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## **Abstract**

The capacity to engage in deep discussion about knowledge should be an expected outcome of all university graduates. This paper describes an attempt to develop teachers as a knowledge builder through a master's level course. Based on the socio-cognitive determinants of knowledge building proposed by Scardamalia and Bereiter, I identified and applied instructional tactics that could help foster knowledge building behaviors among the participants. These tactics include case study, reciprocal teaching, online discussion, and working on a consequential task. The participants consisted of 11 teachers aged between 27 to 50 years old. They actively contributed to the online forum by frequently querying, clarifying, adding and revising their notes. They led group discussions in class and introduced additional reference materials to their classmates. In short, the participants demonstrated high degree of epistemic agency by taking ownership of their learning and contributing to deep understanding of theories related to knowledge building.

## **Keywords**

Knowledge building, Teachers as knowledge builders

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## Developing 21<sup>st</sup> Century Teachers as a Knowledge Builder

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### Abstract

The capacity to engage in deep discussion about knowledge should be an expected outcome of all university graduates. This paper describes an attempt to develop teachers as a knowledge builder through a master's level course. Based on the socio-cognitive determinants of knowledge building proposed by Scardamalia and Bereiter, I identified and applied instructional tactics that could help foster knowledge building behaviors among the participants. These tactics include case study, reciprocal teaching, online discussion, and working on a consequential task. The participants consisted of 11 teachers aged between 27 to 50 years old. They actively contributed to the online forum by frequently querying, clarifying, adding and revising their notes. They led group discussions in class and introduced additional reference materials to their classmates. In short, the participants demonstrated high degree of epistemic agency by taking ownership of their learning and contributing to deep understanding of theories related to knowledge building.

### Introduction

As an emerging field of research and practice, Scholarship of Teaching (SoTL) was succinctly described by Prosser (2008) as an "evidence based critical reflection on practice to improve practice" with the goal of improving student's learning. Prosser (2008) distinguished between research and SoTL in terms of their goals: research "enhances our theoretical and/or conceptual understanding of teaching and learning" whereas scholarship of teaching and learning aims at "improving practice" (p.2). Prosser further warned that SoTL scholars who failed to recognize the differences might risk "losing the focus on improving student's learning." (p.2)

As a researcher and a teacher educator working in the field of learning sciences, which is another emerging field of study that focuses on the *sciences of learning*, it became evident to me that SoTL and Learning Sciences share the common goal of improving learning through evidence-based instructional practices. The field of Learning Sciences, however, has the explicit goal of theory building and includes the study of both formal and informal learning environments. Rather than playing up the differences between research and SoTL, I find synergy situating myself in the nexus of both fields and engaging in both practices. For example, in addition to my experience in teaching, I could employ theories and principles of learning to design intervention and collect evidence for improving my teaching practices.

I have been working on fostering knowledge building (Scardamalia & Bereiter, 2006) in K-12 classrooms and in teacher education. Scardamalia and Bereiter (2003) defined knowledge building 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" (p. 1370) with the over-arching goal of initiating students into a knowledge building culture similar to that of a scientist community. Although the definition looks deceptively simple, the journey of introducing knowledge building into K-12 classrooms has been challenging, to say the least. Building a culture of sharing



## Design Strategies and Instructional Tactics

When designing the course on knowledge building for teacher participants, I consulted the 12 socio-cognitive and technological determinants of knowledge building (Scardamalia, 2002). These 12 determinants could be interpreted as design principles to foster a knowledge building classroom or as indicators for effective knowledge building classrooms. They describe social and cognitive characteristics of a knowledge building classroom, which is supported by an asynchronous online discussion forum called Knowledge Forum. For example, one of the determinants is *Real Idea, Authentic Problems*, which suggests that students should work on an authentic problem of understanding the world (e.g., why is the sky blue?) rather than working on contrived textbook problems.

Each Master level course in the Nanyang Technological University consists of 13 sessions of 3-hour lessons. Working within this constraint, I divide the course into three broad phases: starting from an *initiation* phase that focuses on helping participants form a mental image of a knowledge building classroom, to a *meaning making* phase that encourages the participants to make sense of the various theories and practical issues related to knowledge building, and a *consolidation* phase that requires the participants to apply what they have learnt for a consequential task.

For each of these phases, I look for relevant principles and identify concrete instructional tactics to realize these principles. I realize that it is not realistic to apply all the 12 principles within the curriculum hours. The course design summarized in Table 1 shows the key learning activities within the 13 sessions.

**Table 1.** Summary of key ideas, principle and instructional tactics

Session / phase	Key ideas	Principle	Instructional tactics
Session 1 to 3 Initiation	Form a mental image and describe the characteristics of a knowledge building classroom	Real ideas, authentic problems	Participants study a case report of a knowledge building classroom, identify the characteristics of the approach, and compare their teaching practice with the approach  Participants view video clips on knowledge building classrooms
		Idea diversity	Using Knowledge Forum, participants post their notes on (1) what knowledge building is; and (2) how it is different from their practices.  Participants identify ideas, issues, questions for further exploration
Session 4 to 9 Meaning making of theories and issues related to knowledge building	Making sense of the principles of building a knowledge building classroom	Epistemic agency	Reciprocal teaching: The participants form groups; each group lead a discussion on a topic, for example, collaborative knowing theory.
	Making sense of the collaborative knowing theory	Knowledge building discourse	Scaffolds: Sentence open phrases are provided in the Knowledge Forum to facilitate productive discourse for knowledge building. E.g., "One characteristic of knowledge building is...", "It has the strength of...", "One

	(Stahl, 2004)	Knowledge building discourse	limitation is ..."
	Principles of designing a knowledge building classroom	Community knowledge, collective cognitive responsibility	The participants continue to contribute ideas to the community by posting notes in the Knowledge Forum
	Justifying rationales of knowledge building approach	Constructive use of authoritative sources	Critical discussion on research reports and position papers related to knowledge building
		Improvable ideas	The participants continue to work on each other's ideas for better clarity, coherency and usability of ideas.
		Rise Above	The participants post a note that combine ideas from several notes in the Knowledge Forum; it could be a summary of similar ideas, compare and contrast ideas, a theoretical perspective that better describe the ideas, or a new idea or issues arising from other ideas.
Session 10 to 13	Consequential task:	Rise above and epistemic agency	The participants choose a consequential task, either to design a knowledge building classroom or to present an in-depth discussion of a related issue.
Consolidation by applying the knowledge to a consequential task	Design a knowledge building classroom  OR  A position paper on a theme related to knowledge building		At this stage, the participants should be able to achieve a deeper understanding of knowledge building such that they are able to design for a knowledge building classroom or present a strong argument for issues related to knowledge building

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### Learning Outcomes

The course commenced in January 2010 and ended in April 2010. The participants consisted of 7 male and 4 female teachers, aged between 27 to 50 years old. To study the impact of the course, the following aspects of a knowledge building classroom were examined:

1. To what extent did the participants demonstrate collective cognitive responsibilities in contributing to the class?
2. Did the participants actively improve each other's ideas?
3. Did the participants assume epistemic agency in directing their learning?

### Collective Cognitive Responsibilities

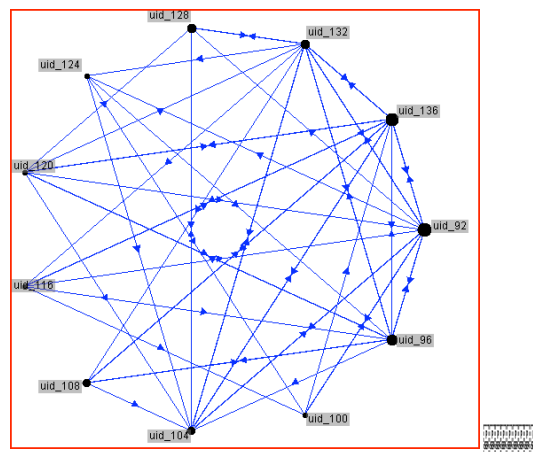
To understand their contribution and performance during this course, some quantitative indicators of the participants' contribution in the Knowledge Forum were used (Table 2):

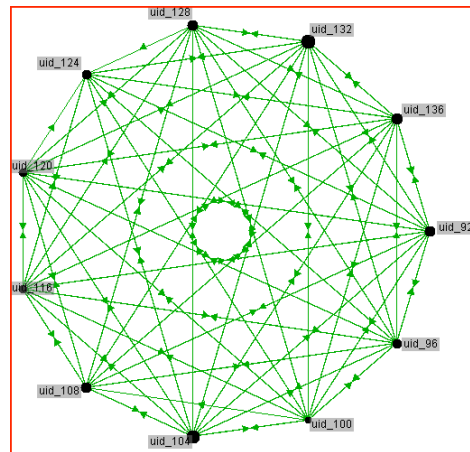
**Table 2.** Quantitative indicators of participants' performance in the Knowledge Forum

	Frequency	Average per participant	Average per week
Total number of notes	195	17.7	15.0
Number of notes revised	273	24.8	21.0
Number of notes read	225	20.5	17.3
Number of notes built on (replied to)	144	13.0	11.1
Number of notes linked (replied to or referenced by other notes)	183	16.6	14.1

The contribution rates were high compared with other studies. For example, in another study involving teacher education on knowledge building, Chai and Tan (2009) reported teacher contribution rate of around 3.7 notes per week. This high contribution rate, together with high frequencies of notes being read, built on, and revised, are good proxy indicators that the participants were actively involved in online knowledge building activities. It appeared that the participants were actively engaged in querying, clarifying, and improving each other's ideas, and they assumed collective cognitive responsibilities in deepening their understanding of knowledge building.

The quantitative indicators of the participants in the Knowledge Forum (Table 2) show high degree of interaction among the participants, which also indicate the extent of social collaborative learning that happened in the class. We could draw similar inference from the high network density of 63.6% of participants building on each other notes (Figure 2) and high density of 98.2% of participants reading each other's notes (Figure 3).

**Figure 2.** Social network of participants building on each other's notes



**Figure 3.** Social network of participants reading each other's notes

### Idea Improvement

Qualitative analysis of their note content reveals numerous incidence of idea improvement behaviors. Excerpt 1 shows the discussion among the participants on whether other technologies, besides Knowledge Forum (KF), can be used for knowledge building (KB). Through the short discussion, important factors like affordances of technologies, access to technology, and learners' characteristics were mentioned.

#### Excerpt 1

Participants A & B, in a joint note: Is it KF better than other methods like wikis, other forum and all? Why? Does KB not happen well with other methods?

Participant C: [My theory] I think we have to look at the affordances of KF here. How do the affordances of KF support KB. BTW, KB is around even before KF is constructed so KB can definitely be conducted without KF, only thing is, will KF improve its effectiveness?

Participant D: [Opinion] I agree with C that the important thing is to ask about the affordances of the platform used (KF, chats, f2f, ...), and would also add that it depends on its suitability to the context (meaning, for example, who are engaging in the knowledge building, access to technology, experience in engaging in KB discourse, group size, subject matter ...). [Example] For example, in maths research communities in universities, the lounge whiteboard and coffee machine are important technologies to support ideas being bounced off each other f2f; certainly a text based technology like KF would not support KB well because of the difficulty in input of math symbol. [Example] In contrast to KF which is asynchronous, the example shared by A's group about the T JC Virtual Math Team technology (see ref below) which allows a combination of chats, whiteboard and wiki seems more promising for Maths.

\*words in square brackets [ ] are scaffolds or thinking cues in Knowledge Forum

### Epistemic Agency

The participants exhibited high degree epistemic agency by taking ownership in directing learning for the course. For example, opportunities were provided for the groups to lead a discussion on a topic. Each of the four groups took at least four hours of contact time to discuss a topic of their interest. One group, for example, introduced Stahl's theory (2004) of collaborative knowing to provide an understanding of the social-cultural theoretical foundation of knowledge building. The group asked the class to participate in



a synchronous online chat out of the curriculum time, recorded and analyzed the chat, and led the class in discussing the meaning of each component listed in Stahl's theory.

Another indicator of high epistemic agency was demonstrated when a few participants lamented that the basic reference materials provided by the instructor was too few. One participant volunteered to search for and upload 22 other journal papers and book chapters related to knowledge building to the forum.

### Challenges

While the results were encouraging, there were some challenges in the implementation of the lessons. As an example, I share two challenges in conducting reciprocal teaching. First, I observed that group members leading a reciprocal teaching session were often more engaged than the other participants. For example, as an audience of a reciprocal teaching session, some participants did not complete the reading assignment prior to the whole-class discussion. This was partly due to the heavy work responsibilities of the participants who were full-time teachers taking this course as a part-time student. I need to find a strategy to help the participants set learning goals (Dweck, 1986) and treat each session as a learning journey, rather than focusing on the short-term performance goal of doing well in the course. Second, as an instructor, I constantly struggled with urge to intervene and offer my opinions when the participants leading the discussion offered alternative ("wrong") views. I am cognizant that as an instructor, my view might be regarded as more powerful and authoritative, and intervening too often or too early might undermine the trustworthiness of the participants leading the discussion. It might become counter-productive in fostering epistemic agency among the participants. I need to examine this aspect of intervention carefully, for example, I will need to develop some guidelines about when to offer my views.

### Concluding Remarks

This paper describes a theory-informed intervention aims at improving practices of teacher education, specifically, the use of principles of knowledge building to develop knowledge building capacity among the teachers. I identified instructional tactics that are consistent with the principles of knowledge building, implemented the intervention, and collected evidence that could reflect the extent of knowledge building among the participants. By doing so, I exploit the synergy between research and SoTL, using theory to improve teaching practice.

I am encouraged by the participants' behaviors and performance in this course, particularly on their motivation to assume epistemic agency in taking ownership of their learning, and the deep level of discussion on theoretical and practical issues related to the topic. This high level of engagement surpassed other graduate courses that I have taught. On reflection, however, I began to wonder whether this should be expected for learning at all levels in institutes of higher education. After all, universities are supposed to be knowledge building organizations where active research activities take place and state-of-the-art knowledge and inventions are generated. Research studies have shown the possibility of developing knowledge building capacity in K-12 students, it is perhaps time to raise the bar of expectation for our university students. More importantly, this higher standard for university graduates will not happen unless we change how teaching and learning occurs in universities.

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