Designing Learning Environments for Knowledge Building: Inquiry Discourse of Chinese Tertiary Classes

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Abstract: This study examined the effects of two designed learning environments for knowledge building. Two groups of first year Chinese tertiary students learning business English were engaged in a strong form of a knowledge-building environment (Principle-based Learning Environment, PBLE) and a weak form of knowledge-building environment (Knowledge Forum Learning Environment, KFLE), respectively. Inquiry thread analysis of the online discourse suggested PBLE students were more able to self-initiate goals for inquiry, improve ideas, and achieve toward deeper collective knowledge advances. The design issues including the importance and manifestation of knowledge building principles are discussed.

Introduction and Background

CSCL studies involving educational interventions are expected to provide information on how a learning environment is created, what effects it brings about, and explanation of factors contributing to success or failure. A striking feature of design research is to design effective learning environments with principles. Knowledge building (Scardamalia and Bereiter, 2006) focuses on creation of new knowledge, representing one of the key examples for educational innovation. Scardamalia (2002) proposed 12 knowledge building principles for the knowledge building community. However, as the principles are usually not sufficiently detailed to determine every design decision (Edelson, 2002, p. 106), teachers may find it hard to transform the principles into classroom practices. For example, the principles are intertwined and may appear unclear and vague in terms of social practices (Hakkarainen, 2009); Chan's project (2011), the Hong Kong Knowledge Building Teacher Network revealed that there were many false starts and surface understanding of principles. Even though ample evidence has been collected to delineate the successful implementation of knowledge building approach in schools (Lee et. al., 2006; van Aalst, 2009; Zhang et. al., 2007; 2009), knowledge building still poses great challenges and demands on teachers (Zhang, 2009). Therefore, more examples illuminating knowledge building classroom and online practices informed by knowledge building principles are needed. This study intends to describe a case of designing environments for knowledge building in higher education setting and address one research question: what are the differences on student discourse between an innovative, principle-based knowledge building environment (PBLE) and a less innovative, only technology (in this case, Knowledge Forum) supported learning environment (KFLE), and how are they manifested?

Method

Two classes (n=60) of first year university students learning business English in a Sino-British Educational Program in Mainland China participated in the study. In view of the innovative nature of knowledge building (*like the Copernican Revolution, profoundly different from even the best of traditional and modern classrooms*, Scardamalia, 2002, p.77), and the didactic past instructional experience of the Mainland Chinese students, we adopted a quasi-experimental design in which Group 1 (n=30) was exposed to a strong principle supported knowledge building learning environment (PBLE) and Group 2 (n=30) was exposed to a weak, KF technology supported learning environment (KFLE); KFLE is less innovative, but still a leap from traditional classroom because technology was used to support learning and communication. We argue such a design is appropriate to

identify to what extent an innovative educational model can be accepted by the students who are new to collaborative knowledge building.

Both classes were taught by the same teacher in a two-semester course, entitled "*Introduction to Business*", which is a franchised course from the Sino-British program, aiming to strengthen students' business knowledge as well as communicative and critical thinking skills. Each semester consisted of 14 weeks, with two consecutive lessons (1.5 hours) per week. In both classes, students followed the same curriculum: learning business concepts, holding discussions and doing group work (projects). After class, they wrote notes on Knowledge Forum (KF), which is a computer-supported platform for collaborative learning. While KF is considered an integral part of knowledge building, we employed it for both PBLE and KFLE. To design and differentiate the PBLE and the KFLE, we focused on three key dimensions of curriculum, engagement, and reflection in particular premising on three KB principles: *improvable ideas, community knowledge and collective, reflective assessment*. (1) We implemented *inquiry-based* course curriculum (case studies, authentic questions, etc.) for both environments and students tried to answer questions and raised their own questions as well. However, in alignment with the knowledge building principle of *improvable ideas*, PBLE students were explicitly scaffolded to focus on ideas. They were not only asked to make their own ideas public on KF, but were encouraged to work with those ideas. They posited an idea has a life; and sufficient time was allowed for them to nurture ideas; elaborate, refine, and revise those ideas; and track the evolution path of them. KFLE students, as typical for tertiary courses, also focused on getting good ideas but they tended to miss out the notion that ideas are objects that are improvable.(2) For engagement, both groups were encouraged to participate actively; specifically, PBLE students were acculturated into a *community ethos* and regarding KF as the public space for idea improvement. They were encouraged to take on *collective responsibility* to build on each other, to improve their initial understanding, and to solve problems in the common goal of advancing collective knowledge. KFLE students were required to answer teacher questions and individual effort was much appreciated. (3) All students were involved in reflective presentations, with PBLE focusing on *meta-discourse* and KFLE on task-accomplishment. From Week 3 to Week 9, an 8-minute or so presentation was conducted by selected student at the beginning of each lesson. For PBLE students, reflection as a way of *concurrent, transformative assessment*, helps them think about what they have learnt, conceive of the connections between new and prior knowledge, and set possible new goals for inquiry. KFLE student were not informed by knowledge building principles and might present in class his/her view of how a task has been completed or how a problem has been solved, without deliberately identifying the knowledge gaps.

Data Sources and Results

Before the study, we obtained the National Matriculation Test scores of the students and an independent sample *t*-test showed there was no significant statistical difference in terms of the students' baseline abilities, $t(58)=.50$, $p=.62$. To compare the discourse process of the designed environments, we included students' forum notes and classified them into inquiry threads. 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 analysis has been widely used to help characterize knowledge building dynamics and track collective knowledge growth.

Student forum discourse during semester one focused on a core theme "Business Environment". Six *views* (online note-writing space) were established, namely "What is business?", "Egg theory", "Political environment", "Economic environment", "Social Environment" and "Technological Environment". In these views, PBLE students wrote a total of 919 notes, and KFLE students 472 notes; apparently, PBLE students were more productive in note creation. To further investigate knowledge building dynamics, we coded all KF notes into inquiry threads. This iterative process resulted in identification of 51 and 30 threads in PBLE and KFLE respectively. Inquiry thread maps (omitted for space consideration) were drawn subsequently to indicate how

many notes were created around a thematic topic, how many students were involved in the discussion, how long the discussion lasted, and the interconnections among the threads (similar to Zhang et al., 2007). However, unlike students immersed in knowledge building for a long period of time and able to initiate all inquiry threads (Zhang et al., 2009), the students in this study were new to knowledge building and the teacher adopted a more eclectic instructional design. He pre-specified some inquiry themes in line with the curriculum topics and, simultaneously encouraged emergent, student self-defined trajectories of inquiry, which were particularly emphasized in PBLE. As a result, 60.8% (31 of 51) of the inquiry threads in PBLE were self-initiated by the students and only 26.7% (8 of 30) in KFLE were self-initiated by students. The other inquiry threads were started by the teacher.

To examine the deepening moves of discourse in the inquiry threads, we analyzed the threads informed by four knowledge building principles: use *of authoritative information, improvable ideas, idea diversity, and epistemic agency*. Based on KB literature and thorough reviews of all the inquiry threads, we developed a coding scheme with different categories and levels indicating the quality of the inquiry discourse (Table 1).

Table1: The coding scheme for the inquiry threads

Category	Level	Description
Use of authoritative information	1	Limited indication of use of information; or simply refer to a web link or suggest sources; information is not pertinent to the issue in question
	2	Indicate relevant sources; copy and paste information, relevant but lack of understanding and digestion
	3	Contribute authoritative information in a digested and constructive manner; use referenced notes; use information to improve theories
Improvable ideas	1	Most of the ideas are scattered, fragmented, and unfocused; claims and assertions from students' common sense
	2	Quite a number of build-on discourses, with examples, investigations, or meaningful information to support and show understanding of a business topic, situation, phenomenon, case, etc
	3	Discourse indicating inquiry developed in a deepening way, forming coherent, refined views on business concepts, situations, phenomena, etc; revision of or improvement on theories and models
Idea diversity	1	Simply show disagreement or being cynical without providing sufficient reasons
	2	Provide some other lens to questions or problems, with good reasons backing up argument, hypothesis, conjectures, etc
	3	Discern critically both aspects of the phenomena, situations or business cases; use another theory to explain, forming a holistic view on existing theories and models
Epistemic agency	1	Ask factual, information-seeking questions; mostly general description, not negotiation of ideas between participants
	2	Show doubt, confusion, puzzlement and seek clarification and better understanding of a business situation, phenomenon, case, concept, etc
	3	Set goals for inquiry; meta-cognitive; review and monitor group discourse development; evaluate and summarize; compare different models; meta-discourse

One rater coded all the threads; a second rater coded 30% of the threads, with an inter-rater reliability of.83 (Pearson's correlation coefficient). The mean scores and standard deviations of each KB-principle category are shown in Table 2. Multivariate analyses conducted indicating significant results following by univariate analyses. Significant differences were obtained for Epistemic Agency, $F\ (1, 79) = 11.0,\ p < .01$; marginal significance for Use of Authoritative Information, $F\ (1, 79) = 3.9,\ p = .053$; and Improbable Ideas, $F\ (1, 79) = 3.7,\ p = .058$; while no significant difference was found for Idea Diversity $F\ (1, 79) = 1.4,\ p = .24$. These results suggest that the PBLE class was more able to ask questions and seek explanations, set forth ideas and theories, and be committed to sustained knowledge advancement with support of outer resources.

Table 2: Comparison of knowledge building discourse between PBLE and TELE

	Use of Authoritative Info.	Improvable Ideas	Idea Diversity	Epistemic Agency
PBLE (n=51) M(SD)	1.6 (.14)	2.0 (.10)	1.4 (.14)	1.8 (.09)
TELE (n=30) M(SD)	1.2 (.19)	1.7 (.13)	1.2 (.18)	1.3 (.12)

To obtain an overall picture of forum discourse, we conducted factor analysis for the 4 items of KB-principle, which led to one factor structure (we call knowledge building discourse) with 71.6% of the variance explained. We then classified inquiry threads into three phases depending on the date of the last written note in a thread, namely Phase 1(Week 1 to 4), Phase 2 (between Week 4 and 8) and Phase 3 (beyond Week 8). As a result, PBLE produced 10, 25, and 16 threads during Phase 1, 2 and 3 respectively; and KFLE created 6, 13, and 11 threads. A 2 (Environment)×3 (Discourse Phase) ANOVA was performed to assess whether knowledge building discourse could be predicted from learning environment (PBLE vs. KFLE), phases of discourse (Phase 1, 2 and 3), and the interaction between these two factors. This analysis of variance revealed a significant main effect for discourse phases, $F\ (2, 75) = 9.2,\ p<.001,\ \eta^2=.20;$ for environments as well, $F\ (1, 75) = 6.0,\ p<.05,\ \eta^2=.07;$ but no significant interaction effect, $F\ (2, 75) = .38,\ p= .68,\ \eta^2=.01$. Figure 1 shows the mean scores of knowledge building discourse across three discourse phases in two learning environments.

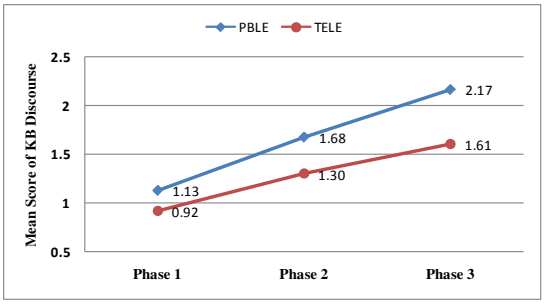

Figure 1. Mean scores of knowledge building discourse across three phases

Conclusion

With the PBLE and KFLE design, both classes were engaged in inquiry and discussion (generating 919 and 472 notes respectively) and improved the quality of their discourse over time (see Figure 1), which is a sharp contrast to and far better than (we argue) the usual teaching environment, characterized by teacher as the sage on stage and limited teacher-student/student-student communication. Inquiry thread analyses indicated that PBLE students demonstrated much more agency for inquiry, used information more constructively, and refined ideas more sustainably than their counterparts in KFLE, which on one hand, removed our fear that whether Mainland Chinese students could accept and adapt to such an innovative notion of knowledge building; on the other hand, shed light on the importance of knowledge building principles in the design process. This study demonstrates how instructional design can be aligned with knowledge building principles. Thread analyses also suggest some principles, such as epistemic agency, could be manifested saliently after the instruction, while others such as idea diversity might not appear so salient.

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