Sustaining Collaborative Knowledge Construction in Graduate-Level Education: Examining Design Issues

Hedieh Najafi, James Slotta, Ontario Institute for Studies in Education of the University of Toronto, Toronto, Canada
hnajafi@oise.utoronto.ca, jslotta@oise.utoronto.ca

Abstract: This paper presents a design-based study of a graduate level course that uses CSCL methods to establish a unique pedagogical form of knowledge community. This interdisciplinary seminar is divided into a set of knowledge media themes, with a different group of students leading each theme. With each new offering of the course, students inherit a course wiki that aggregates the content and pedagogical knowledge from prior offerings. For each theme, the student leaders work closely with the instructor to design pedagogical approaches that engage the class in specific knowledge practices that are pertinent to the theme. This study considers the theme of "immersive environments", and analyzes instructor and student actions through three iterations of the course in terms of pedagogical designs and use of technologies.

Introduction and Purpose of the Study

ICT-supported higher education presumably accommodates active learning, facilitates extended collaborations beyond face-to-face class meetings and provides easy-access repository of resources (Chan & VanAalst, 2004; Bonk & Graham, 2006). Yet the controversial evidence about the quality of ICT integration in higher education (e.g. Vaughan, 2007) demands research-informed pedagogical approaches that truly foster social-constructivist perspectives of learning (Fischer, Rohde & Wulf, 2007; Levin-Peled, Kali & Dori, 2007). This study investigates the design processes of an ICT-integrated course in three consecutive offerings and aims to provide an understanding of the interplay among curricular decision-makings, designed learning activities, selected ICT tools and the learning outcomes as the students and the instructor negotiate their expectations from the course.

In this interdisciplinary graduate seminar each week one student-group selects a theme related to educational affordance of digital media (e.g., podcasts), plans before-class activities and moderates face-to-face class meeting. The instructor and the students together choose ICT tools that suit their CSCL needs and that facilitate a progressive record of the course history. The instructor aspires that students from all offerings form a knowledge community, adopting the ideas that characterize course themes as they are addressed in turn.

The following questions guide the study: (1) How do the instructor and his students negotiate the design and implementation of CSCL activities to achieve their learning expectations form the course? (2) How does the work of students in previous iterations affect current students' design to discuss similar themes? (3) How does the technological infrastructure of the course affect the students' learning experience?

Conceptual Framework

Theoretical perspectives of learning and pedagogical practices that overcome "inert knowledge" and "passive learning" are advocated by educational researchers, but difficult to implement within k-12 or higher education courses (Brown & Campione, 1996; Bereiter & Scardamalia, 2003). Complex problems of the "knowledge-society" that require graduates to apply their knowledge to new situations further necessitates these approaches. Many researchers advocate the notion of "Knowledge Community" and "Community of Learners" to support learning (Brown & Campione, 1996; Bereiter & Scardamalia, 2003; Scardamalia, 2002).

A synthesis of the underlying principles of collaborative knowledge construction as declared by these theoretical perspectives yields the following characteristics of an environment that supports deep learning: 1- A deliberate metacognitive layer increases learners' ownership in setting goals, leading discussions, and selecting learning resources. Application of metacognitive skills transcends individuals to the wider community, helping students take responsibility for monitoring and responding to their peers. 2- Collective expertise is distributed among students, instructors, and other experts; every member is knowledgeable in some aspect of the curriculum and contribution from all members is required to improve the current state of knowledge. Instructors have a critical role in a knowledge community and should balance their authoritative status not to suppress students' cognitive responsibility. 3- Supporting a community of discourse is another requirement to fostering learning communities in classrooms. Mastering discourse skills requires constant modeling and practice; e.g., providing opportunities for students to communicate with experts and with their peers. 4- Seeding generative ideas: A community of discourse allows students to propose ideas and discuss them with their peers. Students should identify generative ideas that can be later adopted and improved by other members of the community.

Supporting peer collaboration is central to pedagogical designs to develop knowledge community-like classrooms. CSCL technologies also support a knowledge community perspective in education by extending

peer discussion and easing access to shared artifacts and resources. Despite theoretical promises, ICT-supported higher education courses tend to focus on knowledge transmission, sustain fixed curriculum, include pre-determined learning activities, emphasize individual achievement, use ineffective CSCL tools and employ rigid assessment procedures (Kirschner, Martens & Strijobs, 2004; Selwyn, 2007; Vaughan, 2007).

Study Design and Procedure

This study is best framed as design-based research (Collins, Joseph, & Bielaczyc, 2004), which brings research and practice together and allows for recursive examination of the interactions among multiple design elements. Results obtained and design implications derived from previous iterations inform future research iterations.

This study was conducted over three successive offerings of the "Knowledge Media and Learning" course and is focused on one of the course themes: "The immersive environments." This theme was selected for analysis because it was addressed in all three iterations of the course. Table 1 shows design iterations, participants and data sources. All names are pseudonyms. Students were interviewed after the course was over.

Table 1: Timeline, data sources and participants in each design iteration.

Design Iterations	Participants	Data Sources
1: Jan-Apr 2006	-One PhD student (Judy) -The instructor	-Classroom observation (from 3 iterations) -Interview with Judy, Group2 and Group3 -Course wiki (from 3 iterations) -Instructor's communications with Group2 and Group3 -Focus group with students from iteration1 and 2
2: Sep-Dec 2006	-One PhD & one Masters student (Group2) -The instructor	
3: Sep-Dec 2007	-Two Masters student (Group3) -The instructor	

Analysis

Following an inductive method and informed by the aforementioned characteristic of knowledge communities, data was reviewed after each iteration and emerging themes were identified (Marshall & Rossman, 2006). After the initial analysis, an Activity System framework (Engeström, 1993) (Figure1) was used to investigate the relationships between these components of the course: students, instructor, content and utilized ICTs.

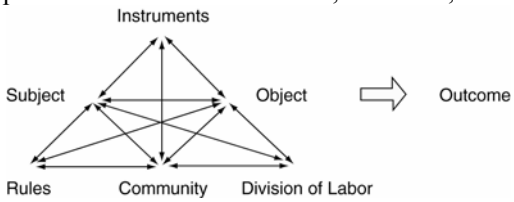

Figure 1. Activity system framework

Activity Theory is a suitable framework for the design and evaluation of ICT applications in education (Russel, 2002) and allows researchers to investigate how newly introduced ICT tools impacts the objects of the individuals and the community, the kind of contradictions that emerge, and the effect of new tools on learning experiences. Tensions between the elements of an activity system are driving forces for innovation and improvement. In this study the activity systems of the instructor and the students who presented the "immersive environments" theme were analyzed. Of interest were actions that the instructor and the students took to respond to the collective object of fostering a sustainable ICT-supported knowledge community.

Findings and Discussion

Design Iteration 1 (Spring 2006): Evolution of a New Course

The course was originally designed as a standard seminar and the instructor had planned to initiate deep, high-level discussions about research related issues pertaining to: "Technology, curriculum and instruction". His design proved obsolete once the class actually met with only two of the four students interested in discussing such topics. Therefore, the structure of the course had to change to be responsive to the new conditions. Once the instructor's original object was no longer feasible, he changed the object of the activity to meta-designing a course to be offered the next term in an interdisciplinary institute within the same university. This format changed the division of labor, requiring students to become co-designers and demanding a higher level of responsibility with regards to the quality of their work. Under the instructor's guidance, the students were expected to propose generative ideas and identify useful resources for the topics selected for the in-design course. According to the instructor, the class gradually moved towards becoming a learning community.

Designing for Immersive Environments

Judy's activity was situated in a tension-intensive context. Yet by the time she was to lead the "immersive environments" topic, she had a good understanding of course expectations in terms of the quality of the

materials and the nature of collaborative learning activities. The instructor maintained close collaboration with the student responsible for each topic and Judy was pleased with the guidance that she received: "[the instructor] was the official course instructor but he was more of a discussion leader. Sometimes he explained things and gave very good analogies of different research designs like fundamentals of it" (Interview data).

Judy wanted to understand "immersive environments" and to help her peers understand them as well. The other three students were given substantial responsibility and were asked to select one of the subtopics, as specified by Judy, and prepare a brief presentation on that. Judy 's role changed into moderating a session where each of the students possessed a certain degree of knowledge and expertise about the topic.

Earlier in the course, the students and the instructor had decided to develop a wiki space to represent their learning experience "… a space where we could capture our discussion which we could all access and edit" (Interview data). After the course ended, Judy and the instructor re-organized the wiki so that future students could better identify generative ideas and use the existing knowledge as a springboard. Consequently, Judy's perspective of the course material became the dominant in the course wiki. Although it is possible to check the original wiki pages through the history, the collaborative nature of the course became less evident in the wiki.

Design Guidelines for the Second Iteration

One outcome of this iteration was a wiki that showed the topics selected by students, pedagogical approaches, and the knowledge base developed during the first iteration. Collaborative development of a technology-supported record of the course became one guideline for the second design iteration of the course. The instructor also deiced to maintain a flexible course outline to accommodate students' interests and expertise.

Design Iteration 2 (Fall 2006): Promoting Student Agency

In iteration 2, the instructor was interested to know how the pedagogical beliefs and expectations for peer collaboration from iteration 1, as represented in the wiki pages, was identified and pursued by new students. During iteration 1 the instructor gradually developed a vision for the course, he still found it challenging to clearly articulate the objectives of the course. The new class spent two weeks brainstorming their learning goals. Although the wiki from the first iteration was introduced early on, the themes did not appeal to the students as they spiraled out of the theoretical material and suggested more recent topics such as social networking. The object of the course remained evolving for the rest of the term, causing confusion for some of students.

The course had a rocky start because the students were new to the idea of designing a course for themselves. However, the instructor noticed that as the course proceeded, the mind-set of the class changed and the students gradually took more responsibility toward identifying their learning goals and planning to enact them. The students in iteration 2 came from faculties across campus including: Education, Information Studies and Mechanical and Industrial Engineering. Interdisciplinary groups could be formed to lead the class discussions. Students made a growing list of specific and more general technological tools. The first topic to be presented was the immersive environment. With 14 students in the class dedicating sub-topics of the theme to every student was impossible. The participation expectation from students changed to: Becoming familiar with the theme of the paper by reading the assigned papers and actively engaging in discussions.

Designing for Immersive Environments

Before the presentation, Group2 divided the class into small groups, assigned each group different papers to read to become "expert" in one aspect of immersive environments. During the class, each groups answered a series of questions posted to a wiki page and used them in the whole class discussion. Group2 worked closely with the instructor but, as one of them mentioned, the instructor refrained from directing their activities and gave them the opportunity to discover their way of framing the presentation.

Group2 explained their intentions as to explore the "variety of ways that these immersive environments could enhance or facilitate [collaborative learning] because the immersive environment have the ability to stretch the boundary of the physical space or reality. So we wanted to understand the possibilities of using the immersive environments that can enhance real world learning" (Interview data). Their search for feasible immersive environments yielded little result, since the functioning immersive environments demanded top of the line computer systems. With the advice of the instructor, they shifted the focus from hands-on experience with immersive environments to thinking collectively about the implications of such environments for learning.

Outcome of Judy's activity, the immersive environments wiki pages, was a starting point for Group2 who critically assessed these wiki pages to separate outdated and usable concepts. The immersive technologies introduced before were mostly non-functional making the object of iteration 1, developing a set of improvable object, compromised. Yet Group2 recognized that the theoretical concepts were still useful. In their wiki pages, they built on the knowledge represented in iteration 1 and added their own ideas with the hope that future students would critically appraise those ideas and further improve them.

In this iteration, the wiki space developed in iteration 1 was introduced to the students as a possible virtual home for the course. Still, the instructor and the students realized that the class needed a communication

medium to maintain contact between the weekly meetings. Considering the abundance of collaboration and communication tools available in Sakai, it was selected to replace the existing wiki. Later, Sakai was abandoned due to continuous technical problems and another wiki platform was chosen. Group2 put a summary of their work in the new wiki and provided a link to the old wiki. Changing technologies caused more work for Group 2 showing one of the challenges of maintaining a sustainable knowledge community.

Design Guidelines for the Third Iteration

Self-evaluation gradually became a part of theme presentation for groups to increase students' agency toward their learning. For students in iteration2, self-evaluation happened in hindsight as a unified template for representing the design and its outcome, as themes was not developed until toward the end of the term. A reflective stance toward learning could encourage the students to advance community knowledge base.

Design Iteration 3 (Fall 2007): Identifying Improvable Ideas

Students in the third iteration had a very different demographic comparing to the second offering, with one third of the class coming from a library sciences branch of information studies. Similar to Iteration 2, the instructor did not solidify the structure of the course and expected the students to overcome their uneasiness with an unusual course. However, he found it difficult not to describe the structure of the learning community of iteration 2: "As in the previous iteration, I found myself doing some quick dance steps in the early weeks to try to convey the key ideas, even as I was still in the midst of figuring those ideas out form myself. But then in the next breath, I would tell them how it would be done- with the themes, and the knowledge activities, etc. There is a fine balance with any student group, because they need some structure and definition." (Interview data) The class demanded more direction and, unlike students in iteration 2, readily adopted existing discussion themes. The structure resulting from iteration 2 was taken for granted although later in the course students slightly let their guards down and experimented with defining the problems they wanted to solve.

Designing for Immersive Environments

The design and implementation of the immersive environment took a drastic turn. The ideas presented by Group3 hardly built on the existing knowledge and with little communication between the instructor and Group3. This group did not meet with the instructor until after they had finalized the presentation plan. The two students in this group had extensive previous experience with high fidelity video games and simulations and assumed little point to share their design with the instructor in order to get his feedback.

When asked how the instructor was involved in their design on of the group member said: "What the instructor did best was to make provocative statements and make us think differently about what we were discussing and that was an effective way to go about it, considering we were discussing new paradigms in technology and education" (Interview data). The instructor, on the other hand, wished to have met with them earlier because Group3 changed the focus of discussion from thinking in terms of designing immersive environments for learning, to "get people to think about what immersive environments are beyond any sort of stereotypical understandings they might have of them" (Interview data). During the class the students worked with different gaming environments in rotational groups. Yet, their activities lacked a collaborative quality.

Group2 hoped that future students critically evaluate their design and further improve it. Instead, Group3 completely changed the nature of the theme. The two students in this group reviewed the last iteration but did not refer to it in during the discussion leading. As a result, is unlikely that other students in the third iteration would have ever visited the work that had been done in the previous iteration. Because the focus of the theme changed without making many connections to what previously had been done, it is hard to decide whether Group2's design for the immersive environments had a capacity to be further developed.

Design Guidelines for the Fourth Iteration

After iteration 3, students from all three iterations were consulted about the changes they would recommend. A recurring request was to decrease the number of the themes to allow for deeper discussion. Also, to make knowledge base more visible the instructor decided to dedicate the first two sessions of iteration 4 to reviewing the course wiki. A comparison of the theme designs and class discussions from the past three iterations revealed a relationship between dominant characteristics of students in a given iteration and cohesiveness of the sought-after persistent knowledge community.

Conclusion

"Knowledge Media and Learning " promotes deep thinking about the implications of new technologies for formal and informal learning contexts. Students are expected to develop a critical understanding of the affordances of various genres of technology while becoming able to flexibly apply their knowledge to new situations (Bereiter & Scardamalia, 2003). Informed by the issues that surfaced in three iterations of this study, it is possible to suggest interim guidelines for similar situations where students co-design their learning.

Despite being at a gradate level of education, not all students may appreciate the diversity of expertise in a learning environment. In the next iterations, it would be possible to explicitly model (Brown & Collins, 1996) the advantages of integrating multiple expertise in designing learning experiences. Moreover, the instructor should make his role as the expert in the learning sciences more explicit so that the student s feel the need to consult with him to ultimately avoid misconceptions about learning and also exaggeration of the strength or weaknesses of technological tools to be used in learning.

As the course gained more structure, the students' responsibility toward identifying their learning needs and designing learning environments to meet those needs may decrease. One example is the course wiki, which in the third iteration became a tool for sharing students' works rather than helping them to frame the learning process. Yet the class could go into a viscous circle if the students in the third iteration were expected to design another virtual presence for the course, similar to what the students in the second iteration undertook.

Studying students' and the instructor's joint effort to co-design a graduate seminar, allowed us to gain an understanding of how the instructor and the students together as a members of a learning community can engage in generative discussions. In the next iteration, the instructor intends to emphasize the conceptual aspect of each theme to balance students' tendency to adhere to applied aspects. Conceptual emphasis can give community members a sense of identity that goes beyond knowledge of ever-changing technological tools.

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