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Dirk S. Hovorka
*Bond University*, dhovorka@bond.edu.au

Michael J. Rees
*Bond University*, mrees@bond.edu.au

Amjad H. Alkilani
*Bond University*, aalkilan@bond.edu.au

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# A Design Framework for Researching Collaborative Learning Environments

Dirk S Hovorka[1]
Email: dhovorka@bond.edu.au

Michael J Rees[2]
Email: mrees@bond.edu.au

Amjad H Alkilani[3]
Email: aalkilan@bond.edu.au

[1,2,3] School of Information Technology
Faculty of Business
Bond University
Qld 4229, Australia

## Abstract

*Despite the increasing use of communication and social media technologies in higher education teaching environments, and an extensive literature describing the potential of using technology in teaching, there is limited empirical literature demonstrating that technology enhances learning. The widespread adoption of some Web 2.0 and other mature technologies in education creates an opportunity to extend current research by identifying relationships between these technologies and pedagogically informed interactions within a Community of Inquiry. In this research, we propose a conceptual framework linking educational pedagogy, technological support of learning interactions, and emergent teaching, social and cognitive presences, which are linked with learning outcomes. This framework grounds discussion of the future design and evaluation of a prototype Collaborative Learning Environment based on the proposed interactions. Additional future research based on this framework is discussed.*

### Keywords

Education, Communication and Social Media, Web 2.0, Learning Outcomes, Community of Inquiry

## INTRODUCTION

Research in the use of communication and social media (CSM) in higher education has a long and broad history in the Education and Information Systems disciplines. The information technology landscape has changed dramatically in the decade since Alavi and Leidener (2001) called for greater research depth and breadth in technology–mediated learning. Yet there remains a fundamental need to research whether technologies improve learning outcomes, and to understand the processes involved. With increasing maturity of applications, and the general availability of CSM technologies in classrooms, interest in understanding how students' educational experiences can be enhanced with technology is growing. The use of technology in education is moving toward the creation of rich learning experiences, based upon active involvement by learners, and upon changing the "way in which knowledge is perceived: not as something that is reliable and changeless but as something that is an activity, a process of finding out" (Savin-Baden, 2000 p 4). But beyond the value of experiential learning (Kolb et al., 2000), we wish to emphasize the opportunity provided by communication and social media to enhance research in technology-mediated learning by learning outcomes by supporting learning interactions and presenting unique opportunities gather relevant data on the learning process.

The potential benefit of technology is not simply replication of existing educational practice, but its ability to sustain a variety of pedagogies and to support the development of communities of learners. Drawing upon Wenger's (1998) Communities of Practice, we adopt the perspective that *learning* is fundamentally experiential and social, and that learning results in the ability to extract meaning from experiences and negotiate meaning through collaboration. The constructivist, collaborative and project/problem solving pedagogies stand in contrast to the objectivist or knowledge transmission approach, in which knowledge is a product that can be transferred (Benbunan-Fich et al., 2005). Through engagement and negotiation of meaning, learning creates new mental structures, and these changes in mental models can be measured. Many pedagogies recognise the influence of learner engagement, the negotiation of meaning, and the value of peer-to-peer and collaborative activities in improving learning outcomes. Activities that involve project/problem solving provide a tension that creates a

"readiness to perceive and to act... to make sense of its own situation both intellectually and practically" (Polanyi, 1958 p 120).

As the use of CSM in teaching is increasing, educators are recognizing that students and the goals of learning are changing. This change has been articulated as:

> "the vast and rapidly growing accumulation of information and knowledge has implications at all levels of education. In the Colleges, the most apparent need is to change the emphasis of instruction away from transmitting fixed bodies of information toward preparing students to engage in continuing acquisition of knowledge and understanding. In terms of pedagogy, the preparation for continuous learning implies a shift toward more active forms of instruction... It is time, therefore, to think seriously about multiplying the opportunities for students to reason carefully about challenging problems. Such an effort will presumably call for greater emphasis on promoting active discussion in class" (Bok, 1986 p 165).

But very little empirical research, based upon use of new generations of CSM, has been published. In reviewing the literature we deemphasize evidence claims (of which there are many) where there is no comparison of learning outcomes between learners undertaking similar assessment tasks with and without the benefit of CSM. Many studies use CSM as part of the learning process and measure improved participation and self-reported learning experiences on the part of the subjects. These indications alone are assumed to improve learning outcomes without the latter being measured. In part, this is due to the lack of a robust model of technology-mediated learning processes which incorporates both instructional integration of technology and learning outcomes. Thus, as a starting point, this research provides a conceptual model of Collaborative Learning Environments based upon an set of CSMs integrated with face-to-face classes in higher education.

In this research the CSM is viewed as an integrated part of the learning environment, not as an *ad hoc* afterthought. The value of CSM integration in education is its capacity to facilitate interaction, and to provide a "space" for the construction of meaning and knowledge within a Community of Inquiry (CoI) (Garrison and Anderson, 2003). Although the idea that technologies can provide spaces which people inhabit is not new, and is clearly seen in the use of avatars in virtual worlds, we stress the aspect of space as providing the 'potential for action' (Hovorka and Germonprez, 2010; Winograd and Flores, 1986). The CoI model posits the emergence of a community in virtual space which interacts with the action of inquiry. The CoI learning model identified and conceptualised the key components and the relationships between teaching presence, cognitive presence and social presence necessary for educational experience. This research adapts the CoI model to include propositions for *actions* (e.g. interactivity, peer-to-peer communication, collaboration, problem solving) based upon the learning interaction model (Sutton, 2001; Swan, 2003). These particular learning models were chosen because they are dynamic presentations of multifaceted dimensions to the educational experience with an emphasis on student learning. A set of specific collaborative and social media technologies, which have been discussed in the literature as enabling interactions, have been mapped into a framework for a Collaborative Learning Environment. Note that throughout this paper social presence is used strictly according to its definition as part of the CoI model.

The paper proceeds as follows. First, we provide an overview of prior research, briefly discuss relevant pedagogies, and review the interactivity and CoI models of learning. These models become the background for discussion of the relevant characteristics of CSM technologies. We then propose an integrated conceptual framework which will guide future research in the design and evaluation of a prototype Collaborative Learning Environment. We conclude with a discussion of the implications, limitations, and future research which can be based on this new model.

## PRIOR RESEARCH: A BRIEF OVERVIEW

Both the IS and Education disciplines contain an extensive literature on teaching with technology, asynchronous learning networks, computer-mediated learning, virtual learning communities, and learning networks (Benbunan-Fich et al., 2005). Prior research is quite broad in scope, covering online learning, distance education, and blended learning environments, and a thorough review is beyond the scope of this paper. But a substantive literature review reveals that much of the research literature is dated, relative to the current functional capabilities and availability of CSM technologies, with many prior empirical studies focused on discussion boards, email, and video conferencing.

However, the idea that students seek social connectivity, autonomy, and socio-experiential learning environments (McLoughlin and Lee, 2009) has contributed to the use of blogs, social networking, and podcasts in educational contexts (Boulos et al., 2006; Chong, 2010; Kane and Fichman, 2009). Technology has been viewed as transformative in blended learning environments (Garrison and Kanuka, 2004). Although these

specific technologies facilitate students' abilities to personalize spaces, and to collaborate with peers through web-based applications, some studies suggest that e-learning is a fad that has not lived up to the hype (Zemsky and Massy, 2004). The technologies themselves have been heralded as transforming the education model to fit the next generation learner (McLoughlin et al., 2009) and has also been criticized as focusing on technology rather than human agency as the source of educational change (Fisher, 2006).

Current CSM technologies are commonly aggregated under the rubric of "Web 2.0" broadly indicating the presence of a component of interaction that was not available with earlier forms of technology. Ongoing technological change has resulted in a set of tools which are widely available and far more mature and functionally capable than technologies available even a few years ago. Combined with the transformation of media users from passive recipients to active participants (Hovorka and Rees, 2009), we suggest the need for a new theoretical framework for designing a collaborative learning environment with current tools. The environment should be informed by activities and contexts from the literature on learning, and which can be supported by the functional characteristics of the current technologies. The framework is therefore based on kernel theories which will be used in the planned artefact design (Gregor and Jones, 2007; Hevner et al., 2004).

**Pedagogy**

Educational pedagogy can be loosely defined as the teaching strategies and activities used to impart the specialized knowledge/content of their subject area (Canning, 2007). There has been gradual movement away from pedagogies dominated by teacher-directed learning to more interactive strategies which emphasize collaborative learning (Bruffee, 1999), constructivist learning (Jonassen, 1999), and problem-based learning (Savery and Duffy, 2001), the principles of which are described in Table 1. That learning is, in some sense, fundamentally social is generally accepted (Swan and Shea, 2005). Learning always involves interactions among people, or people and technologies. Blended learning environments (Aspden and Helm, 2004), which combine classroom teaching with CSM supported interactions (either within or external to the classroom),rely on both situated and distributed learning activities. Situated learning posits that the physical and social situations are integral to the learning experience, and that meaningful activities must make use of their context. Although meaningful interactions have been defined from many perspectives (Woo and Reeves, 2007), in this research we construe meaningful as having a direct influence on learning (Woo et al., 2007). Distributed learning posits that knowing is not localized and isolated, but is developed through interaction with self, other and with cognitive tools which support interactions (Swan et al., 2005).

Table 1: Principles of Included Pedagogies

| Pedagogy | Description | Pedagogical Principles |
|---|---|---|
| Collaborative Learning (Dillenbourg, 1999) | Aimed at marshalling peer group influence to focus on intellectual and substantive concern. | • Based upon a situation in which forms of interaction are expected to occur.<br>• Clarify ideas through discussions.<br>• Create environment of exploratory learning.<br>• Interaction triggers specific activities and cognitive mechanisms more frequently than individual learning. |
| Constructivist learning (Savery et al., 2001) | Focuses on activities and the context in which learners create meaningful experience and knowledge. | • Knowledge is within our interaction with the world.<br>• Learning is a result of content, context, activity and learner goals.<br>• Knowledge is socially negotiated through interactions which test and enrich a learners understanding. |
| Project/Problem-based learning (Norman and Schmidt, 1992) | Learning results from the process of working toward the understanding or resolution of a problem. | • Enforces critical thinking through generation and testing of hypotheses.<br>• Seeks to enhance motivation and self-directed learning; learning how to learn.<br>• Enhances knowledge retention through contextualization. |

Our proposed framework is focused on blended learning environments in which CSM are integrated into face-to-face activities, and become a focus for interaction inside and outside the classroom. Pedagogies and interactions in distance education models and purely online education were not considered. This means that CSM becomes one of many potential interaction agents, and is only part of the set of interactions a learner may have. But each of

the pedagogies in Table 1 emphasize *interactions* – which we posit can be with the teacher, with other learners, or with the CSM itself. A learning environment based on CSM allows for new patterns of interactions, different temporal sequences, and new activities. Recognising how interactions shape learning becomes a critical aspect of designing for learning.

**Interactivity Models of Learning**

While we agree with research which places interaction as fundamental to learning, rather than passive exposure to information, defining interaction becomes a central principle for design. Interaction can be defined from multiple perspectives (Dourish, 2001; Winograd et al., 1986; Woo et al., 2007), we choose to modify the interaction model of Swan (2003) to include the CSM as an actor, making human-CSM interactions possible (Winograd et al. 1986).

Following Sutton (2001) and Swan (2002; 2003), we posit four types of interactors (Figure 1): direct interactors, in which learners directly interact with other learners or with the instructor; actors who provide one-directional input but do not receive reciprocal feedback; vicarious interactors, who benefit from observational learning (Bandura, 1986), but do not directly contribute, and simply absorb the interactions of others; and non-actors, who do not participate in the communication process at all. In addition, we propose that the interactions can be divided into two environments: the face-to-face (classroom) interactions (solid circle in Figure 1), and CSM- mediated interactions, which occur in the CSM virtual space or "cloud" (dashed 'cloud' in Figure 1). We also posit that the CSM virtual space is a direct interactor, by being a repository, a direct interaction channel, and as an initiator of information delivery (e.g. RSS feeds, 'pushing' specific information such 'most read entry', other subscription services, content change notifications).

These two environments are distinct but overlapping. The CSM cloud provides asynchronous interactions outside the classroom, but may also become an actor for in-class interactions (e.g. displaying learner-generated content in the context of the class meeting). The cloud also provides the potential for interactions with a larger group of experts or contributors who are not officially part of the university course (light circles). Vicarious learners may benefit from observation of both the in-class interactions and the CSM interactions. Although Hillman et al. (Hillman et al., 1994) suggests that the learner-interface interaction is important, we do not include it, because those interactions are not meaningful in this context, and we assume that a majority of current students have basic efficacy with computer interfaces.

The direct interactions in the class environment, within the CSM environment, support the types of activities in the collaborative pedagogy. A wide range of group or dyadic interactions can be planned, and the record of the direct interactions between learners or learners to the teacher is available for vicarious interaction by observers. The CSM environment supports the type of knowledge discovery and creation of meaning that characterises constructivist pedagogies. The CSM can also become a focal actor for problem/project based learning. The CSM is a knowledge source and a repository of learner generated content and decision history, and also can initiate reciprocal interactions in which learners must respond to specific conditions or criteria, and generate feedback loops without direct teacher intervention.

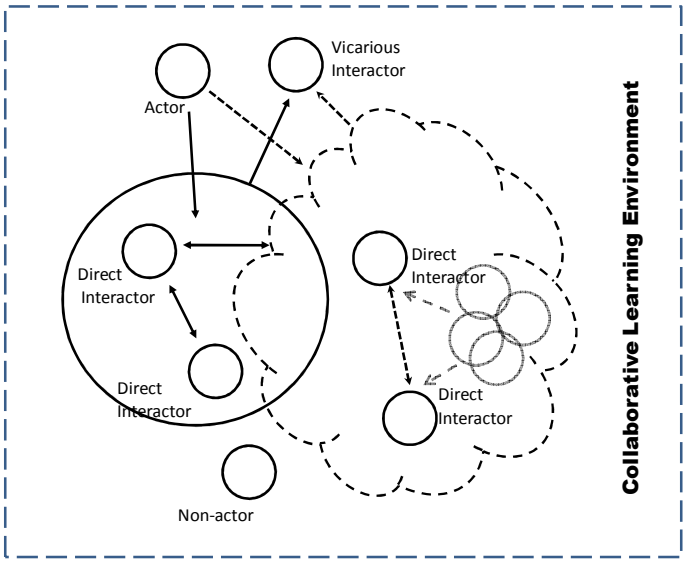


Figure 1: Types of Interactors in CSM (adapted from Swan 2003)

These interaction types and contexts inform the collaborative learning environment in two ways. First, learners and teachers who create patterns of interactions are the basis of communities. Wenger (1998) discussed communities of learners as a type of practice and the Community of Inquiry framework has been widely studied (Garrison and Arbaugh 2007) and applied in both IS and education research. Second, technological components of an integrated CSM must be supportive of meaningful interactions associated with learning. There are numerous CSM technologies which can be evaluated for their suitability for supporting these types of interaction.

**Community of Inquiry**

The observation that knowledge and learning are a part of all communities that share paradigms, practices and values leads to the notion of *communities of learners* (Swan et al., 2005). Wenger (1998) maintains that authentic learning is the result of reciprocal engagement, shared repertoire of practice, negotiated meaning and shared goals. The Community of Inquiry framework (Garrison and Arbaugh, 2007) has received extensive empirical research demonstrating how different forms of immediacy or *presence* emerge within learning environments.

Three forms of presence have been identified as necessary but not sufficient for learning: social, teaching and cognitive. Space limitations prevent a thorough review of this extensive research, but an overview is warranted. Social presence is described as the ability of learners to be perceived as "real people" either in CSM-mediated environments or in face-to-face interactions (Garrison et al., 2007). Research has shown social presence enhances group cohesion and effectiveness, open communication, satisfaction and learning outcomes. Social presence is a phenomenon which emerges in stages from acquaintance and communication (interaction), to purposeful exchange (discourse) and finally to a sense of community and camaraderie (Brown, 2001). Teaching presence emerges from structures and parameters which focus interactions in a specific direction. Three components have been identified: instructional design and structure, facilitation of discourse, and direct instruction in content (Anderson et al., 2001). Cognitive presence is described as the degree to which learners are able to construct and confirm meaning through reflection and discourse. The four phase process of triggering, exploration, integration and resolution provide a parsimonious, yet highly simplified view of a construct related to critical thinking (Garrison et al., 2007).

The three CoI constructs have been used as surrogate measures of learning outcomes. But although valid measurement instruments exist, Garrison (2007) notes that little research has examined the interdependence of the presences in the same context. In this research, the CoI framework serves as a background upon which to view the types of meaningful interactions which result in learning, and the characteristics of the suite of CSM which may be integrated in a Collaborative Learning Environment.

## CONCEPTUAL MODEL: COLLABORATIVE LEARNING ENVIRONMENTS

The framework of interaction (Figure 1) and the Community of Inquiry model provide grounding for a proposed design framework for Collaborative Learning Environments (CLE) (Figure 2). Interactions are fundamental to the emergence of social, teaching, and cognitive presence (dashed ellipses). Without interaction, either reciprocal or unilateral, no sense of community can form. What differentiates this framework is the mapping of interactions in a blended environment to the realization of presence and in the ability of the CSM itself to be an actor which both supports and contributes to community.

The arrows labelled CSM represent direct interactions between Teachers (T) or Learners (L) and the CSM. Interactions may be requested information searches, scheduled or conditional information delivery, notification, or CSM-generated content. The CSM is also a repository for all information generated by the community, and importantly, contains a record of all discussions, edits, and contributions allowing the community as a whole to see and reflect on the negotiation of knowledge. The face-to-face and online CSM virtual environments are distinct, yet overlapping, and together form the Collaborative Learning Environment.

Vis-à-vis the classroom environment, the CSM environment is an actor outside the face-to-face environments. It supports direct, vicarious and unilateral-actor interactions in its own right. These learning interactions continue on a 24/7 basis continuing to allow opportunities for learning throughout and beyond the duration of the class meetings. Should university policy allow it, the evolving resources, comments, alerts and information feeds can potentially become a public repository, projecting course outcomes to the community at large. Such educational resource exemplars will be curated by the teacher actors for their own use in future courses. At the same time, the reputation of the institution is potentially enhanced via this community outreach, and the built-in logging of interactions, outlined in the next section, allows the level of success in reaching outside the institution to be measured.

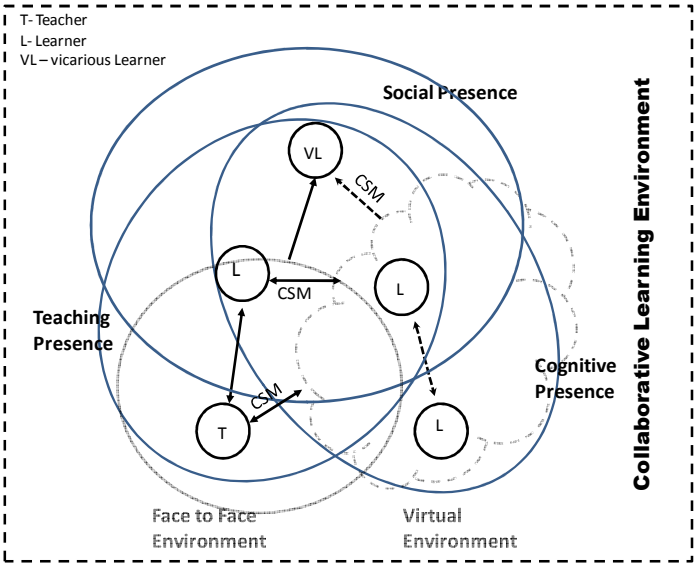


Figure 2. Conceptual Framework for Collaborative Learning Environment

**Teaching with Communication and Social Media**

CSM technologies create new potential for interaction, by enabling communities of learners and teachers to interact asynchronously in virtual space, and to interact directly with CSM while engaged in face-to-face meetings. The knowledge created in virtual space becomes potential content for discussion, refinement, or new discovery, both within the class environment and outside it. Weblogs (blogs), wikis and social bookmarking, described below, are widely adopted in education. In particular, these CSM technologies are used where collaboration and user construction of content is desired.

A blog site allows authors to share online posts containing text, images, and video. Readers may contribute comments on any post for social interaction. Student groups can use their blogs to build a corpus of interrelated knowledge via posts and comments. Such comments provide valuable feedback and encouragement from teachers and peer groups. The reverse chronology of blogs aids assessment, as a post represents the newest version of a student's understanding of the material (Brooks and Montanez, 2006). The posts facilitate a series of extended discussions beyond class meetings, which help students clarify their ideas. In addition this helps create an environment of vicarious learning, when posts are read but rarely written by the interactor. Vicarious learners benefit from posts of their peers and the discussion surrounding them.

Blogs provide one-to-many interactions, which allow students to reflect on their own experience as well as connect with other students. In addition, bloggers control the structure of individual posts, and can encourage their peers to make comments (Lin et al., 2006). Posts have individual authors, which engenders a sense of ownership. This increases the likelihood of successful online communication, and creates potential for much deeper peer-to-peer learning and teacher-student interaction. Walker (1985) states that 'creative interaction with one's own development helps to ensure that new knowledge is incorporated in and integrated with existing knowledge' (p 65). A blog offers interaction with reflective comments, and also the ability to interlink to related ideas. Teachers can subscribe to an RSS feed that allows them to obtain instant notifications and updates relating to any new content added by their students.

Wiki sites allow one or more people to build a corpus of knowledge in a set of linked web pages, by creating and editing pages. Wikis encourage students in direct interaction, and a fully social constructivist mode of learning. Wiki reading lists allow incremental growth of knowledge by a group, and the production of collaboratively edited material. Students can flag areas of the wiki that need attention, provide feedback on each others' writing, and attach files and documents to enable students to build resources collaboratively (McMullin, 2005). Wiki pages provide a vast amount of information to facilitate exploration learning and stimulate critical thinking. Teachers, at any time, can supply page structure, or hints describing structure, and then provide feedback on students' generated content.

Educators expect wikis to facilitate communication, and also the collaborative discovery and sharing of knowledge. Wikis incorporate a many-to-many model of knowledge discovery and sharing, as opposed to the one-to-many model supported by blogs. Wikis may be configured to allow different levels of student editing

which encourages interactions as students help other students correct their knowledge as part of a community of learning.

Social bookmarking sites allow users to store, classify, share and search links to online content. When links are saved they are given a "tag" - a keyword used to describe the link. This user-generated labelling, or folksonomy, provides a collection of tags chosen by a group of students. Students maintain a personal collection of links online, and choose which links to share with others. Tags allow students to express differing perspectives about resources by creating informal information networks. These networks leverage the collective activity of students, and provide a sense of the interrelationship of resources. Social bookmarking provides a convenient approach for to distributing reference lists, bibliographies, media, and online resources of all kinds, which can create new communities of interest. Teachers can continually evaluate for quality, and counts of bookmark contributions or popularity ratings may be used for assessment measures.

These specific CSM, blogs, wikis and social bookmarking sites, allow users to communicate, collaborate, and negotiate shared meanings through different types of interactions. For example, key concepts may be collaboratively negotiated through comments and feedback in a blog, leading to positive interdependence of group members (Abrami and Bures, 1996). The teacher, or the CSM itself, may trigger constructivist learning through exposure to contributed page content and related posts about certain topics and ideas. These interactions present students with new ideas that must be integrated with prior knowledge. Meaning and learning is derived through reflection and opportunities to exercise, verify, and improve their understanding, through discussions and information sharing. In addition, CSM can create and support social and cognitive presence, as they have the potential to serve as a knowledge platform for a community of learners. Teachers using such media can support and enhance social and cognitive interactions through instructional management, supporting the building of understanding, and direct instruction.

Although other forms of CSM may also contribute to learning, wikis, blogs, and social bookmarking facilitate different learning interactions, and may lead to the emergence of the core elements of a community of inquiry. In addition, the integrated platform of these CSM may reduce potential student frustration with technology, which could be caused by the problem of multiple passwords access, and the challenge of communication through separated islands of information.

## PROTOTYPING AND EVALUATING A COLLABORATIVE LEARNING ENVIRONMENT

Design Science Research (Hevner et al., 2004; Venable, 2006; Walls et al., 1992) contributes to knowledge through a process of building and evaluating IS artifacts. Kernel theories inform the design principles and evaluation by grounding (Goldkuhl, 2004) the design in theories from the behavioural sciences, engineering or other existing design research. This grounding of the Collaborative Learning Environment prototype (CLEP) in existing theories (in these case Communities of Inquiry, the interaction model of learning, and the CLE conceptual framework) provides a chain of reasoning that the design may address the identified problem. The CLEP will then be trialled against a set of evaluation criteria to test the design principles and the validity of the conceptual framework. CLEP will implement and track all the interactions described in Figure 2 so that a measurable increase in learning outcomes will be implication offer some validity to the conceptual framework.

Blogs, wikis and social bookmarking sites were selected as communication and social media, because together they offer the potential to support interactions amongst the actors and the emergence of the three presences from the CoI model (social, teaching and cognitive). Candidate CSM services will therefore be chosen from one or more publically available blog engines, wiki sites, and social bookmarking services. A CLEP, therefore, needs to wrap the identified beneficial features of the candidate CSM sites into an apparent unified whole, so that the human actors perceive a single environment to as great a degree as possible.

The actor entry point to CLEP is envisaged as a single page web application displayed in a browser, containing student material drawn dynamically from the candidate CSM sites. Scripts within the page will draw dynamically upon local and remote database services and call the APIs provided by the candidate CSM sites to extract and manipulate information to be presented on the CLEP page. Where appropriate, the CLEP page contents will allow data entry, so that user-generated content and/or parameter management of the underlying CSM sites will be possible.

To meet the goal of a single environment the design features of CLEP must encompass:

1. a single authentication and access point
2. a single “view” which summarizes the CLEP current state drawing on the underlying public CSM sites
3. clear presentation of the social, teaching and cognitive presences represented as interaction states
4. simple attention direction such as a ‘traffic light’ displays to indicate to the users parts of the learning environment that warrants their attention

5. provision for the CLEP dashboard to be refreshed automatically to reflect current activity by community members.

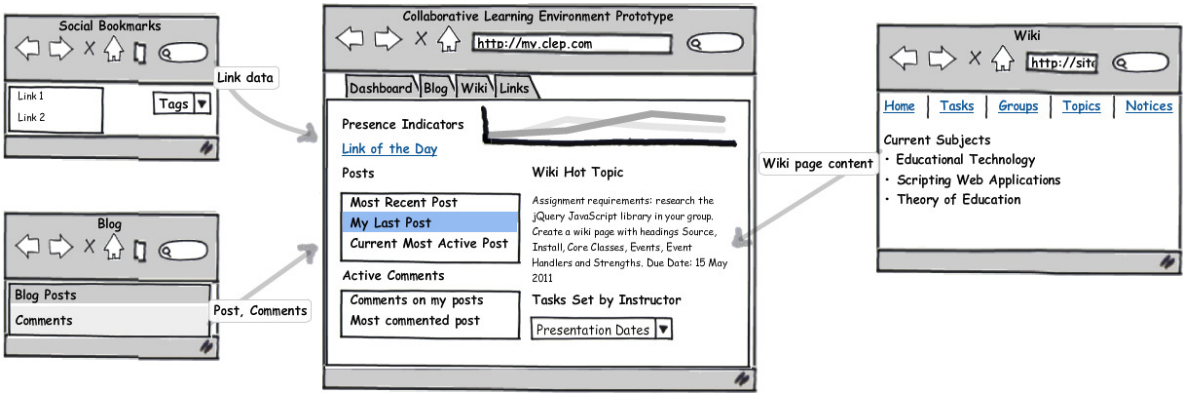


Figure 3. Mock-up for a Collaborative Learning Environment

A tentative mock-up (Figure 3) demonstrates how the CLEP will appear to the end user. The visible content is drawn as required from the chosen candidate CSM sites as shown in the middle design feature. It should be noted that the tabs in the central web page display represent the actual candidate CSM sites themselves and the user is able to navigate directly to these sites at any time. Using OpenID the CLEP will have already authenticated the user via the single sign on mechanism.

An advantage of the CLEP as a web application, using a browser as the execution environment, is that its display layout is adjusted according to browser type. In particular, the CLEP can automatically reformat its web pages to suit mobile phones and hand-held devices. No native applications will be needed for the growing number of different mobile phone platforms.

It is important to note that the information surfaced by the CLEP can be fully automated, and can be designed to show the richness of the scope of the interactions with the potentially large set of actors. Some freshness in the presentation can be introduced by selecting such artefacts as link of the day, most viewed blog post, or the wiki page with the most comments. This serves to maintain learner interest and curiosity and to create a sense of ownership for contributing strongly discussed postings. A listing of current system users can be used to build social presence, and the specific users status as a participant (e.g. the users recent activities), may encourage interaction and the sense of community.

The CLEP will fall into the category of software generally known as a mashup. As already described, the CLEP will use client-side and server-side scripting to call the APIs of the CSM candidate sites to both extract information for display, and to submit information that is to be shared by all users. Creation of a single point of login access is easily met by using choosing sites that support the OpenID standard. Either the CLEP itself or a chosen candidate site can act as an OpenID provider and all other sites are selected as being capable of supporting OpenID login.

The existence of sites like Netvibes and Google already provides a wide range of dynamic components of web pages (e.g. gadgets) that could be customized for CLEP use with supplementary scripts where needed. Yahoo Pipes even open the possibility of crafting gadgets that call some of the APIs of the candidate CSM sites without any script being needed. Another possibility offering precise control, but requiring sophisticated programming skills, are the web parts supported by SharePoint and its internal blogs, wikis and lists of links capabilities.

Evaluation of the prototype has two goals; to determine the validity of the conceptual model and to determine whether the CLEP increases learner satisfaction, perceived learning and measureable learning outcomes. Implementing CLEP as a mashup opens up significant opportunities to automatically collect the evaluation data. All interactions, including even those by the vicarious actors who simply observe, can be recorded along with contextual and temporal ordering. Various counts and frequencies of interactions are straightforward to generate. Apart from timestamps, durations, source device, and actual links activated, additional text-based discourse data can be subjected to qualitative analysis. From this basic data a series of social network analyses, measures of network centrality, and text-based assessments using text mining techniques are possible.

In the 10 years since the introduction of the CoI model, a series of papers detailing the measuring processes for the social, teaching and cognitive presences have been validated (Anderson et al., 2001; Bioca et al., 2003). Presence measures will be adopted to determine the differences in presence for the CLEP intervention. Additional measures of perceived learning (Richardson and Swan, 2003), measures of changes in learners' mental models or concept maps and pre/post tests may also be used to measure direct learning outcomes. Evaluation of the

prototype will be based on longitudinal comparisons of student outcomes after completing tasks completing tasks with and without the CLEP.

## CONCLUSION

Theoretical frameworks which organize key concepts and their relationships are critical to the design and evaluation of information systems whose goal is to enhance learning. Although numerous models and frameworks of computer-mediated learning have been suggested, few identify the processes hypothesized to influence learning outcomes. Still less do we find proposals for a guided selection of components from the wide range of communication and social media that can instantiate these models and frameworks for use in the learning context. The lack of an extant information system that controls the integration of the collaboration and social media with the educational framework renders evaluation of computer mediated learning problematic. By synthesizing frameworks from the Information Systems and the Education disciplines this research contributes to the literature in three important ways:

First, we synthesize important concepts and relationships from the education and information systems discipline which inform our understanding of learning processes, actors and interactions. Suggestions from the discipline usually specify a largely virtual environment for enacting the learning processes in distance education or look to bolt on existing communication and social media technologies unchanged as mere supplements to classroom environments. On the other hand we specify a carefully integrated blended learning approach which combines face-to-face and computer-mediated interactions. We then go further and identify the kernel theories which underlie a conceptual framework for carefully planned and purposed Collaborative Learning Environments. The framework specifies the interactions among learners, teachers, and the technology itself which contribute to building a community of inquiry which for a decade is thought to be close to an ideal environment for encouraging learning.

Second, the research proposes design principles which may be used in integrating communication and social media with face-to-face interactions. In specifying two distinct but overlapping environments which students inhabit, the framework can play a significant part in allowing a better understanding of how to integrate content, interactions, assessment and technology in higher education classes. The particular media selected have been demonstrated over a number of years to support the types of activities associated with beneficial learning interactions. Integration substantially reduces issues of fragmentation of attention, multiple logins, limited search capability and the series of closed worlds which characterise many educational learning management systems. At the same time, as a controlled web application, the proposed CLE prototype can by linked with existing learning management systems for use in the short term.

Finally, this research identifies specific measures by which the design may be evaluated. Both quantitative measures captured in the interaction with the technology and qualitative measures of learning are described. Although evaluation of the prototype is the focus of future research, these evaluative measures can be applied to other research. While the proposed conceptual framework is has not been implemented, it provides a testable set of design principles which will inform both further CLE designs and implementations and educational models of interaction and communities of inquiry..

The proposed design framework for Collaborative Learning Environments has its essence drawn from established educational theories, encompasses the latest supported models and frameworks that explain learning processes, and ties directly to the range of communication and social media in an integrated technical design. Moreover, the outline of a feasible technical implementation is provided together with measures that can evaluate the influence of a Collaborative Learning Environment on learning processes and outcomes.

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