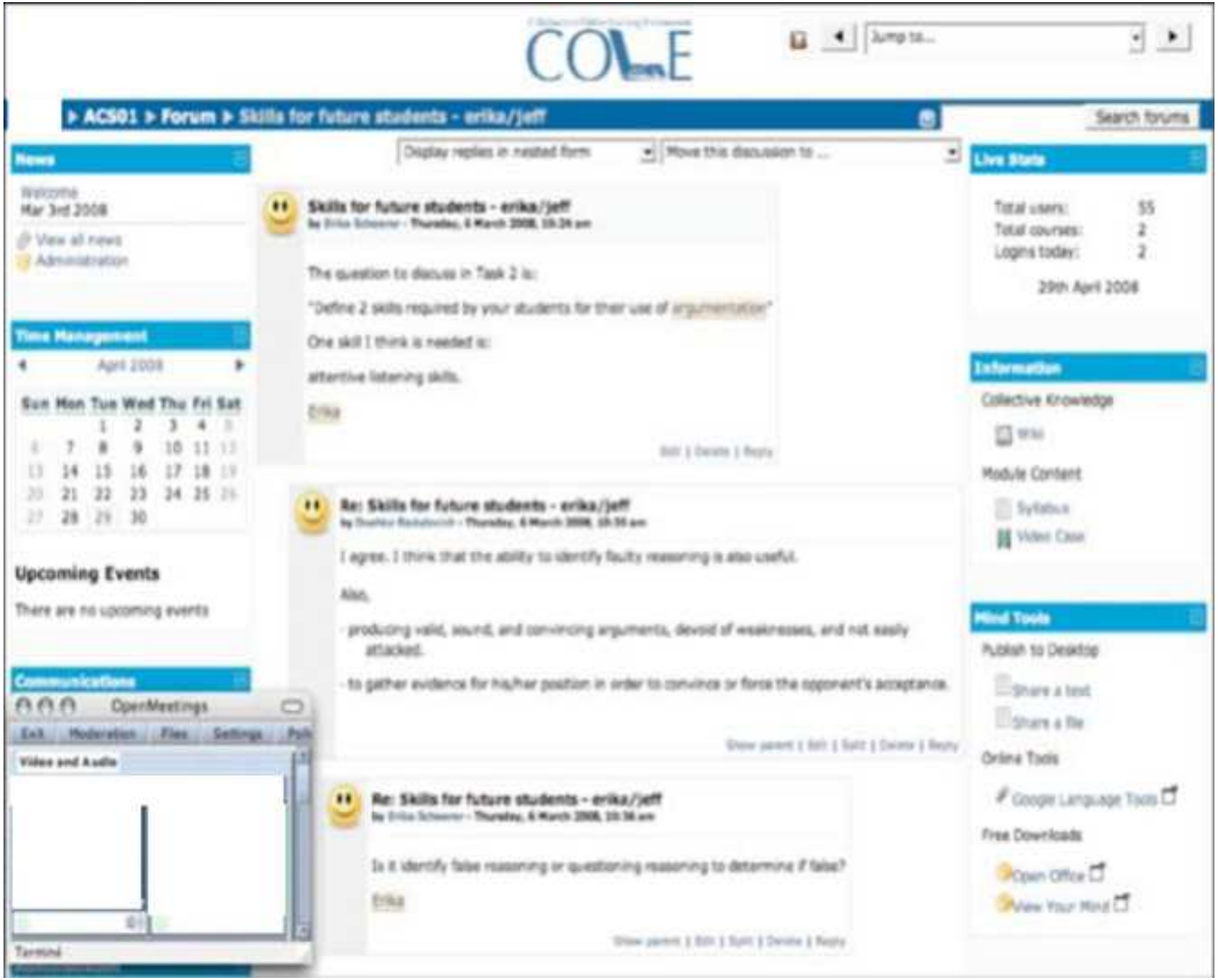
Wenger, E. (1999). Learning as Social Participation, *Knowledge Management Review*, 6, p. 30 - 33

Wenger, E. (2000). Communities of practice and social learning systems. *Organizations* 7(2), 225-246.

Western Governors University (2014). Professional Development vs. Professional Learning: How To Become A Better Teacher. *The Night Owl Blog*. Retrieved from https://www.wgu.edu/blogpost/professional-development-vs-professional-learning-teachers#

Williams, R. & Edge, D. (1996). The Social Shaping of Technology. *Research Policy*, 25, 856-899. Yoon, S.,

Figure


COLE
Jump to...
ACS01 ▸ Forum ▸ Skills for future students - erika/jeff
Search forums
News
Welcome
Mar 3rd 2008
View all news
Administration
Display replies in nested form
Move this discussion to ...
Live Stats
Total users: 55
Total courses: 2
Logins today: 2
29th April 2008
Skills for future students - erika/jeff
The question to discuss in Task 2 is:
"Define 2 skills required by your students for their use of argumentation"
One skill I think is needed is:
attentive listening skills.
Erika
Edit | Delete | Reply
Time Management
April 2008
Sun Mon Tue Wed Thu Fri Sat
1 2 3 4 5
6 7 8 9 10 11 12
13 14 15 16 17 18 19
20 21 22 23 24 25 26
27 28 29 30
Information
Collective Knowledge
Wiki
Module Content
Syllabus
Video Case
Upcoming Events
There are no upcoming events
Re: Skills for future students - erika/jeff
I agree. I think that the ability to identify faulty reasoning is also useful.
Also,
- producing valid, sound, and convincing arguments, devoid of weaknesses, and not easily attacked.
- to gather evidence for his/her position in order to convince or force the opponent's acceptance.
Show parent | Edit | Split | Delete | Reply
Mind Tools
Publish to Desktop
Share a text
Share a file
Online Tools
Google Language Tools
Free Downloads
Open Office
View Your Mind
Communications
OpenMeetings
Exit Moderation Files Settings Poll
Video and Audio
Terminé
Re: Skills for future students - erika/jeff
Is it identify false reasoning or questioning reasoning to determine if false?
Erika
Show parent | Edit | Split | Delete | Reply