Fostering Collaborators and Deep Learners through Knowledge Building among Chinese Tertiary Students

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Abstract: In this study, we designed and examined a principle-based knowledge building environment that aimed to (a) promote collaboration, deep learning and domain understanding among Chinese tertiary students, (b) characterize knowledge building discourse patterns to understand the changes. The quasi-experimental design involved two groups of students: one in knowledge building environment (KB), the other in technology enriched environment (NKB). Questionnaire survey results showed both environments students improved on conceptions of collaboration and approaches to learning, but only the KB students acquired significant improvement. Also, students in KB environment outperformed their peers in NKB environment on domain understanding. The knowledge building inquiry thread analyses indicated students in KB environment were more engaged in Knowledge Forum (KF) and able to contribute discourse with high-level knowledge advances. The results also showed a trajectory of knowledge building process, suggesting students move toward deep learning, understanding, and emergent knowledge advancement by assimilating knowledge building principles over time.

Keywords: Collaboration, learning approaches, knowledge building principles, inquiry threads

Introduction

Educational reform in China, as articulated by the *National Outline for Medium and Long-term Educational Reform and Development* (*from 2010 to 2020*), emphasizes the needs of establishing a learning society, promoting lifelong learning, and fostering high quality talents with innovative abilities. Elsewhere in the world has witnessed an emerging theme of research focusing on developing people's capacities for knowledge creation, inquiry and collaboration (Chan, 2011). Research on computer-supported collaborative learning (CSCL) has demonstrated its huge benefits to students, for example, higher-order thinking skills, active involvement in the learning process, and improved classroom results (Roberts, 2005). However, problems and challenges remain. For example, implementing innovative approaches in teaching and instruction is difficult in higher education, and simply putting students in a CSCL environment does not necessarily generate deep learning and collaboration (Hewitt, 2005; Kreijns, Kirschner, and Jochems, 2003). Research on students' learning has revealed students' beliefs about learning and approaches to learning may predict their academic performance (Biggs, 1999; Law, Chan, and Sachs, 2008). However, most of the studies are correlation studies and fewer of them have examined designing a CSCL environment that brings about changes in learning approach through instruction. Much more evidence is needed to investigate learners' beliefs on collaboration and how collaboration can be fostered and contribute to learning in complex educational

settings. The goal of the study is to design and examine a principle-based CSCL environment to foster collaboration, deep learning, and domain understanding in the context of higher education.

1. Theoretical Perspectives

Over the past few decades, perspectives on learning have emphasized its distributed, social, and collective nature, and learning is often examined when mediated by the use of technology (Bereiter, 2002; Sfard, 1998; Stahl, 2006). This study adopts the knowledge building model (Scardamalia and Bereiter, 2006), a forerunner of CSCL, to examine students' changes in collaboration, learning approaches as well as domain understanding when they are engaged in a designed learning environment. Knowledge building focuses on knowledge creation as a collective work of a learning community. Ideas, which are improvable by means of discourse, are posited at its centre. To support student discourse, Knowledge Forum (KF) is designed to transform classrooms into a knowledge-building inquiry community (Bereiter, 2002; Scardamalia, 2004). KF provides "Scaffold" tools such as "My Theory", "I want to understand" and "Putting our knowledge together" to support and objectify the creation and improvement of ideas manifested in the form of notes (See Figure 1).

Scardamalia (2002) has proposed a system of 12 knowledge building principles to facilitate and examine the socio-cognitive and socio-technological dynamics of knowledge creation. Principles such as *improvable ideas, epistemic agency, collective responsibility, and constructive use of authoritative sources* are often cited by the international community working on knowledge building model to design conditions needed for both individual and collective knowledge growth. A wealth number of studies have been done in the investigation of knowledge building classroom practices (Chan, 2011; Lee et al., 2006; van Aalst and Chan, 2007; van Aalst, 2011; Zhang et al., 2007).These studies revealed the effectiveness of implementing knowledge building model in literacy development and depth of inquiry. However, many previous studies were done in schools and in discipline of science or science-related fields. Fewer empirical studies on knowledge building inquiry were done in the domain of business studies at the tertiary level against the Chinese background. In ijCSCL's first paper from Mainland China, Ge (2011) reported tertiary students major in engineering in Beijing disliked collaboration despite the fact that Chinese people have been traditionally ranked high in the collectivist cultural dimension (Hofstede, 1980). Ge's study also indicated students' strong reliance on teachers even they had been put in a CSCL environment for as long as a school year. This gave rise to the issue as how instruction could be designed to turn agency over to the students and to facilitate collaboration.

Biggs (1999) points out that the concepts of surface and deep approaches to learning are very helpful in conceiving ways to improve teaching and learning. An important goal of twenty-first century education is to cultivate deep learners. Many studies about learning approach have been conducted in traditional classrooms. It is interesting to see how student learning approach may or may not change when they are engaged in CSCL environments. Few studies in the past have linked students' conception of collaboration with student approaches to learning and domain understanding, especially in a principle-based learning environment. Researchers have differentiated students' inquiry discourse on KF as knowledge sharing, knowledge construction and knowledge creation (van Aalst, 2009); it is meaningful to discern how they are manifested among students and how they may be related to students' conceptions of learning, collaboration and domain understanding.

Therefore, two research questions are included: (1) what are the effects of the designed learning environment on students' conceptions of collaboration, learning as well as domain understanding? (2) what characterize students' knowledge building discourse and how they may be related to students' changes in the learning environments?

2. Method and Design

2.1 Participants and procedures

The participants were two intact classes of first year university students in a good business-and-economics-oriented university in Shanghai, China. A quasi-experimental design examined the effects of a principle-based knowledge building environment (KB, n=30) and a non knowledge building environment (NKB, n=30). The KB environment was characterized by KB theory, pedagogy and principles, coupled with KF, the technology platform. The NKB environment was a typical teaching environment which was composed of teacher's lecture and students' discussion; there was no KB principles governed, however, KF was also used due to the school policy for comparable educational experience. More importantly, by adopting KF to both classes, we could examine closely whether it was merely the inclusion of technology or the deeper impacts via knowledge building principle-pedagogy-technology that might contribute to changes. Both classes were taught by an experienced instructor who had taught in higher education for 12 years and observed KB teachers' meetings frequently and accessed a large amount of KB discourse. The course in this study was titled Introduction to Business, which was conducted in two semesters of academic year 2010-11. Each semester had 12 teaching weeks and each week had two lessons, which was 1.5 hours in length. English was used as the medium of instruction. Students had face-to-face discussion and inquiry in class and wrote computer notes on KF after class. For the KB environment students, the above-mentioned KB principles were explicitly mediated, for example, they were asked to give presentations regularly to track, reflect, and think about ways to improve their online discourse; For NKB class, students were encouraged to use KF as a new technological platform to communicate and learn; no explicit KB principles were introduced to them.

2.2 Design of a knowledge building environment

To foster collaboration and deep learning, we designed a leaning environment based on knowledge building pedagogy. (1) *Cultivating a collaborative learning culture*. The first few sessions provided the students with learning experiences which familiarized them with the technology and acculturated them into the practices of collaborative inquiry. A focus was placed on making ideas public on KF *view* (Figure 1) and assuring them psychologically safe in contributing ideas to KF. (2) *Developing knowledge-building inquiry*. The course included some big, core ideas, which were tailored into a progressive curriculum (Caswell and Bielaczyc, 2001). Student through face-to-face and online discourse, elaborated what they know about the topics, set forth their theories, and explored the answers in a cyclical way. (3) *Improvable ideas and emergence*. Students worked continuously to improve the quality, coherence and utility of ideas (Scardamalia, 2002). Agency was turned over to them to create, revise and refine ideas. As inquiry went deeper, they even self-defined goals and activities for solving emergent problems, and the teacher acted as a facilitator and co-inquirer. (4) *Formative assessment*. Concurrent formative assessment played an important role in the design. Students were involved in classroom reflective presentations and group electronic-portfolio assessment during semester 1 and 2

respectively, which were used to scaffold learning, collaboration as well as characterize collective knowledge advancement.

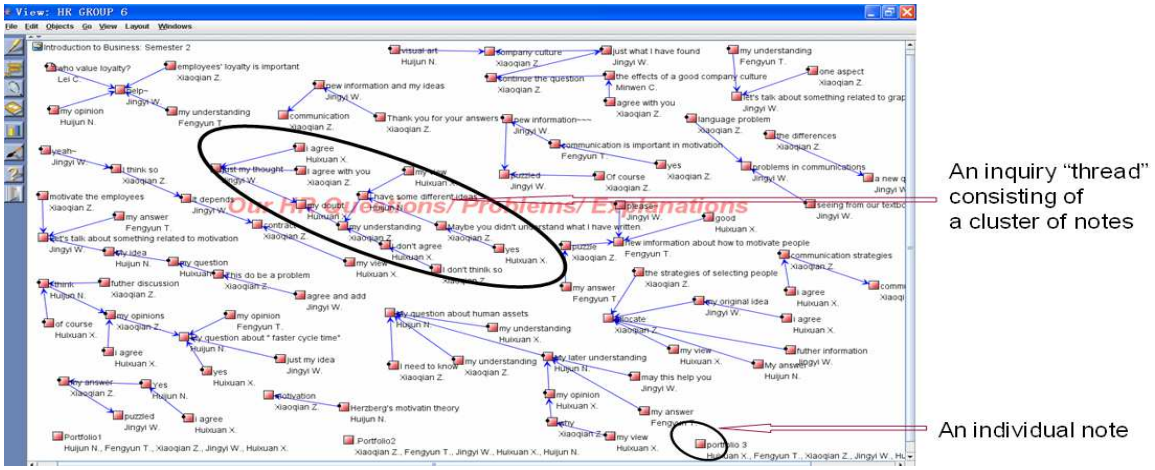

Figure 1. A knowledge forum *view*, including individual notes and inquiry threads

2.3 Data source

We collected multiple-source data for the whole study and included only part of them to answer the above research questions. Two questionnaires, investigating students' conceptions of collaboration and approaches to learning, were done in a pre- post fashion. The questionnaire on collaboration was developed by Chan & Chan (2011), which consists of 12 items and uses 5-point Likert scale examining students' views of collaboration aligned with the notion of knowledge building. The questionnaire on approaches to learning was based on Biggs' (2001) Revised Version of Study Process Questionnaire (SPQ), which is comprised of 20 items, with 5-point Likert scale and two-factor structure of deep and surface approaches to learning. Students' domain test papers were collected to examine their understanding of business concepts. The test paper was comprised of five core, open-ended questions asking students to explain their understanding of business concepts (for example, Do you think Shanghai has a good business environment now? Why?) It was done in a pre- post manner and one teacher blind marked all the test papers according to a marking scheme jointly developed by the teacher and the course leader in the university. Students' KF discourse was included. In particular, we classified their Semester 1 inquiry discourse into threads (Figure 1). An inquiry thread was defined as a cluster of notes addressing the same principle topic or problem in the communal space (Zhang et al. 2007). Thread analyses helped to characterize knowledge building dynamics and track collective knowledge growth.

3. Analyses and Results

3.1 Changes in conceptions of collaboration

The Questionnaire on Collaboration required students to reflect their experiences in their learning environments. The pre- and post Cronbach's Alpha were .84 and .85 respectively (n=60), indicating good scale reliability. The pre-, post scores for students in the KB environment were 3.87 (.50) and 4.23 (.43), and paired t-test showed students improved their conceptions of collaboration significantly with $t\ (29) = 6.14$, $p<.001$, *Cohen's d =.72*. While in the NKB environment, the students' pre-, post scores were 3.98 (.51) and 4.16 (.51) respectively, and paired t-test revealed that although student obtained higher scores at

the end of the program, their improvement on conception of collaboration was not statistically significant with *t (29) = 1.53, P=.14*.

3.2 Changes in approaches to learning

Students' responses to SPQ were rated and the pre-, post Cronbach's Alpha for deep approach were .76 and .78 (n=60); and .82 and .87 (n=60) for surface approach, which were consistent with previous studies and indicated good scale reliability. In the KB environment, the pre- post scores of deep approach were 3.35 (.53) and 3.73 (.42); and 2.18 (.58) and 1.91 (.49) for surface approach. Paired t-tests showed that students in KB environment improved both on deep and surface approaches (improvement on surface approach means decreased score at the end of instruction). For deep approach, *t (29) = 4.47, P<.001, Cohen's d =.71*, indicating a significant level of improvement. For surface approach, *t (29) = -2.38, P<.03, Cohen's d =.47,* suggesting fair improvement at a certain level. In the NKB environment, the pre- post scores were 3.25 (.51) and 3.40 (.60) for deep approach; and 2.22 (.62) and 2.14 (.71) for surface approach. However, analyses of pre- post scores using paired t-tests showed that students in NKB environment had not obtained statistically significant improvement, for deep approach, *t (29) = 1.65,P=.46*; and for surface approach, *t (29)= -.75, P=.11*.

3.3 Improvement on domain understanding

Domain test paper was designed to tap into students' understanding of key business concepts. The pretest was given at the beginning of the instruction and the posttest was done at the end of semester 1. The pre-, post scores were 28.9 (6.65) and 60.3 (8.27) for KB class; and 28.0 (8.59) and 52.4 (7.89) for NKB class, respectively. Analyses of pre-, posttests using paired t-tests showed both classes improved on domain understanding tests with KB class, *t (29), = 23.5, p<.001*; and NKB class, *t(29), = 14.1, p<.001*. Further repeated measures (Pre-, post x KB, NKB) were conducted and the results indicated the Environment x Time interaction was significant, *Wilks' λ =.85, F (1, 58) = 10.3, p<.005, η^2 =.15,* favoring the KB Environment students over their NKB counterparts, *F (1, 58)* = 6.6, *p<.05, η^2 =.10*.

3.4 Characterize knowledge building discourse

During semester 1 both KB and NKB classes wrote notes on a big curriculum topic "Business Environment", which was subdivided into six *views* on KF, namely, "What is business", "Egg theory", "Political environment", "Economic environment", "Social Environment" and "Technological Environment". Notes of the six views were retrieved and we coded them into inquiry threads, for example, KB class students wrote 30 notes and NKB class students wrote 18 notes respectively to discuss "definition of business", thus constituting a thread titled "what is business". Ultimately, we identified 57 discussion/inquiry threads from KB class and 29 from NKB class. We then further analyzed these threads in terms of whether it shows continual testing and modifications of ideas; uses authoritative sources to build-on ideas constructively; and demonstrates communal awareness and efforts in advancing collective knowledge. Rated by the level of knowledge advances, three discourse patterns emerged: *(1) Low-level knowledge advances thread* (LKA) which was usually not long, consisting students' quick or naïve ideas and lacking a well treatment of a topic. *(2) Moderate-level knowledge advances thread* (MKA) in which students were able to answer questions from various perspectives; a pool of business ideas were accumulated yet repetitions occurred frequently showing a inclination of task-completion and a lack of community awareness. *(3) High-level knowledge advances*

thread (HKA) in which students were engaged in a question-explanation-intertwined process, identified and addressed gaps in collective knowledge, negotiated meaning and formulated more sophisticated views toward business theories or concepts. Table 1 and 2 showed examples of LKA and HKA respectively.

Table 1: An example of LKA thread

Student	Description	Excepts from the inquiry thread
FXX	Question	(I need to understand) How to make a market survey and meet customers' need?
NHJ	Reasonable answer	(My theory) We can give some leaflets to different people…, listen (to) their ideas. It will tell us what customers need. The leaflet can contain price …advice to the product…
JYH	Digression	(My theory) It's too early to think this now. What we should do first is learning more about business so that we are able to solve problems…
FXX	Disagree	(My theory) But I think we should consider questions from all aspects. Also, it's necessary…
JYH	Discourage	(My theory) But you don't have any professional knowledge to consider questions from all aspects. For example …
SL	Elaborated answer; but ended here	(My theory) Maybe, firstly you should know … problem to solve. Then you … design a series of… After that, you organize …give out to people of different ages. Finally, you analyze …

Table 2: An example of HKA thread

Student	Description	A few excepts from the inquiry thread
ZXQ	Start with puzzle	(I need to understand) *PUZZLE*….Foreign countries say that we have the biggest market…we say the population is burden. How do we comment on the population in China?
YSH	Explanation	(My theory) ... More people there are, larger the market will be, (more) business opportunity...the mobility of population …Population re-aggregation will lead to …
CXF	Elaborated more	(My theory) More population means…However …the more …, the bigger social pressure. If…, people's living standards will…
ZXQ	Ask for explanation	(I need to understand) *Puzzle again:* I know everything has two aspects. But …which one is more important …Because…
WQY	Authoritative information	(My theory) Disadvantage outweighs…Relevant data (from the Internet) showed …a series of problems such as … Due to …it's hard to …we should consider questions from all aspects…
WJY	Strive for coherence of ideas	(My theory) As we all know…However, behind is the serious population problem. …more negative effects … Firstly, …challenge to resourses. Secondly, …harm to environment …Finally, …burden to governmet and society, such as …
ZCY	Relevant problem	(I need to understand) …in recent years, we have a problem of aging..
CMW	Explanation	(My theory) …the birth rates…fewer babies…old people live longer … problem of aging appear(s) … In the long run, it will …
YSH	See the complexity	(My theory) The aging issue is thorny …human's life expectency is …birth rate…contradict…unable…
SYM	Idea diversity	(My theory) It seems …But …only one of the aspects. Since the trend of aging…why not seize the opportunity? In fact, it can be taken advantage …instead of…
CMW	Collective responsibility for solution	(My theory) First, as many calssmates mentioned, we can resort to the postponing year of retirement. Many people … As far as I'm concerned, … new ideas…Furthermore …solve the aging problems…
FTY	Summarize	(Putting our knowledge togehter) 1 my understanding of your question

	and rise above based on 9 community notes	2 My anwer 3 population 4 My opinion 5 The issue of population in China 6 need high quality population 7 It will take a long term...8 Why the logo 'Made in China' can't become a logo 'Creat in China' 9 my thoughts First, …confused about the question. …involved many aspects…not a clear direction. Secondly,…Thirdly, …large population ..manpower…employment pressure. Then, China… Despite … After that …Finally, it comes to…However, the government …In conclusion, the population is a problem … ways to solve it …

Note: Notes included here are shortened and selected to highlight the key features only.

We rated all the threads in both KB and NKB classes and the results were shown by Figure 2. It indicated KB students were more productive both quantitatively and qualitatively than their peers in NKB environment. For example, the KB class generated 26 HKA threads (28.1% of total threads generated) as compared to 5 (17.2%) in the NKB class.

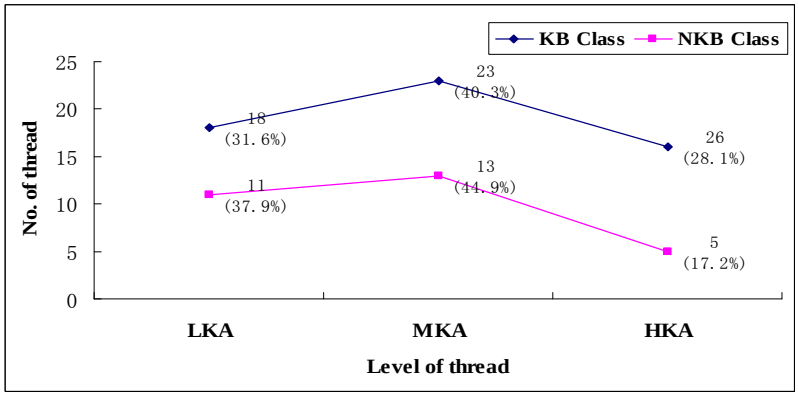

Figure 2: Comparison of threads between KB and NKB classes

Using the forum log information (judging by the ending date of each thread), we classified the threads of KB class into three periods of time, namely Period 1 (week 4), Period 2 (week 8) and Period 3 (week 12 and beyond). As shown by Figure 3, HKA threads increased from period 1(1 and 7.7% in total threads of period 1) to period 3 (7 and 38.9% of total threads of period 3) steadily and LKA decreased across time (from 7, 53.8% of periods 1 to 1, 5.6% of period 3). When students were more immersed into knowledge building culture and principles, they seemed able to refine their discourse toward emergent knowledge creation.

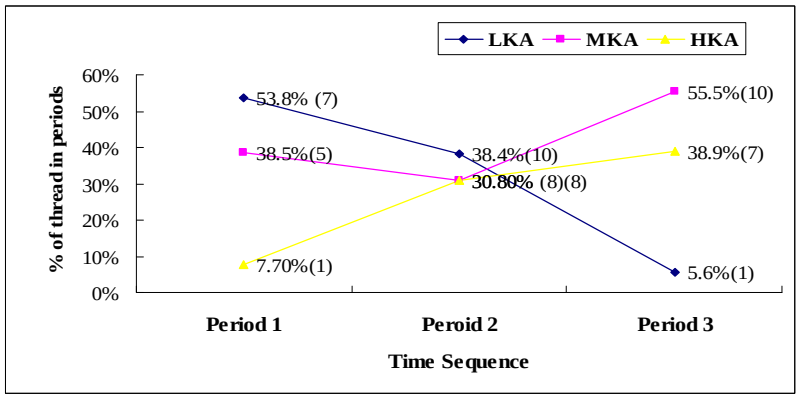

Figure 3: Levels of thread across 3 Periods of time in KB class

4. Conclusion and implications

This study has designed and examined a principled-based knowledge building environment in promoting learning, collaboration and domain understanding among Chinese tertiary students. Following a quasi-experimental design, the study showed both KB environment and NKB (merely-technology-supported) environment students improved their conceptions of collaboration and manifested a tendency of moving to deep learning. However, the KB environment showed salient advantage over the NKB environment in facilitating collaborators and deep learners. The domain test results also suggested both classes strengthened understanding of business concepts, with KB students again outperformed their peers in the NKB environment.

We examined students' knowledge building discourse on KF. Inquiry thread analyses revealed that KB students were actively engaged in the knowledge space by raising authentic problems, using resources constructively, striving for an intertwined question-explanation-based idea improvement, and moving toward high-level meta-discourse. In fact, online forum is now very popular in China and else where in the world, however, many discussion threads have found to be merely chit-chat or on a surface level of knowledge sharing, just like the products of the NKB environment in this study. In the KB environment, we identified a large number of sophisticated discourse patterns which indicated KB students, working in a community, have embarked on a trajectory of progressive problem solving, idea improvement, and moving to emergent knowledge advances. We acknowledge the limitation that there might be some teacher effects contributing to the differences between the two environments. However, we argue that technology needs to be informed with pedagogy and collective views of knowledge building. Only when students have been acculturated in the designed environment and assimilated the principles appropriately can deep learning, meaningful collaboration, and high-level knowledge advances take place.

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