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# Knowledge-Building in an Online Environment: A Design-Based Research Study

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**Abstract**

This paper explores knowledge-building in an online distance-learning environment. The research examines how knowledge-building principles can be translated into online classroom practice for graduate students. Specifically, how do the course components and the online learning environments created in two online graduate courses contribute to student knowledge-building as evaluated by the twelve determinants proposed by Scardamalia (2003)? The results of the study indicated that the emphasis on social interaction and collaboration has enhanced student learning and fostered the socio-cognitive developments for knowledge-building. The course components and the learning environment created in the courses have encouraged knowledge-generation, representation and linked annotations, which helped learners to organize their ideas from multiple perspectives and "integrate them with personal knowledge" (Hannafin et al., 1999). Several significant findings are discussed including the students' strong feelings about community, and new ways of working and interacting in online settings. The students' learning process and products presented in this paper indicate a rich knowledge-building experience.

**Abstrak**

Kertas kerja ini melihat pembangunan pengetahuan dalam persekitaran pembelajaran jarak jauh atas talian. Kajian ini menilai bagaimana prinsip pembanguan pengetahuan boleh diubahsuai untuk praktis dalam bilik darjah atas talian untuk pelajar-pelajar siswazah. Secara khusus, bagaimanakah komponen kursus dan persekitaran pembelajaran dalam dua kursus siswazah atas talian menyumbang kepada pembangunan pengetahuan pelajar seperti yang dinilai oleh dua belas penentu seperti yang dicadangkan oleh Scadamalia (2003)? Keputusan kajian menunjukkan penekanan ke atas interaksi sosial dalam kolaborasi telah meningkatkan pembelajaran pelajar dan menggalakkan pembangunan sosio-kognitif pembangunan

pengetahuan. Komponen kursus dan persekitaran pembelajaran yang dihasilkan dalam kursus-kursus ini telah menggalakkan pembangunan pengetahuan, perwakilan dan hubungkait anotasi yang membantu pelajar untuk mengurus ide mereka daripada pelbagai perspektif dan mengintegrasikannya dengan pengetahuan peribadi (Hannafin et al., 1999). Beberapa dapatan yang signifikan dibincangkan termasuk perasaan pelajar yang kuat terhadap komuniti, cara bekerja baru dan berinteraksi dalam persekitaran atas talian. Proses pembelajaran pelajar dan hasil yang disampaikan dalam kertas kerja menunjukkan satu pengalaman pembangunan pengetahuan yang kaya.

## Introduction

As the number of online courses and distance-learning programmes has increased drastically in recent years, educators have begun to focus on the quality of these courses and programs (Muirhead, 2000, 2001). Researchers (Rovai & Lucking, 2003) claim that it is vitally important to build communities in order to have a successful online distance-learning experience. One proposed approach for community building is to consider knowledge-building communities. It has been argued that establishing knowledge-building communities enables a fundamental change from traditional isolated classrooms to a constructivist pedagogy (Scardamalia & Bereiter, 1992). This paper explores knowledge-building in online graduate learning environments. I start with a brief review of the related literature and a discussion of the theoretical underpinnings of this investigation. I then outline specific course components and the learning environments created in the online courses. Next, I examine the effectiveness of these course components and the online learning environments in supporting knowledge-building communities. Finally, I summarise the principal findings of this study and discuss possible implications and recommendations for future research.

## Collaborative Knowledge-Building

Knowledge-building is defined as "the production and continual improvement of ideas of value to a community, through means that increase the likelihood that what the community accomplishes will be greater than the sum of individual contributions and part of broader cultural efforts" (Scardamalia & Bereiter, 2003). The focus of knowledge-building communities is on developing a collective knowledge base and

enhancing learners' problem-solving skills. A key concept of knowledge-building communities is that knowledge is constructed as the collective goal of a learning community (Gilbert & Driscoll, 2002; Scardamalia & Bereiter, 1994). A critical principle in creating knowledge-building communities is that the learner-produced objects should become public materials that support the learning goals of the community and advance community knowledge, rather than as materials to hand in for grades (Lebow et al., 1996). Knowledge-building, rather than knowledge-replication or retrieval, is central, and "knowledge in this environment is dynamic, and is changed and reconstructed over time" (Gilbert & Driscoll, 2002). The communal approach to learning shifts the teaching, learning process and the focus. Researchers generated four primary traits for knowledge-building communities (Gilbert & Driscoll, 2002):

(i) A focus on knowledge and the advancement of knowledge rather than tasks and projects;
(ii) A focus on problem-solving rather than the performance of routines;
(iii) Dynamic adaptation in which advances made by members of the learning community change the knowledge conditions requiring other members to readapt, resulting in continual progress; and
(iv) Intellectual collaboration as members pool intellectual resources, making it possible for communities to solve larger problems than individuals or small groups can.

In the last decade, interest has emerged in the way computers facilitate the interaction of learners as well as the collective activity which is characterised by authentic, collaborative work (Pea, 1994). It has been argued that technology provides an effective means for implementing knowledge-building strategies that would be difficult to accomplish in other media (Driscoll, 1994). More importantly, according to Scardamalia and Bereiter (1996), KF facilitates knowledge-generation and manipulation. It helps students to form questions, identify information to enter into the database, study the information in the database, and find gaps. Thoughts are dynamic rather than stable, concrete things that get stored, retrieved or navigated. They are constructed and reconstructed. In such a dynamic setting that students are constantly engaged in higher-level cognitive processes.

Technology is critical in knowledge-building processes: "Although in principle you could have the practices without the technology, we have found the technology to be important not only for practical reasons – to overcome the objective obstacles created by classroom conditions – but also for conceptual reasons" (Scardamalia, 2003, p. 75). Previous research has demonstrated that the use of KF supports knowledge-building. This fact, however, should not limit knowledge-building to a specific technological tool like KF. The focus should be on the fundamental principles to support knowledge-building communities, such as promoting discourse among community members and open access to shared information (Jonassen, 1999) rather than any specific technology. Further, exploring knowledge-building using different kinds of technology extends our understanding of the issue and provides practical guidelines for knowledge-building.

## Theoretical Framework

The theoretical framework of this study is the twelve socio-cognitive determinants (I use the term principles hereafter) described in Scardamalia's (2003) work. Grounded in social-constructivist philosophy (Vygotsky, 1978), knowledge-building theory and pedagogy have far-reaching effects. In her recent work, Scardamalia (2003) has proposed twelve principles that, in combination, distinguish a knowledge-building classroom from "even the best of traditional and modern classrooms" (p. 75). These twelve principles are: (1) real ideas & authentic problems; (2) improvable ideas; (3) idea diversity; (4) rising above; (5) epistemic agency; (6) community knowledge and collective responsibility; (7) democratising knowledge; (8) symmetric knowledge advancement; (9) pervasive knowledge-building; (10) constructive uses of authoritative sources; (11) knowledge-building discourse; and (12) embedded and transformative assessment. For ease of reference, I use italics to refer to the specific knowledge-building principles. These twelve ideas are closely interconnected and applying one idea tends to trigger the others. In addition, technology is considered to be a critical aspect of knowledge-building. Table 1 presents the details of these twelve socio-cognitive principles of knowledge-building.

**Table 1** Socio-Cognitive Determinants of Knowledge Building (Scardamalia, 2003)

| Ideas | Socio-cognitive dynamics | Course components designed to nurture the ideas |
|---|---|---|
| Real ideas, authentic problems | Knowledge problems arise from efforts to understand the world. Ideas produced or appropriated are as real as things touched and felt. Problems are ones that learners really care about – usually very different from textbook problems and puzzles. | * Collaborative group project<br>* Threaded discussions |
| Improvable ideas | All ideas are treated as improvable. Participants work continuously to improve the quality, coherence, and utility of ideas. For such work to prosper, the culture must be one of psychological safety, so that people feel safe in taking risks – revealing ignorance, voicing half-baked notions, giving and receiving criticism. | * Threaded discussion<br>* Safe environment created in the course (e.g. netiquette) |
| Idea diversity | Idea diversity is essential to the development of knowledge advancement, just as biodiversity is essential to the success of an ecosystem. To understand an idea is to understand the ideas that surround it, including those that stand in contrast to it. Idea diversity creates a rich environment for ideas to evolve into new and more refined forms. | * Threaded discussion<br>* Safe environment created in the course (e.g. netiquette) |
| Rise above | Creative knowledge building entails working toward more inclusive principles and higher-level formulations of problems. It means learning to work with diversity, complexity and messiness, and out of that achieve new syntheses. By moving to higher planes of understanding knowledge builders transcend trivialities and over simplifications and move beyond current best practices. | * Leadership in discussion |
| Epistemic agency | Participants set forth their ideas and negotiate a fit between personal ideas and ideas of others, using contrasts to spark and sustain knowledge advancement rather than depending on others to chart that course for them. They deal with problems of goals, motivation, evaluation, and long-range planning that are normally left to teachers or managers. | * Threaded discussion<br>* Collaborative group project<br>* Leadership in discussion<br>* Web portfolio |

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**Table 1** (*Continued)*

| Ideas | Socio-cognitive dynamics | Course components designed to nurture the ideas |
|---|---|---|
| Community knowledge, collective responsibility | Contributions to shared, top-level goals of the organisation are prized and reworded as much as individual achievement. Team members produce ideas of value to others and share responsibility for the overall advancement of knowledge in the community. | * Leadership in discussion<br>* Collaborative group projects<br>* Web portfolio |
| Democratising knowledge | All participants are legitimate contributors to the shared goals of the community; all take pride in knowledge advances achieved by the group. The diversity and divisional differences represented in any organisation do not lead to separations along knowledge have/have-not or innovator/non-innovator lines. All are empowered to engage in knowledge innovation. | * Threaded discussion<br>* Collaborative group projects<br>* Web portfolio |
| Symmetric knowledge advancement | Expertise is distributed within and between communities. Symmetry in knowledge advancement results from knowledge exchange and from the fact that to give knowledge is to get knowledge. | * Threaded discussion<br>* Instructor's openness and adoption of new knowledge |
| Pervasive knowledge building | Knowledge building is not confined to particular occasions or subjects but pervades mental life – in and out of school. | * Threaded discussion<br>* Collaborative group project<br>* Leadership in discussion<br>* Web portfolio |
| Constructive uses of authoritative sources | To know a discipline is to be in touch with the present state and growing edge of knowledge in the field. This requires respect and understanding of authoritative sources, combined with a critical stance toward them. | * Tasks (e.g. critical analysis of texts) |
| Knowledge building discourse | The discourse of knowledge building communities results in more than the sharing of knowledge; the knowledge itself is refined and transformed through the discursive practices of the community – practices that have the advancement of knowledge as their explicit goal. | * Threaded discussion<br>* Shared web portfolio<br>* Tasks (critique of each other's project proposal) |
| Embedded and transformative assessment | Assessment is part of the effort to advance knowledge – it is used to identify problems as the work proceeds and is embedded in the day-to-day workings of the organisation. The community engages in its own internal assessment, which is both more fine-tuned and rigorous than external assessment, and serves to ensure that the community's work will exceed the expectations of external assessors. | * Threaded discussion<br>* Ongoing improvement of web portfolio<br>* Informal surveys and discussions with students |

## Purpose and Rationale of the Study

This research examines how knowledge-building principles can be translated into online classroom practice for graduate students. Specifically, how do the course components and the online learning environments created in two online graduate courses contribute/hinder to student knowledge-building as evaluated by the twelve knowledge-building principles? Previous studies on knowledge-building have often been situated in elementary and secondary schools (Gilbert & Driscoll, 2002). This study broadens previous research by examining the graduate-student population. Further, this study adds to the knowledge-base by placing the focus on online courses rather than on traditional face-to-face classes.

Another unique feature of this study is the adoption of a design-based research paradigm, a growing field of educational research. According to Dede (2005), "Design experiments bring together two critical pieces in order to guide us to better educational refinement: a design focus and assessment of critical design element" (p.5). Rather than distancing themselves from the experiment to prevent tainting the research environment, in design-based research, researchers "tinker with both a design and theory to better match their observations with what they had expected to see" (Squire, 2005, p.13). In this study, I used a "design-intensive and iterative redesign approach to developing the … curriculum activities" (Pea, 2002, p.6). Specifically, the twelve principles of knowledge-building (Scardamalia, 2003) guided my design and creation of the learning environments. I intentionally included researchers, educators, and learners in this process.

### *The Learning Environment*

The two courses were graduate courses on educational technology that were delivered online using Blackboard™. To engage students in cognitive and meta-cognitive thinking, I used various activities, resources and tools in the courses. Specifically, four components were designed into the courses, each with a specific function based on principles of knowledge-building community and previous experience.

***Threaded Discussion***

Threaded discussion was used extensively in the courses. The students were required to read weekly textbook assignments and contribute at least two messages to the online discussion per week. Focusing on the promotion of knowledge-construction rather than knowledge-replication, the students were asked to respond with reflections, insights, and thoughtful questions to the readings and their relationship with the real world. Students had the freedom to respond to other messages or start new threads on different topics, such as their own reflection on designated reading assignments.

***Leadership in Discussion***

Students took turns to be the weekly leader(s) for the online discussion. Each week, leaders jump-started the class discussion at the beginning, facilitated and dialogues online and summarized at the end.

***Collaborative Group Project***

The major project used the student-as-multimedia-author-and-designer approach that involved planning, developing and evaluating integrated units of study. Each group was required to create a proposal which described the goals, selected topics, related readings, intended strategies and technology integration. These proposals were published online and the students were asked to respond to each other. The assignment had to be written in ways that everyone could easily adapt and implement.

***Personal Web Portfolio***

To promote a sense of community, the students were asked to develop and maintain their personal web portfolios. Further, students published their assignments, projects, and relevant material in their portfolio which became public material supporting the learning goals of the community and each individual. This portfolio also served as a knowledge-repository and a device to record student growth.

## METHOD

***Participants & Data***

The participants were 25 female and 11 male graduate students who enrolled in two graduate courses. They had diverse educational and technology backgrounds. Most of the students lived at a distance, ranging

from the Middle East to South America, except for three who chose the distance program for the flexibility it provided. All the names used in this paper are pseudonyms. To triangulate data, various data sources were collected for this exploration. First, the whole corpus of the transcription of the discussions was analyzed. The second data source was my reflective journal recording my actions and reflections on activities, administration issues, and the structure in general. This journal included lesson plans and summaries of a wide range of issues that arose from week to week. The third data source was the students' units of instruction and personal web portfolios. The final data source was the anonymous course evaluation conducted by the university at the end of each term. After each course, I carefully analyzed the responses and the information formed the foundation for the revision of my subsequent courses.

***Data analysis***

Two graduate assistants and I, coded and analysed student assignments, their comments and my journal repeatedly throughout the study. Current data were used to drive future design of the learning environments as well as informal conversations and logging activities. First, open coding was used to categorise or label data collected (e.g., this note indicated a weakness of authenticity). Along with open coding, axial coding was used to make connections between various data categories or to subdivide a category. During this process we looked for explicit links between these categories and the twelve principles of knowledge-building. We always coded data independently first, searched for negative examples, and then arrived at consensus through discussion. When the final round of coding was finished and the categories determined, the categories were carefully mapped into the Twelve Principles. There were some categories that did not fit into any of the principles. These were grouped into two categories and presented in the section "pitfalls and difficulties" and "new ways of working."

## Results and Discussion

In this study, the twelve knowledge-building principles (2003) were used not only as the criteria for the examination but also as the organisational structure for the presentation. Because the twelve principles were intertwined and one could trigger another, in some cases, the results reported in one section could present more than one principle.

***Real ideas, authentic problems***

The first knowledge-building principle focuses on the authentic problems that learners really care about. Ideas in knowledge-building environments should reflect the reality in the world (Scardamalia, 2003). In this study, two pedagogical approaches were designed to promote authentic learning. First, the parameter for the final project was intentionally broad to give students freedom to choose a topic of interest. In addition, students were encouraged to find real "clients" for their "instructional units" to make the task more authentic. The real "clients" could be anyone including their classmates, or other departments of their schools/organisations. The analysis of the final project showed that nine out of sixteen units had real clients. This process of working with real clients sparked the students' genuine interest in learning and working on the problems. The students were highly motivated because their work was put to some use. As exemplified in Jane's final reflection:

> "…My project with Kyle has been a dream. He is so collaborative and a good teacher… The best thing is he will use this as a teaching guide which makes it more interesting…. I highly believe in these application projects. It helps ground all the ideas and theories into a relevant item. As well, it allows me to really understand each of them…"

The second approach to promote authenticity was that the students took turns in leading weekly threaded discussions. This strategy fostered students' ownership and self-direction in learning. The students were empowered by taking more personal responsibility for their own learning. The reading and responding tasks became more authentic because the learning questions were coming from them so the key issues were evolving from their own practice and were related to their concerns. In addition, students were able to exercise leadership roles and this approach put them right into the role they would need to play in their future work. In their final reflections, many students indicated that they benefited from this activity:

- This exercise is rewarding, I appreciated the opportunity to experience the instructor's side of the distance-learning equation which is just as important as the participant and learner side of the equation [Ken].
- The weak of being "group leader" is stressful but a necessary part of growth in a learning community [Janet].

- The task of being group leader? It was a great opportunity to really learn about facilitating online and what a challenge it can be [Kent].

This assignment engaged students in a higher-order thinking process such as synthesis and critical analysis, which ultimately led to knowledge generation. This process not only allowed students to experience quality learning, but also provided a good model of the appropriate integration of technology into practice.

***Improvable ideas and idea diversity***

The second and third principles address improvable ideas and idea diversity. These two principles are closely related. According to Scardamalia (2003), no idea should be treated as something that is cut in stone in a knowledge-building environment. Rather, all ideas should be worked continuously to improve their quality, coherence, and utility. Students need to feel safe to take risks – revealing naïve thoughts and constructively critiquing each other's work. In the courses, creating a safe environment was a high priority. At the beginning of each course, a policy was established emphasising the netiquette – etiquette guidelines for posting in online environments. This policy set the tone for the whole course and helped to establish a non-threatening learning environment. During each course, thousands of messages were posted and numerous ideas were shared; the tone was always friendly, warm, supportive, and encouraging. On several occasions, even though students took contradictory positions, none of the discussions was hostile. Rather, students felt very comfortable sharing their ideas, emotions, and even depressions in this environment. For instance, Heather posted a long message expressing her frustration in the third week. She questioned the applicability of the learning theories we were discussing (detailed in Epistemic Agency and Pervasive Knowledge-Building). This message had drawn everyone's attention and responding messages flooded in. In fact, it attracted the highest number of responses within 24 hours. Students shared their own thoughts, ideas, feelings, and even personal stories. Newly learned theories were applied to real life situations. This account showed evidence of the formation of a true community:

> "…Heather… I think it is totally cool that you shared your day and frustrations with us!!!! To all those negative people out there who say distance ed can't work and that in this type of environment,

> relationships cannot form — HA HA HA! Look at the result. I am inspired by everyone's words and I have no doubt that you have been affected by them too! This is a community – not just of learners, but of people…."

The courses apparently created a non-threatening atmosphere in which students freely expressed their ideas. They openly identified problems, discussed possible solutions, and took the risk of applying their learning to reality. Their ideas were encouraged by the whole community. The learning was enhanced through the comparison of ideas, awareness building, careful consideration of practice and connecting knowledge and experience.

Another approach to foster idea diversity and improvable ideas was the exercise of critiquing each other's project proposals. Students were required to provide constructivist feedback to others' ideas as well as taking up others' suggestions to refine their own projects. This exercise helped students to improve their ideas and advance their knowledge. They worked continuously to broaden the scope, raise the quality, test the applicability, and refine the pedagogical approaches. Their understanding was greatly enhanced by this discursive process.

> "…I really liked the idea of responding to everyone's proposal – it gave us all the chance to see what other groups had done, and I found that I really had to put some thought into what improvements I could suggest/feedback I could give…." [Alex]

One example that shows the support for diverse and improvable ideas was the account of changing the format of the threaded discussion. At the outset, the threaded discussion was designed to have a question-and-answer approach. In the second week of the course a simple questionnaire was sent out to the students asking for their feedback about the course. One student responded that the standard questioning/answering way of threaded discussion was good at first but it became very boring after a number of courses (since distance courses are often delivered this way). I thought this was a valid point, but was not sure about other formats. I turned to the students and posted:

> "…I really like the idea of trying different formats for threaded discussions. However, to date, I can only think of one different format: debate…I would like you to think creatively about different formats for threaded discussion & encourage volunteers (group leaders) to try different formats…."

This motivated students and a number of suggestions were discussed. As the term unfolded, various approaches (including role playing, debating, and mock interviewing) were used. Students really enjoyed this and commented that they were "sceptical at the beginning but … discussion turned out to be one of the highlights of the course" [Anne]. The idea of changing the discussion format had arisen and evolved during the course, resulting in unexpectedly fruitful outcomes. I modelled not only accepting criticism, but also taking up the criticism and turning it into appropriate pedagogical strategies. This openness provided a role-model for students to accept diverse views, to share tentative but improvable ideas, and constructively give and receive criticism.

***Rise above***

The fourth knowledge-building principle relates to the idea of rise above. Knowledge-building entails "learning to work with diversity, complexity and messiness, and out of that achieve new syntheses" (Scardamalia, 2003), and moves to higher level of understanding. To support this, I designed weekly leader synthesis of discussion. In this exercise, leaders had to practise higher-order thinking such as analysing diverse views, juxtaposing similar and contradictory positions, and synthesising different ideas. For instance, Jane did an excellent job in facilitating the first week's discussion which resulted in rich and flourishing dialogues amongst students with over 250 messages generated within a week. This flood of messages, however, contained its own challenge. She confessed that:

> "…As I began to approach the synthesis part of the discussion, apprehension was mounting. The responses were rising to the 250 mark and I was unsure how I could possibly put all of those responses in some reasonable format that would make sense, be easy to read and act as a reflective tool for us as we progressed through the course…."

Her summary was a comprehensive synthesis of the discussion and an "authentic and informative piece of work" [Vicky] that was referred to

many times in the following weeks of the course. Students used this information to help form their decisions and to support their arguments. As shown in this case, the students went beyond trivialities and were able to draw important issues out of convoluted situations. The students' understanding of the content was enhanced through this process and knowledge-building was fostered.

***Epistemic agency & pervasive knowledge-building***

The fifth principle addresses epistemic agency and the ninth principle focuses on pervasive knowledge-building. In essence, learners in knowledge-building communities "set forth their ideas and negotiate a fit between personal ideas and ideas of others" (Scardamalia, 2003, p. 76). Knowledge-building should not be restricted to school learning or any particular occasion; rather, it is pervasive in daily life and work (Scardamalia, 2003). The course components designed in this online environment encouraged pervasive knowledge-building and helped democratize knowledge because it was difficult to take a free ride:

> "…I found that the online course was designed in such a way as to engage the learner in collaboration and interaction to enable learning to take place. There was no way that one could 'sit back' and observe…" [Bill].

The transparency of this environment encouraged every member in the community to engage in knowledge-innovation.

> "…The distance delivery model really facilitates the construction of knowledge. The face-to-face classes I have taken tended to set up the proof as the source of all knowledge. In distance courses, I find I make a greater attempt to build understanding on my own, prior to seeking out the proof. I used to expect to memorize a lot of information; I now expect to think more deeply, question my own thinking more deeply, and memorize fewer isolated facts…" [Mark].

Knowledge-construction was no longer restricted in any particular setting but pervasive in all occasions. For example, in the week of learning theories and philosophy, Heather posted this message:

> "… Today a more caustic but very grounded colleague informed me that kids don't sign up for my courses because they are too hard, because I actually expect the kids to think, because I don't do worksheets and I have courses that aren't spoon-fed and regurgitated… I just sat and became more and more dejected as he continued on…

I was so excited last Monday because I was given a new course. I explained to the students that we had to follow the Curriculum but the sky was the limit in how we did it. Did the kids get pumped because there wouldn't be worksheets and it wouldn't be a prescribed, laid out curricula where they just came and vegged and then wrote an exam? … Only two students stayed … I had a colleague dump all over me because I was being creative and stomping loudly outside the "teacher" box. Also, what about the time that we (the students and I) designed a course based on their desires? Enthusiasm lasted about a week and the familiar refrain was – this is boring! As you can see, I am bummed and am in desperate need of validation and verification that the idealism continues to be the right and true course to follow. Do I side with the cynics and "step into reality" or do I continue on my naïve way, thinking that maybe the constructivist way would work, that kids really do want to learn and be a part of what happens to them?..."

Everyone was attracted by this post. Messages flew back and forth to explore ideas, to provide insights and to generate new thoughts. They discussed their confusion, compared multiple viewpoints and reflected on their individual and shared understanding of the theories and problems they encountered. This examination of learning theory against reality suggested the epistemic agency? "personally held beliefs are viewed in relation to ideas suggested by others and by everyday phenomena" (Scardamalia, 2003) as well as pervasive knowledge-building. Here, learning was no longer restricted to any particular setting; it was woven seamlessly into their daily life and work. Later, Heather posted the note:

> "…Thank you for all the support!" You people are amazing. Thank you so much. Two quick anecdotes to amuse you.… New student joined the course today because the word spread that we were doing something cool! Scenario: Grade 8 class. Rotten reputation for being horrible – noisy, disruptive, obnoxious, rude, disrespectful … I had them yesterday for the first time and they gave me a pretty rough ride. So, I hitch up my pants and think about all the "stuff"

> that we have been reading and discussing and get right down to creating the lesson to end all lessons. They show up today ready to make mincemeat out of me but noooo, I am ready for them. Killer lesson coming up. I had them – no wisecracks, no redness or disrespect. All eyes on the front and squeals of joy every once in a while. This lesson had them engaged, it had them motivated, it had them captivated, it had them entranced …"

It was evident from this example that the students' learning and their understanding of the content, in this case the learning theories, had reached a higher level. Students were actively engaged in testing knowledge presented in books in their daily practice. The discussion provided students with opportunities to analyze different learning theories and examine them in the context of their own practice and daily life.

**Community Knowledge, Collective Responsibility and Democratising Knowledge**

The sixth and the seventh knowledge-building principles are closely related ideas addressing community knowledge, collective responsibility and democratising knowledge. In a knowledge-building community, contributions to the shared goal of the community are as important as individual achievement. Everyone is responsible for the development of the knowledge in the community and "all participants are legitimate contributors to the shared goals of the community; all take pride knowledge advances achieved by the group" (Scardamalia, 2003, p. 75). The increased social interaction, stimulated by the course design, fostered students' knowledge-construction. For example, many students commented that "the online discussion has been the most enlightening place to be" [Becky] or "I think online discussions are imperative" [Cathy]. Bev commented at the end of the course that "I can't thank the people in this course enough for being so understanding and supportive. Who says that online doesn't build community; I truly feel like there are relationships here that would never have existed in face-to-face."

In the courses, conceptual artefacts such as written assignments were shared in open workspaces. These artefacts were not treated as final, definite outcomes or entities only for grading. Instead, ideas and insights were refined, revised, and evolved through the community's collective efforts that were reflected by reading, critiquing and building on each

other's work. This attitude resulted in synergetic advancement of knowledge in the community. For instance, when critiquing each other's proposal, Ben was interested in a group project that used iMovie for language art and science. He requested: "I hope that you will allow me to try this out with my grade 11's. I will then be able to give you some kind of formative evaluation of the program." This was carried out later and Ben's feedback provided a solid foundation for the revision of the final project. In addition, collaborative group work in the courses supported the development of community knowledge and sharing of collective responsibility. Although most of the students were working at a distance and had never met, the evaluation of final projects as well as the development process reflected in the courses indicated that all the groups worked successfully together.

**Symmetric Knowledge Advancement**

The eighth knowledge-building principle deals with symmetric knowledge advancement. In essence, knowledge-building is not limited to students but distributed among members in the communities (Scardamalia, 2003). In this study, symmetric knowledge advancement was apparent in my enhanced understanding of the e-pedagogy for online learning. Since online teaching and learning is relatively new, there is a lack of comprehensive understanding of the most effective pedagogical approaches. I need to explore and learn in the process of online teaching, along with my students. For instance, no space was initially designated for me to post important announcements or to discuss issues pertaining to the whole class. During the course, students posted some suggestions and recommended readings. Learning from this, I added a "virtual office" folder in threaded discussion. Students were very happy about this change because they no longer needed to worry about important instructional notes being missed or buried in a flood of messages. One commented that "this is an excellent idea – the first time I've seen this being used in any of the courses I've taken" [Mark].

**Constructive Uses of Authoritative Sources**

The tenth principle describes constructive uses of authoritative sources. In knowledge-building communities, learners need to explore and examine the current state, new trends, and issues in the field in order to understand

a discipline. This inevitably calls for thorough understanding and critical examination of authoritative resources (Scardamalia, 2003). In the courses, I used textbooks and other initial readings to provide basis. More importantly, everyone was encouraged to find and share new information. Each week, the leaders were required to summarize the new information, including the citations shared in the discussion. All the references and other tangibles were collected with annotations and shared in a central folder called "Resource Forum." At the end, a useful and consolidated list of resources was generated.

Another approach that fostered constructive use of authoritative resources was the critical examination of the textbooks and readings. I emphasized that they should consider me as a regular participant in discussions and I encouraged everyone to discuss, question, and even challenge my views. This promoted not only the respectful understanding and absorbing of authoritative resources, but also the constructivist building of knowledge. For instance, an instructional design model named "FACTS" was presented in a textbook. The leaders, prompted by scepticism, challenged their classmates:

> "… In [this week's reading, the authors] advocate the FACTS model for instructional design. It is an algorithmic model that uses a fairly linear method of creating a course design. What is your opinion of this model? Is it flexible enough to work in a real-world classroom?..." [Bob].

This call for critical examination of the authoritative texts by putting theory into practice sparked a lively discussion. Everyone presented his/her ideas about the model, its relationship with various learning theories and its practicality. Some thought it was an excellent tool while others questioned its usefulness. Joan responded:

> "… I find this model to be incomplete and I'm unsatisfied with it. I find that some "pieces" or "processes" of instructional design are missing. I did not see anything about the learners? Also the language used is not what I'm used to see. For example when I read "learning environments are instructional strategies" (p. 61) … that's not the way I see things. I like to see the environment and the strategies as two distinct categories …".

David echoed this and added: "As far as the question of flexibility, I think this model's greatest foible may be its flexibility. The model seems to try to be all things for all people. As a result, it is a compromise." Others, however, had different views. Sam suggested:

> "…When I first saw the diagram for the FACTS model, I was prepared to dislike it. It looked very algorithmic. However, after reading more about it, I found it to be much more flexible than I had first thought … A number of posts have commented on the lack of any visible part designated for the student. I am unsure whether I would want that to be the case, as this could lead to a compartmentalisation of the student in the design process. It might be better to not have a piece of the puzzle labelled "student", and instead have student considerations be omnipresent in all parts of this design model ... My fear is that by establishing a separate category for student, this will lure developers into a false sense of security – think of the student at this point in the development process, and then you're done with it and can move on…"

A healthy debate occurred and the students were fully engaged in the discussion. The constructive use of authoritative resources was in action. Students did not just sit there and passively accept what they were taught. They critiqued different theories, identified multiple perspectives, examined advantages and disadvantages, compared diverse and even contradictory realities, analyzed and articulated their prior experiences, and integrated theoretical ideas and concerns. All these, in turn, enabled them to internalize theories and content.

Learning was fostered by the students' perceptions of what they were learning rather than my interpretation or experts' opinions; hence, knowledge-building was nurtured. The debate, weaving together practical and theoretical perspectives, guided students' attention to conflicting ideas and increased the likelihood of exposing inconsistencies, gaps and misconceptions. These conflicts, inconsistencies, gaps and misconceptions were recognized, challenged, modified, corrected, and reconstructed. The process engaged students in self-monitoring contradictory thoughts and constructing new knowledge, and therefore built coherent understanding of the content.

## Knowledge-Building Discourse

The eleventh principle concentrates on knowledge-building discourses. It is claimed that the discourse shared in a learning community should result in … more than the sharing of knowledge, the knowledge itself is refined and transformed the discursive practices of the community practices that have the advancement of knowledge as their explicit goal … [ideas and problems] emergent rather than predetermined goals and workspaces (Scardamalia, 2003, p. 78).

As shown in previous examples, the discussions in the courses supported knowledge-building discourse. For instance, the format for threaded discussion was changed from standard question-and-answer to various approaches such as debating and role-playing. This was an unexpected result from the discussion of the boringness of the standard approach. As it turned out, this variation of format enhanced student learning by boosting students' interest and forcing higher-order thinking. In nine out of twelve weeks of discussion in one course, leaders took the initiative and adopted different formats other than the standard question-answer approach. One week, the leaders set up a scenario and assigned each student to one of three roles: teacher, administrator, or technical supporter. In the first half of the week, students discussed this scenario in their group in private forums based on these roles – reading and participating in other group discussions was prohibited. In the second half of the week, all students went back to the main forum and had a general discussion. This time, the private forums were made public, so everyone could hear the discussions that had taken place in each group.

The first part of the discussion was interesting and informative. What really fascinated the students was reading other perspectives found in each private forum in the second half of the discussion. The multiple perspectives and even contradictory views provided in these dialogues enhanced the students' understanding of the issues. The students needed to put themselves into other people's shoes. This process forced them to move out of their comfort zone and appreciate a different reality. This experience inevitably caused them to seek out new knowledge, apply it to a real-life situation, and internalize their understanding. They questioned assumptions that they had taken for granted and broadened their

perspective. This circular growth of knowledge resulted in widely applicable and transferable knowledge.

**Embedded and Transformative Assessment**

The last knowledge-building principle is embedded and transformative assessment. To foster knowledge-building, assessment needs to be an integral part of knowledge-advancement. It helps to identify problems as the work proceeds, and it improves learning. "The community engages in its own internal assessment, which is both more fine-tuned and rigorous than external assessment, and serves to ensure that the community's work will exceed the expectations of external assessors" (Scardamalia, 2003, p. 78). By emphasising the weekly discussion, the design of these courses embedded assessment into daily learning. The daily exchanges allowed me to discern problems quickly and make adjustments accordingly. In addition, using various methods to include formative and summative assessment allowed parallel advancement of knowledge-building and evaluation. For example, the issue of boringness in threaded discussion was identified by an informal survey and was consequently addressed by the revised pedagogical approaches. The final outcome of a varied format for threaded discussion became a highlight of the courses, and emphasized the importance of the embedded assessment in promoting knowledge-building.

**Pitfalls and Difficulties**

Despite the success of the courses, there were pitfalls and difficulties. One such issue was related to online discussion and learning tasks. In the first class, although most students commented that they really enjoyed the discussion and benefited from it, one student remark at the end of the course caught my attention. The student wanted to have more emphasis on specific learning tasks in order to acquire practical skills. Although discussions help conceptualize the content and create a safe and collegial environment, he wanted more guided learning tasks to connect theory and practice. Mindful of students' workload, I designed some small tasks as alternative assignments in my next course. The results, however, were not as predictable as I had thought. Many students chose to do the tasks and consequently, there was a lack of lively discussion. Two students expressed, in their final evaluation, a sense of loneliness. Although this

feeling of isolation was well documented in previous research, it was such a contrast with the previous online course (see "Improvable Ideas and Idea Diversity"). The issue of balancing online discussion and meaningful learning tasks has never been so critical.

Difficulties arose in embedding assessment in daily interaction. For instance, giving 40 percent weight to weekly discussion was appropriate in order to get students' attention and involvement. Evaluating the students' contributions, however, was difficult and time-consuming. As suggested in previous research (Hill, Wiley, Nelson, & Han, 2004; Kearsley, 2000), interactive online courses result in a heavy workload for both instructors and students. In one course, a total of 1218 messages were posted with an average of 61 messages per student. The highest number of posts of a single student was 123 while the lowest was 33. It was difficult, if not impossible, to check whether students had read a message (the system only indicated which file was opened but not by whom). Qualitative content analysis might determine whether a message was read by a particular student, but this approach, would require many laborious hours.

Another difficulty related to the lurking phenomenon. As suggested in previous research (Schultz & Beach, 2004), lurking (i.e., reading messages without contributing in online environments) is common in online environments. In the classes, several students were lurkers. One posted only 39 messages but had read 1127 items (as indicated by the computer system), and another posted 56 messages and read 1385 items. How this should be integrated into assessment remains to be answered. A third difficulty of evaluation dealt with technical problems and instability associated with online environments. For instance, Blackboard™ crashed twice during a course when students had trouble sending messages and, in some cases, the author's name was changed. This incident and numerous computer difficulties affected my ability to accurately evaluate the student learning process.

**New Ways of Working**

One theme identified from the analysis of the data was the fundamental change of ways of working, interacting and communicating. Concentrated listening, focusing on one task at a time, was no longer the best or the only

way to learn and interact. Some students preferred online learning over f2f learning for psychological reasons, as exemplified in Cathy's message:

> "…Right now, I am listening to the radio, have a text open in front of me, am typing this message, and am stopping to doodle when my thoughts stop. I have your message open to refer back to and have two programs opening on my task bar. It's great! I feel motivated and focused in this environment. In the physical world – this would not be a positive way for me to have a conversation. In fact, I often feel guilty when I'm at a meeting and start doodling. Without the "information overload" I find it hard to stay focused! Crazy isn't it?!..."

This suggested that students' ways of working have changed in cyberspace. Learning in a comfortable and relaxed? Both mentally and physically – setting, students could "swim freely in the knowledge sea". Their motivation increased and they became more focused on the learning tasks. In contrast to previous results (Rovai & Lucking, 2003), my students found it was not hard to express feelings and share emotions. Responding to Cathy's message, John posted:

> "Wow Cathy! They say that it's difficult to express emotions in the online forum but I must say your enthusiasm and excitement jumped right out of my computer monitor."

Students learned to adapt to this new learning environment and it possibly impacted their way of thinking:

> "I must say, I've got better about communicating in the typed format. It still requires more thought… that is a good thing because I can make more meaningful contribution to online discussions than f2f discussions [Jacky]."

## Conclusion and Implications

Examining the online graduate courses through the lens of the twelve socio-cognitive principles of knowledge-building, we can see that it is possible to establish a knowledge-building community online in higher education and to create a culture in cyberspace. One significant finding in this study relates to students' strong feeling of a sense of community and more importantly, they established "relationships that would never have

existed in face-to-face". I was surprised to read this and wondered what caused it. I probed further. Students contributed this to the safe environment established from the early stage of the course. Another vital factor is that students felt easier to take risks and share sensitive ideas:

> "… I share my thoughts on learning and feel no fear in experimenting with my thoughts and ideas in the digital world. But do I find it nearly as easy to express my thoughts in person, in a physical world – no way!!! One reason is that I feel a certain security in the digital world which allows me to throw out my best and take risks that I might not in person. And as a result, I do prefer to learn this way – socialized, but physically isolated…" [Cathy].

This finding suggests that it is possible and even desirable to establish communities online for a couple of reasons. Because students can build such strong relationships, they are more willing to share tentative ideas or prickly issues. This strong sense of community fosters knowledge-building through democratising knowledge, improvable ideas and idea diversity. One important theme emerged is that changing the environment has fundamentally changed students' ways of working and communicating. This result confirms that pedagogical, ideological, or philosophical ideas cannot be simply copied from f2f to online settings. One implication is that thoughtful critiques and careful consideration of appropriate e-pedagogies is vital in order to facilitate successful knowledge-building in this new learning environment.

Knowledge-building in an online environment is not always positive or problem-free. Indeed, a number of issues arise from this study. Special concerns in the delivery of distance-education deserve our careful consideration. One issue identified in this study is the paradox between the call for blending synchronous and asynchronous communication and the need for the flexibility provided by the asynchronous mode. The courses were designed in the asynchronous mode only to accommodate the geographically dispersed student population. Aaron, who lived in the Middle East, indicated that "I'm working around a 10-hour time difference, not to mention different weekend days (weekends here are Thursday and Friday). I specifically chose this course because there were no synchronous sessions planned." Despite that students believed that a true knowledge-building community was established, few still felt the need for synchronous interaction. They suggested that the asynchronous

mode, coupled with a few formal synchronous sessions, would be the best approach.

A significant issue identified in this study relates to the new ways of learning, working, and communicating in online environments. As indicated in this study, some students enjoyed learning in this physically isolated, yet mentally connected, learning environment. It is probable that this fundamental change in the way of working and communicating will also change students' ways of thinking and knowledge-building. Further research focusing on these aspects is highly recommended.

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