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An Interactive and Iterative Evaluation Approach for Creating Collaborative Learning Environments

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Abstract: Inspired by a three-year Creative University 'arena' initiative at Luleå University of Technology in Sweden, an international team of faculty researchers conducted an exploratory study in 2005, which aimed to investigate the efficacy of an interactive design and evaluation process for technology-enabled collaborative learning environments. This applied research approach was designed as a collaborative evaluation process for co-creation of technology-enabled, learning-focused physical and virtual 'learning commons.' Faculty researchers from Sweden and the United States used Soft Systems Methodology tools, including the Process for Organisational Meanings (POM) model, to guide sixty-two students' participatory co-design and evaluation activities. In this paper, the POM evaluation model is explained and related to the Japanese concept Ba. Application of the models is illustrated within the context of student learning through boundary crossing information exchange and knowledge creation. As evidenced in their iterative and interactive evaluative recommendations, students' learning outcomes included development of improved capabilities for identifying socio-technical elements of distributed learning environments, suggesting that student beneficiaries can successfully reflect upon their experiences and provide valuable evaluation insights. In addition, when this evaluation is iterative, students' insights into project management, software needs, and services design can improve their technology-enabled learning experiences. Concluding comments explore the efficacy of the POM model implementation for guiding other learning-focused, user-centric initiatives, which aim to promote interdisciplinary, or boundary crossing, exchanges concurrent with advancing team-based knowledge creation proficiencies among project participants.

Keywords: interactive formative evaluation, learning commons, soft systems methodology, process for organisational meanings (POM) model, Ba, higher education pedagogy

1. Introduction

Between January and June 2005, an international research team investigated the efficacy of an interactive design and evaluation process for technology-enabled collaborative learning. The research subjects in this study involve sixty-two students in four disciplines - computer science, library and information science, computer and systems science, and social informatics - on three campuses - California Polytechnic State University (Cal Poly) and San José State University (SJSU) in the United States and Luleå University of Technology (Ltu) in Sweden. Faculty supervisors and student participants in two graduate courses – information science and knowledge management – and two undergraduate courses – social informatics and human computer interaction (HCI) – explored a shared topic of inquiry: a 'learning commons'. The research team also applied a shared research methodology, which assumes that student beneficiaries are able designers and evaluators of socio-technical learning spaces and places. In our paper, we present the theoretical framework informing this user-centered process for co-creation of collaborative physical and virtual learning environments through interactive and iterative evaluation processes. Selected research results provide additional detail on the evaluation process and learning outcomes.

The 'commons' construct emerges from a three-year Creative University 'arena' initiative at Ltu, Sweden (Andersson 2003; Andersson et al. 2002; Edzén 2005; Edzén et al. 2004; Holst 2004; Holst and Mirijamdotter 2004; 2005; 2006; Sandström 2004). It also acknowledges the contemporary transformation of information commons (Bailey 2005; Bailey and Tierney 2002; Beagle 1999; 2002; Crockett et al. 2002) into learning commons, where the focus is on learning rather than technology (Beagle 2004) and relates to the shift from a teaching culture to a culture of learning (Bennett 2003); a change sweeping American higher education as necessitated by the distinctively different expectations and preferences of the NetGeneration student population (Brown 2005; Lippincott 2005). Similarly, the Swedish Creative University initiative also originated in response to changing assumptions and requirements among the populations they sought to serve. Expressed need on both continents to revisit traditional assumptions – toward the end of reinventing

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education – prompted this international research alliance.

This research collaboration is unique in its involvement of student beneficiaries in design and evaluation activities for collaborative learning environments. To date, the learning and design planning principles (Johnson and Lomas 2005) for "learning ecosystems" (Alexander 2004) reflective of expanded teaching and learning ambitions has explored such disparate elements as the relationship between learning technologies and innovative space design (Joint Information Systems Committee, 2006; Brown and Lippincott 2003). Included in the exploration are also strategies for community-based planning processes, collaborative service and system delivery models, and collaborative project planning and implementation considerations (Lippincott 2004a; 2004b; Wedge and Kearns 2005). But none explicitly involve students substantively in the design and evaluation activities. In response, the interdisciplinary research team sought to evolve a formative evaluation approach which both advanced learning commons design and student learning outcomes. Employing interactive and iterative evaluation methodology, we introduced a variety of technology supported tools for initiating and advancing physical, virtual and mental facets of collaborative learning environments, including two Learning Management Systems (LMSs), two e-meeting software, 3-way video conferencing, Instant Messenger (IM), wikis, and email. We were also attentive to the social factors affecting tool utility, including cultural expectations, time zone differences, and role variation among both faculty and student learning groups. Throughout, we employed the lens of interactive design and evaluation (Newman and Lamming 1995; Preece et al. 2002), which has similar objectives as formative evaluation, for creating and sustaining dynamic technology-enabled, dialogue-driven communities of inquiry.

Our interactive and iterative evaluation methodology applied knowledge creation and systems thinking theories, especially the work of Nonaka (Nonaka 1994; Nonaka and Toyama 2003; von Krogh et al. 2000) and Checkland (Checkland 1981; 2000; Checkland and Holwell 1998; Checkland and Scholes 1990). We used the principles of knowledge exchange embedded in the concept of Ba, as advanced by Nonaka and others (Nonaka and Konno 1998; Nonaka et al. 2000), in coaching our students in their collaborative development process to make tacit information explicit. According to Nonaka et al, making tacit explicit is a prerequisite to enable information sharing and knowledge creation and also to establish shared physical, virtual and mental contexts. To collaboratively evaluate this development, i.e., the practical feasibility of constituting and linking learning communities to create new disciplinary knowledge, share it across disciplinary communities, and co-create dynamic technology-enabled learning environments, we employed systems thinking methodology. This methodology involves discourse, dialogue and communication and thus enabled faculty and students to create shared meanings. Intersubjective sense making discourse, hence, served to define purposeful actions to be taken in the light of negotiated intentions and accommodations. In this paper, we outline the approach, which provided the analysis model for evaluating the efficacy of the interactive design and evaluation process. Thereafter we introduce the design of the learning commons project followed by illustration of students' process and lessons learnt. Lastly, we discuss findings from this collaborative learning environment study.

2. Interactive evaluation for collaborative learning

Interactive and iterative evaluation contrasts with more traditional methodologies in which researchers act as experts in the evaluated domain and defines what is to be evaluated and how. It is often assumed that the evaluation is conducted 'objectively', i.e., independent of social and political context, and the intention is to measure some phenomenon to find out its status. Moreover, evaluation results are oftentimes assumed to be an accurate representation of the actual situation (Guba and Lincoln 1989). While evaluation may have many purposes, e.g., control, change management, policy making and learning (Hansen 2005; Hedman and Borell 2005; Mackenzie and Blamey 2005; Oliver et al. 2005), in interactive design and evaluation, the purpose is improving through continuous learning. Therefore, according to Newman and Lamming (1995), it corresponds to a formative evaluation approach. Where the intention of the evaluation is to create learning and thereby improvements, formative evaluation based on a stakeholder model involving interactive and qualitative processes is necessary (Hansen 2005). With this approach, user-generated interpretations are viewed as 'meaningful constructions' - meaningful to the people involved in the situation because the interpretations make the situation of which people are a part more intelligible to them. Furthermore, such an approach assumes that evaluation is a social-political process in which social, cultural, and political factors are viewed as significant aspects of the process – i.e., 'meaning creators' – not 'annoying inconveniences' that threatens

research validity. Evaluation, in this perspective, is a process to create shared reality and meaning (Guba and Lincoln 1989) which leads to an awareness of social and political aspects influencing both evaluation and learning processes.

In the information science (IS) field, there is increasing awareness of the importance of an ongoing evaluation process as a basis for action (Hedman and Borell 2005). Over the last years various action-oriented evaluation models have been developed (e.g., Guba and Lincoln 1989; Patton 1990). Common for these models, according to Rolfsen and Torvatn (2005), is that evaluators and stakeholders should work together in real-time and co-create knowledge useful for both the evaluation and the stakeholders, in this case, participants in the evaluation process. To manage ongoing evaluation processes and action-oriented evaluation, a model of processes is required. Hedman and Borell (2005) suggest integrating organisational sense-making and double loop learning as developed by Argyris and Schön (Argyris 1976; 1991; Argyris and Schön 1974). However, given our focus on collaborative learning environments, we adopted the Process for Organisational Meanings (POM) model (Checkland and Holwell 1993; 1998) to manage the formative evaluation, i.e. interactively and iteratively. The POM model depicts ongoing processes, which occur in interaction between the components Agents, Organisation and Technology, which is why we find it suitable for capturing processes aimed at creating collaborative, learning environments. The people who interact to create the wholly, or partially, shared meanings and thereby make sense of their world, are called Agents. The interactions take place via various forms of Organisations which can be embodied in a division or project team, but may also include tasks, patterns of communication and reporting. Finally, the processes of the POM-model acknowledge Technology, through which information support is provided. See Figure 1.

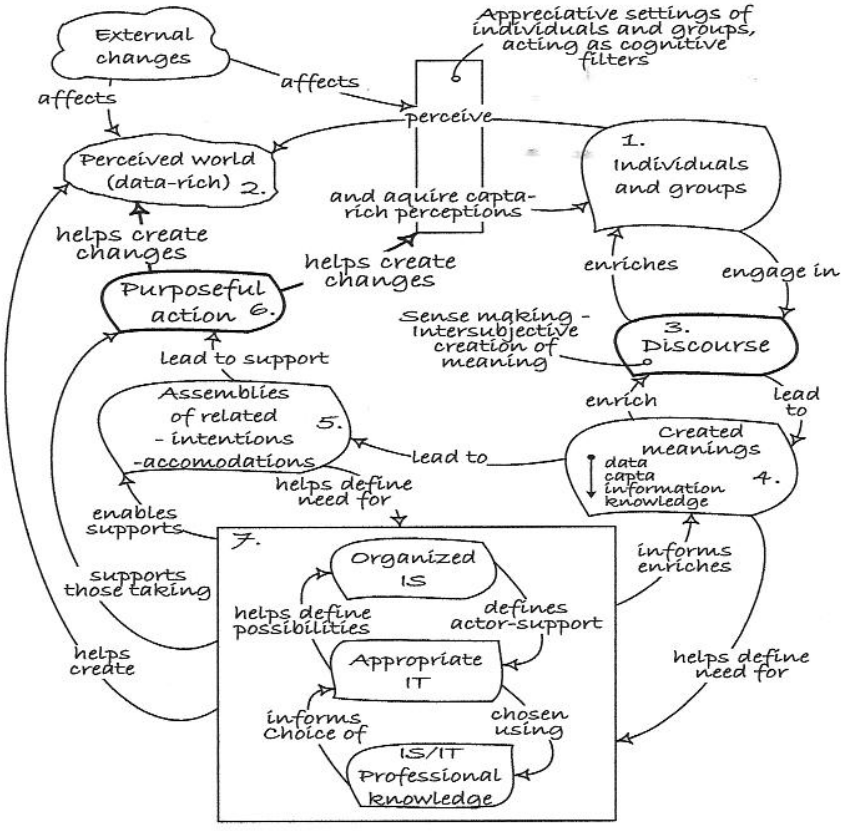

Figure 1: Process for Organisational Meanings (POM) Model. After Checkland and Holwell (1998: 106).

The POM-model offers a process-based organisational model for application to information systems design. The model emerges out of Vickers's concept of an appreciative system (Checkland 1994a; 1994b; Checkland and Casar 1986; Vickers 1983a; 1983b) as well as Soft Systems Methodology (Checkland 1981; 2000; Checkland and Scholes 1990). The POM-model addresses the relationship-maintaining aspects of organisations and also visualises them as ongoing processes of creating meaning through organisational discourse. It has in earlier studies been used for information systems development (Checkland and Holwell 1998; Rose 2002), in

relation to project management (Costello et al. 2002), and as a sense making model for knowledge creation in multi-disciplinary settings (Holst and Mirijamdotter 2004; 2006; Mirijamdotter et al. 2005) and for understanding emerging work practices (Köhler et al. 2005; Mirijamdotter and Somerville 2005). In this context, we use the model, its elements and their relations, to assess and evaluate the learning processes involved in effective design and application of collaborative learning environments. We want to understand what hinders and what enables collaborative virtual processes where the focus is purposeful communication and dialogue aimed at creating shared reality and meaning. Furthermore, this evaluation approach offers a dynamic process model for continuous on-going group learning and strong participatory involvement while concurrently advancing negotiated actions.

Figure 1 depicts the model's seven elements that address the relationship-maintaining aspects of – in this case – virtual learning communities, and the underlying social, cultural, and political context. Elements 1-2 represent identification of relevant environmental elements, an exercise that both depends upon and extends project participants' data collection and analysis expertise. The notion that information exchange drives ongoing processes of creating meaning through dialogue and discourse is expressed in elements 3-4-5. The intention is to affect collaborators' appreciative settings (top of Figure 1). It follows then that dialogue and negotiation processes inform purposeful actions (element 6), based on accommodated views. Shared understanding then informs the formally organised distributed learning systems (element 7), by means of which needed social and technical support is identified, iteratively, through these recurring processes. In using a systems thinking approach for interactive, formative evaluation and collaborative learning, as depicted in the POM model, we honour the mental constructs that people generate to understand – or to obtain an improved understanding of a situation. We recognise that these mental constructs are largely formed by individual worldviews, perceptions, and values that, in turn, are based on individual background and previous experience. This corresponds to the concept of social-cultural learning, which is the essence of collaborative learning (Selzer and Woodbridge 2004).

To deepen reflective insight through dialogue-based collaborative interaction, we draw from Nonaka's SECI model of the knowledge creation process (Nonaka et al. 2000; Nonaka and Takeuchi 1995; Nonaka and Toyama 2003). The model delineates four phases, Socialisation, Externalisation, Combination, Internalisation, that characterise effective information exchange for knowledge creation. Ideally, dialogue is held over a prolonged period of time because occasional interaction is insufficient to produce knowledge creation. The human activity of knowledge creation, which crosses existing boundaries (Holst 2004; Holst and Mirijamdotter 2005; Nonaka 1994; von Krogh et al. 2000), occurs through the interaction between individuals, and between individuals and their environment. Over time, through face-to-face – or 'face-to-face like' – experiences, as individuals share feelings and emotions as well as information including mental models, commitment and trust emerges adequate to support knowledge creation. The SECI model is embedded in the concept of Ba (Nonaka and Konno 1998; Nonaka et al. 2000). Ba is the context, place and space, shared by those who interact successfully – physically, virtually, and mentally – for the purpose of knowledge creation. It expands the dialogue and interaction illustrated in the 3-4-5 elements of the POM model. In our interactive and iterative evaluation approach, Ba epitomises the desired outcome of the learning commons – i.e., boundary crossing information exchange for knowledge creation, enabled appropriately by information and communication technology (ICT).

3. The collaborative learning environment project

Universities in Sweden, as in many other countries, are experiencing major changes due to, for instance, cut backs and budget reductions caused by fluctuations in government funding, variability in students' decisions about when or whether to choose university studies, and last but not least advances in ICT. As a consequence of these environmental changes, Luleå University of Technology (Ltu) made the strategic decision to transform into "The Creative University." University leaders encouraged innovative thinking by constituting cross-functional or multidisciplinary faculty and student groups comprised of members with differentiated knowledge. Recognising the power of crossing knowledge boundaries, the university next created meeting places, called Arenas, for the purpose of encouraging intentional integration and creation of knowledge through interdisciplinary research and education. This is, in short, the background for the present interactive evaluation project in which findings informed collaborative investigations among Ltu, California Polytechnic University (Cal Poly), and San José State University (SJSU) participants focusing on the shared concept of a learning commons.

Learning commons initiatives benefit from a decade of information commons development in North America. Typically located in libraries, information commons normally provide computing equipment and information services to students and faculty. They reflect varying degrees of shared service and support responsibilities between staff members in university libraries and information technology services (Bailey 2005; Bailey and Tierney 2002). The commons construct stems from the British academic tradition of gathering in public rooms, typically after a meal, where academians with various disciplinary backgrounds met to discuss contemporary issues with their students (Bennett 2003). From these early origins, the concept has now matured to embrace virtual as well as physical learning. While there is widespread agreement that learning commons places and spaces should enable collaborative learning (Brown and Duguid 1991; Brown 2005; Johnson and Lomas 2005; Wedge and Kearns 2005), there is a paucity of literature on how best to design for this. Furthermore, the evaluation literature is limited to measuring user satisfaction with services and facilities with only occasional attention to assessing learning outcomes for collaborative learning commons projects (Gillette and Somerville 2006; Somerville and Gillette 2006/7).

Thus, this project significantly advances the emerging learning commons literature. This was accomplished by providing a common 'learning object' across two undergraduate courses and two graduate courses, as well as a shared metaphor facilitative of information exchange among these student-learning communities. In addition, the four researchers and sixty-two students shared a common purpose – to evaluate the efficacy of an interactive evaluation process model for collaborative design and collaborative learning in a virtual learning environment. The scope of the four courses were intentionally complementary, to encourage the need for information exchange in order to obtain a 'big picture' of the holistic Learning Commons initiative.

- The fourth-year Ltu students were pursuing degrees in computer and systems science, and social informatics. They were well versed on Ltu's innovative construction of interdisciplinary learning environments or 'arenas.' They also had extensive experience in team-based project management intended to enable knowledge creation, in line with Nonaka's SECI and Ba constructs. In this course, they intended to further their proficiency in research methodology, data collection and analysis, and report writing. Within this framework, Ltu students developed and implemented a strategic design process for a campus learning commons that would be managed by students for learning purposes that varied greatly and changed frequently, (reported in Lundkvist et al. 2005). The learning commons would also benefit from partnerships with collaborating campus partners - i.e., Ltu faculty, librarians, and technologists.
- The SJSU graduate students were completing their degree requirements in library and information science. In this course, they investigated the impact of ICT on interdisciplinary exchange and knowledge creation. This focus intended to prepare them for information provision, as well as knowledge enablement, in their future careers as information and knowledge professionals in academic, public, and corporate environments. To ready themselves, students completed team-based projects on the design and development of the services and systems necessary for collaborative learning in the Cal Poly Learning Commons.
- The undergraduate and graduate Cal Poly students were enrolled in computer science courses. Their human-computer interaction and knowledge management assignments involved design and development of software applications that could be implemented in the Cal Poly Learning Commons. With the intention to enable information exchange and knowledge creation among student beneficiaries, they gathered information from student peers and used these needs assessment findings to inform their team-based projects.

In addition to classroom activities, students from the four courses on the three campuses regularly exchanged information for the purpose of stimulating synergistic, interdisciplinary insights. Students' cooperative exploration and collaborative engagement around the common learning object required their usage of a wide variety of application tools, supplemented by other commercial and open source communication technologies. Students pursued projects aligned with their disciplinary focus – for instance, Ltu students embraced the university's 'arena' pedagogy, students in library and information science explored implications for information and knowledge management systems, and computer science students designed and developed Internet2 broad bandwidth applications. Group information exchange was facilitated through four video conferencing sessions of between from one to three hours in length. In addition, four Ltu students and three SJSU students conducted more frequent information exchanges. Throughout

the research project, these students – and also faculty – communicated through additional technology such as e-mail, learning management systems, e-meeting software, wikis, and a web conferencing system.

Design of the student projects originated in the five energisers described by Nonaka et al (2000). The project start-up activity provided 'creative chaos' through a short presentation on the concept of a learning commons, followed by distribution of background documents. From here the student groups worked autonomously to select their topic and design their processes. In the most highly functioning group, the Ltu team, the students assessed team members' knowledge assets. In addition to variety in work styles, the disciplinary differences complicated communication challenges – while ensuring the presence of the requisite variety necessary to creative thinking. To varying degrees, the fifth element of energising Ba, trust, developed. Faculty support consisted of responsive modification of learning environment elements, including technologies, as well as coaching students on enabling processes, structures and means for communicating successfully. In this way, amidst the variety of investigatory approaches to a common topic, all students' learning experiences shared a common pedagogical strategy.

The interactive and iterative evaluation process for student groups and faculty researchers was designed according to the POM model. The students had meetings, both physically and virtually, with supervisors at regular intervals when they presented their progress. Additionally, they wrote interim reports and shared them with other teams. Streaming video archives of the videoconference sessions also encouraged reviewing proceedings. The process and progress in each team project was assessed and evaluated collaboratively by students and faculty, as were cross team successes and failures, leading to accommodated decisions on future actions and activities, including the technologies component. A formal group interview with the Ltu students provided additional information on learning experiences achieved through the course and assignment. The interaction between the four Ltu students and three SJSU students, which we discuss below in some detail, provides a textured look into the interactive evaluation process and learning outcomes.

4. Student process and findings

The following highlights express the Ltu students' processes in attempting to establish communication and collaboration with the SJSU students, and their recommendations on creating a distributed learning commons. Subsequently we report lessons learned from our interactive and formative evaluation study on technology-enabled distributed collaborative learning: on the design of a collaborative learning environment and on its processes for collaboration. We emphasise the interactive social networking processes embedded in the POM-model, with the aim of creating a shared (accommodated) vision for virtual collaborative learning participants. We are especially interested in the information systems, which support both the interaction and the activities that result from the accommodations. In so doing, we explore the efficacy of POM to both design and learning through iterative formative evaluation.

4.1 Social implementation factors

The Ltu students began their project through a videoconference with faculty from Ltu and Cal Poly in which they discussed the concept of a learning commons and the Ltu students' plan for their part of the project. Three students from SJSU had volunteered to interact with the Ltu students to obtain first-hand experience working in a distributed international learning commons. However, because of practical problems, the SJSU students did not participate in this first videoconference. In retrospect, students recognised that their inability to interactively communicate early on in the proposed collaboration proved irreparable. Though students experimented with various communication technology media, such as e-mail, a learning management system, Instant Messenger (IM), and a wiki, their attempts to overcome time differences and cultural differences remained unsuccessful. They never progressed beyond the first 'intention' phase of forming a viable international working group. Cultural complications played an especially significant factor, as expressed in assumptions about independent versus team action and autonomous versus collaborative work decisions, causing insurmountable difficulties in reaching an accommodated understanding of common purpose and goals. From reflection on this data, participants concluded that great difficulties arose which interfered with evolving common appreciative settings (see top of Figure 1) and thereby prohibited reaching intersubjective creation of meaning. Communication improved somewhat when the students used a chat function, which also showed when students were on-line. By chatting they got a better understanding of each other's social and working/studying conditions. However, the SJSU students were available on-line at different times

during the day due to other existing work and study obligations. In contrast, the Swedish students' workday was focused exclusively on this project – though 'nine hours ahead' of the California students because of time zone differences. As their frustration over communication difficulties increased, students increasingly recognised the critical importance of understanding the cultural and situational context of potential collaborators. Interpersonal communication differences were further complicated by time zone differences. Frequently, a day was 'lost' – between questions and answers – when e-mailing. Attempts to establish synchronous interaction meant scheduling virtual conversations 'in the middle of the night' on one side or the other of the Atlantic. Therefore, in retrospect, students realised the value of deciding well in advance on a time for chatting and/or for being on-line and accessible.

4.2 Technology for collaboration

As the project evolved, students realised that when separated by distance and reliant on ICT, it is of utmost importance to come to agreement early on about how to communicate. The students explored various software with only intermittent success during their collaborative attempts. To enable created meanings (element 4 of Figure 1), they found that technology which supports both voice and picture is the best way for establishing and furthering information exchange and collaboration. Particularly for initial contact, the Ltu students preferred video conferencing as it provided both audio and visual information and thereby avoided the best opportunity to establish rapport with potential partners using IT (element 7) – rather than relying exclusively on text-based media. Chat was another highly rated technology but, since the US students were monolingual, this medium required usage of written English, which is the Ltu students' second language. In addition, the information gleaned by body language – not only through gestures but also by tone of voice – was unavailable in a chat. Chat moderation presented another complication, students came to realise, as did the requirement for 'speed on the keys'. During the course of the project, participants demonstrated increasing sophistication in articulating both their communication and learning needs and also their judgments about potentially useful hardware and software. In addition, they learned that baseline proficiency in 'tech know how' was essential and a common 'tech platform' was desirable.

4.3 Collaborative learning process

In reflecting on the collaborative learning process, students recommended clear objectives for distributed collaboration. This is in contrast to the assumption in the POM model (see element 5, Figure 1) which suggests that shared purposes will 'naturally' evolve through stakeholder negotiations about common intentions and accommodations. However, in this case, students experienced great difficulty in establishing communication, which complicated sense making activities. The Ltu students were especially sensitive to the lack of shared purpose. Its absence disabled efforts to initially understand US students' possible contributions to their work in Sweden.

In addition, both US and Swedish students recommended establishing protocols for bridging cultural differences, which influenced team operations and impeded cross-team interactions. This proved to be less necessary within a homogeneous team. For instance, when carrying out their own part of the project, the Swedish students praised the 'independence' approach which allowed them to form their own work, testing their abilities to manage information and create knowledge from original data on a topic of their own choosing. They developed considerable ownership of the project and declared that this pedagogy has been the most valuable during their four year of studies (Lundkvist et al. 2005). It gave them strong motivation and meaningful knowledge transferable to future research work. Their common culture and shared work styles and work values permitted them to work effectively together, without need of extensive faculty supervision.

However, both Swedish and American students recognised that the formative phase of group work requires specific direction in a distributed environment where the members do not know each other. In contrast, they were able to collaborate easily in a physically gathered group where proximity made others' knowledge assets more easily recognisable. Also, in a distributed team, personal and cultural experiences and expectations have to be shared explicitly through 'leading questions', which reveal unspoken assumptions and expectations. Otherwise it is easy to assume that potential collaborators are 'just like us'. Ultimately, although the Ltu students did not manage to come to an agreement on a common purpose for collaboration with the three SJSU students, they benefited from the course-to-course video conferencing system-mediated information exchange that provided new ways of understanding approaches for the Swedish learning commons project.

While many of the environmental characteristics, as expressed in the above, are within the 'hands' of the faculty, it is the student participants who 'drive' these changes within an interactive and

formative evaluation context. For instance, students recognised that more robust technology was required, as context and meaning evolved, and as their reflective dialogue on design/redesign advanced. They then explored additional technologies, like chat, wikis and blogs, to find suitable means for social information exchange. This experimentation advanced their insights into technology purposes. For illustration, they found that chat was quite good to learn to know each other. On the other hand, it was not enabling when discussing the project and seeking agreement on purposes, forums for dialogue and interaction, and division of work tasks. Students also concluded that a more robust medium was needed to formulate a knowledge-sharing context.

5. Discussion of findings

From the iterative and interactive evaluation findings, the faculty research team learned that common purpose, structure, and forums for dialogue and interaction are necessary to teamwork, as are enabling technologies appropriate to negotiating and accommodating quickly and efficiently. Video conferencing was a preferred medium for more sophisticated information sharing across teams. It permitted participants to make their disciplinary tacit knowledge explicit, thus creating sufficient shared understanding to facilitate cross team communication – i.e., to move beyond the 'single lens' of 'discipline bounded' training. Additionally, when we began to schedule time for reflection during video conferencing sessions, interdisciplinary insights began to unfold. We conclude, while 'creative chaos' (Nonaka et al. 2000) is useful within limits, it should be managed to avoid disablement arising from insurmountable differences in experience and expectations of project work, cultural background and time zones, living and working conditions, and technological access, awareness and proficiencies. Discourse and dialogue emerged as a means of advancing collective understanding through information exchange, knowledge sharing and meaning creation illustrated in the POM (Checkland and Holwell 1998) and Ba models. This took the form of defining purposeful actions to be taken in the light of negotiated intentions and accommodations. Building on these models can potentially mediate the challenges present in international collaborations and improve cultural conversance through negotiation of regional, national, or ethno-cultural differences. Preliminary findings also suggest that the socialisation aspect (Nonaka et al. 2000) of Ba could, over time and with proper management, have moderated the continuum of orientations from individualistic to teaming behaviours, and advanced appreciative recognition of other team members' knowledge assets. When the groups depend on enabling and supporting technologies, as in a distributed virtual learning community, these challenges are heightened and therefore need to be consciously addressed. The results, presented and discussed in this paper, suggest significant promise for this user-centered design and evaluation approach when energising interactions of Ba and dialogue-driven insights of POM are embedded into the collaborative learning environment. Additionally, besides addressing facets involved in distributed collaboration for knowledge exchange and knowledge creation, this action-oriented approach implies value for higher education pedagogy; in the interactive and iterative process students demonstrated improved capabilities for their own learning – i.e., for learning how to learn. Such skills are recognised as very important and valuable when educating students for business and industry.

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