Teachers' Understanding of Knowledge Building in an Emerging Community

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Abstract

This paper reports Year 1 of a study examining design, principles and trajectories of teacher growth in knowledge building in the context of a teacher community in Hong Kong. The knowledge-building teacher network, funded by the Ministry, consists of 7 teachers (seconded teachers) with various levels of experience in knowledge building working together with 22 teachers mostly new in implementing knowledge building in schools. Data sources include student participation and discourse on Knowledge Forum, teacher and student interviews, teacher discourse in meetings and workshops supported with Knowledge Forum. Various designs were developed that aimed at embedding knowledge-building principles in teacher professional development activities. We observed a gradual changing trajectory from procedure to pedagogical and epistemological-based discourse; there was also emergent growth in *agency, sustained idea* and *embedded assessment* reflected in teachers' practice. We also found various patterns of teachers' understanding; pedagogical and principled understanding was related with students' deeper views of collaboration. Implications of principled-based understanding and changing trajectories of teacher growth for knowledge building are discussed.

Introduction

Changing paradigms of learning and educational reforms now emphasize developing competent "knowledge workers" for the knowledge era. These changing demands have presented major challenges for teachers. Teacher development in face of educational reforms often involves providing support to help teachers acquire new knowledge and new skills in dealing with new curriculum. We propose that teacher learning should go beyond the acquisition of know-how or merely the acculturation of good practice. In the current knowledge era, we need to understand how teachers work together to build knowledge, to understand innovations, and to address continual changes. Teacher learning needs to be *congruent* with the processes of progressive knowledge building, and teachers need to work together *inquiring* and building knowledge about new visions of learning in innovative classrooms. This study is premised on the notion that teacher development needs to mirror the process of knowledge building involving progressive inquiry and collective growth. We explore teacher understanding of classroom innovation in the context of examining the design, principles and trajectories of teacher growth in a knowledge-building teacher network in Hong Kong.

The current emphasis on social views of learning has led to a widespread interest in the notion of "learning communities" to advance student and teacher learning. Researchers begin to argue that classrooms are to become communities of learning and thinking where students learn about how to learn (e.g., Bialaczyc & Collins; 1999; Brown

& Campione, 1997). Similarly, teacher learning takes place collaboratively (Borko & Putnam, 2001; Richardson & Placier, 2002); various approaches now focus on teachers working together in teacher networks (e.g., Liebermann, 1999) and communities of practice (Barab, Barnett, & Squire, 2002; Cochran-Smith & Lytle, 1999; Stein, Silver, & Smith, 1998) mediated by technology (e.g., *Tapped In*, Schlager, Fusco & Schank, 2002; *Math Forum*, Renninger & Shumar,2002).

Although the idea of teachers working together in communities of practice has already been widely recognized, questions remain as to how we can understand the dynamics of these communities and how to promote teachers' understanding for innovation in classroom within these communities. To-date, many large teacher networks focus on providing support for teacher knowledge and teachers sharing good practice (e.g. National Writing Project). As well, "lesson study" is a common approach focusing on teacher collaboration. Nevertheless, as argued by Oshima and colleagues (2006), this approach of teacher collaboration may help improve existing practice but it has little impact on empowering teachers to understand educational innovations; we need new models and approaches for examining teacher learning for new educational goals. Research has also shown that we need to consider the dynamics of teacher epistemology, teacher practice, technological affordance and wider community for innovations (Bialaczyc, 2006). If our goal is to develop students as adept knowledge workers in the knowledge era, then it is important that teachers themselves become knowledge builders – they need to engage in progressive inquiry and community growth; they need to experience pedagogical change as well as epistemological shifts.

What is the kind of teacher for knowledge era? What kind of teachers do we need for the knowledge era? The early research on models of literacy and teachers may provide a useful framework (Bereiter & Scardamalia, 1989) Three kinds of teachers are portrayed: Teacher A is the prototype who follows procedures and routines exemplified in the 'exercise model'. Teacher B may be considered the 'constructivist teacher model' that focuses on pedagogical strategies to enhance student learning and understanding. Many of the current teacher learning models belongs to this type. Teachers do develop deep understanding towards pedagogical content knowledge and domain expertise and some do produce deep student learning consequently. However, it is Teacher C that reflects the model of a knowledge-building teacher – Teacher C turns over high-level cognitive activities to students; he or she scaffolds students to do for themselves what Teacher B would have done for them. The knowledge building teacher codesigns learning with students who become valuable contributors to knowledge-building goals of inquiry, collaboration and capacity to work with knowledge. Knowledge building teachers do not just follow routines and procedures (Teacher A) or merely focus on pedagogical strategies (Teacher B); they work at the epistemological level viewing their knowledge and practice as an object of inquiry for continual improvement.

The model of Teachers A, B and C postulated in the 1990s takes on more interesting dimensions with current development of knowledge building theory and pedagogy. The earlier characterization has identified these different models of teachers; we propose that such prototypes may also be identified among teachers implementing innovations in classrooms. At different stages, teachers may focus on procedures, routines and technical issues whereas some may focus on strategies and pedagogy, and we envisage that there will also be teachers who will consider innovations as *principle-*

based understanding for continual improvement. Scardamalia and Bereiter (in press) discussed the tension of teacher development focusing on procedures versus principles; we will examine in this paper how principles may support teacher growth. In addition, with knowledge-building dynamics, we propose that when teachers at different phases in their developmental trajectory engage in knowledge work, they may help build new knowledge and improve practice for the community. We envisage these teachers of different trajectories will also develop individually and collectively.

Previous research on teacher development in knowledge building has primarily focused on teacher case studies (e.g. ICS teachers) and development within a school (e.g., case studies of ICS). Research on teacher education and knowledge building has also shown possible models for developing teachers' knowledge building communities (Chan & van Aalst, 2006) and promising ways to develop virtual communities for teachers in networked classrooms (Laferriere, 2001). Along this line of inquiry, the current study seeks to develop knowledge building practice and innovation in the context of a knowledge-building teacher community. We view teacher learning as knowledge building since teachers need to consider problems of innovation as an object of inquiry. The set of knowledge-building principles developed by Scardamalia (2002) characterizing the dynamics of knowledge-building will help inform us ways for scaffolding teachers within this networked community. It is commonly known that there is a schism between research and teaching,. We aim at developing a hybrid culture (Bereiter, 2002) using a design study model whereby teachers and researchers work together advancing knowledge-building understanding and practice.

The goal of our study is to design and to examine the emerging growth of a community for knowledge building in the context of a teacher network in Hong Kong. Specifically, the objectives include: (a) To design a community of knowledge-building teachers comprising of teachers with different expertise and experience who will collaborate to develop good practices of knowledge building in schools; (2) To examine the roles of the knowledge-building teacher community on teacher and student change; (3) To explore principles, patterns, and trajectories of teacher change and to examine how community knowledge develops. This paper reports the initial phase (Year 1) of this study on developing a knowledge-building teacher community in Hong Kong.

Context and Methods

Background

The context of the study is a knowledge building teacher network established upon an EMB[1]-funded teacher secondment scheme in Hong Kong. Seven teachers who had implemented knowledge building at varying degrees in their own teaching were seconded half-time to a tri-partite partnership between the EMB, University and schools designed to support teachers interested in implementing knowledge building in their schools. In this network, experienced knowledge-building teachers will be involved in (a) developing knowledge building practices in their classrooms; (b) helping other teachers in their own

[1] EMB stands for Education and Manpower Bureau, which is the equivalent of the Ministry of Education in Hong Kong.

schools and new KB teachers in other schools in designing, facilitating and assessing the knowledge building curriculum

The teacher network consists of the seconded teachers as core members and other teachers new to knowledge building. All seconded teachers meet regularly to engage in discourse on classroom work; such arrangement means that mentoring of new KB teachers by any one seconded teacher is the result of collaborative efforts of the teacher community. Regular face-to-face contacts via school visits and workshops are organised and other contact among networked teachers is supported through online discussion using Knowledge Forum. The expectation is that in the long run, seconded teachers together with colleagues in their schools will create a 'hub school' effect. New knowledge-building (KB) teachers will in time become experienced mentors to others, and eventually form another hub school. A snowballing effect for sustaining and scaling up knowledge building in schools is thus anticipated.

Participants

The teacher network comprised of the 7 seconded teachers, core members of the community, and 22 other teachers, the vast majority had never used Knowledge Forum prior to joining the community. Students of these network teachers also partook in this study.

Method

A design-based research approach, now well established in examining classroom innovations was employed. Design-based research *simultaneously changes* classroom processes while *examining and evaluating* how change takes place in *iterative* processes for improvement (Collins, Bielaczyc, & Joseph, 2005). As such, design research contributes to theory development and is particularly relevant for studying large-scale innovations as well as teacher change in classroom settings. The design-based approach has long been used in studies of knowledge building; we employ it in this study for understanding theory as well as design for teacher understanding of innovations in knowledge building.

Various sources of data were collected to track the growth of the community and to examine its roles on teacher and student understanding. We are currently examining database participation using ATK and Applet tools; the Knowledge Forum contribution provided another set of rich data. We collected information from school students' performance results as well as domain knowledge tests. Teacher interviews were conducted at the beginning and end of the year to track changes in teacher understanding. We also conducted student interviews to examine students' conceptions and beliefs. In addition, we administered two questionnaires examining students' approaches to learning (Kember et al., 2004) and collaboration. Teacher discourse at meetings and workshops were videotaped.

All teachers of the network were interviewed in the first three months and at the end of the year. A semi-structured interview was employed to ensure that the main themes

pertaining to the knowledge-building teacher network were examined while allowing other themes to emerge. The interview protocol was designed to capture the following themes: (a) Project experience, (b) Beliefs about knowledge building; (c) Strategies and classroom practice of knowledge building, and (d) Relations with mentor and teacher network. While preparing this paper, we are in full swing with our second round (one year follow-up/post-test) interviews. Slight modifications were made in the interview scripts from pretest to accommodate complex data made available from students' discourse on the Knowledge Forum and teachers' evolving conceptual and pedagogical understanding towards knowledge building. Specifically, the questions on classroom practice were asked vis-à-vis their databases and classroom work.

In order to measure the impact of the knowledge building teacher community on student learning, a student questionnaire was constructed based upon the idea that the knowledge building approach would change students'approach to learning and views of collaboration. There were 2 parts to the questionnaire: (1) *Approach to Learning* -- The 22-item Learning Process Questionnaire (Kember et al., 2004, Appendix A) was administered for secondary students (Grades 7 to 13). The LPQ has been widely used with established norms in Hong Kong. (2) *Knowledge Building Principles, Collaborative and Online Learning* -- Another 18 items were constructed based upon the knowledge building principles, collaborative and online learning. All statements were ranked along a 5-point Likert scale. Students were asked to compare their learning experience in classroom with and without knowledge-building pedagogy. Examples of questionnaire Items are as follows:

- Ideas and views we discuss in the group are improvable.
- Each group member has a responsibility to advance the knowledge of the group.
- Contribution of each member of the group is important and valued.

We are still in the process of collecting post-test questionnaire data as the academic year in Hong Kong ends in mid June and so are most Knowledge Forum discussions.

Designing for Teachers' Understanding and Emerging Community Growth

In this section, various activity structures for examining and fostering teacher growth are described. We examine how knowledge-building principles underpin the design of these activity structures and examine emerging community growth.

1) Emerging Collective Agency in Teacher's Discourse (Design Meetings)

There were weekly meetings among the 7 expert teachers with project members as a design team. We designed the meetings for developing teachers' *collective epistemic agency*. Teachers were required to set goals and identify issues that needed inquiry and problem solving. They took turns in chairing these design meetings. Continual sharing among teachers in the community was supported with technology on the teacher database.

Throughout the first few months of the first year (September-March), with the exception of planning for key events such as workshops, these meetings were mainly

about procedural and organizational matters. Much discussion was spent on timetabling schedules and project management issues. Difficulties with project personnel and social dynamics were observed in the initial growth of the community.

Also at the beginning stage, seconded teachers (ST) seemed reluctant to discuss their mentees' knowledge building work during their weekly meetings. Over time as mentors had gradually developed rapport with their mentees, usually through direct involvement in introducing Knowledge Forum to students and conducting classroom knowledge building activities, changes happened. Experienced teachers began to discuss their mentees' databases and pedagogical strategies that could be used to support knowledge building in classrooms. Collaborative problem solving was evident. An interesting example was brought by one mentor who pointed to the problem of elementary students being incapable of Chinese word processing when 'writing' on Knowledge Forum. The team collectively came up with suggestions of replacing word processing with scanned images of students' drawing and written text (notes). In subsequent meetings, the effect of the innovative ideas on enabling young Chinese students' knowledge building work was continued. These were *collective achievements* of the group that could not be achieved by an individual teacher. It started as a simple pedagogical tactic but it has the potential of addressing epistemological issues of learning diversity for knowledge-building practice.

While the gradual shift from an overwhelming focus on managerial and procedural issues to pedagogical aspects of knowledge building was evident, epistemological shifts were more gradual although 'signs' could be seen more often in recent meetings. There was more realization that individual classroom implementation cases were to be artefacts to be critiqued and improved akin to students' knowledge building practice in classrooms. Second, the teacher community was willing to take up new challenges and ideas rather than staying with their current practice. When the new idea of "explanatory coherence" was introduced as a result of contact with other communities in international collaboration, rather than rejecting it as something irrelevant to teacher practice, there was collective inquiry and discourse on what it would mean in different domains and further explorations continued.

2) *Collective Mentoring and Principle-Based Understanding (School visits)*

The expert (seconded) teachers were funded by the EMB to provide support to new teachers to try out new practices in schools. This emphasis on face-to-face contact is common in teacher development. The design feature we have is one such that the different cases were brought back to the wider group for collective mentoring discussion as an object of inquiry and for improvement. Teachers also made records of their ongoing visits and posted them on Knowledge Forum. These then became new problems to be tackled by the community. Through the expanding space mediated by technology, the visits were not just personal contacts but collective artefacts for examining improvable ideas and practice among members of a diverse background in the community.

At an early stage, most mentee teachers were mainly concerned with how to use the Knowledge Forum. They mainly wanted the mentors to show them how to use certain KF functions. Other mentees found the most useful gain to be the opportunity to see

successful pedagogical practice from others, and to know the different strategies. One of the mentee teachers, however, noted how school visits and mentoring helped develop a principle-based approach to understanding knowledge building. This teacher said:

> *What I wanted my mentor to do is to be able to let me know the principles behind. I want my mentor to understand the knowledge building approach well and to be able to discuss with me and to explain why certain approach may work or not work. I am a science teacher and I have this tendency to keep asking 'why'. I really need an explanation. It is great that my mentor shows me many examples and I am really glad he can also explain to me the principles behind the design and with that understanding I can continue to try those out myself (Ms H).*

3) *Collective Artefacts and Community Knowledge (Teacher Workshops)*

Apparently teacher workshops are key to teacher professional development programs. We strived to design workshops that do not only provide 'know-hows' to teachers but opportunities for understanding the principles, collaborative problem solving and working together as members of the community. In the first workshop, we explained the set of knowledge building principles. In the second workshop, we focused on 'improvable ideas', one of the principles in connection with the pedagogy for deepening discussion. The third workshop focused on 'concurrent, embedded and transformative assessment". Principles were not delivered as declarative knowledge but examined and abstracted through various examples and instances.

We found these workshops useful because through the process, the expert teachers had to work together to produce new ideas and products as "collective artefacts". Everyone contributed to the growth and extension of knowledge in the community. In contrary to providing one or two take-home strategies similar to most teacher workshops, we provided many contextualized examples from both expert and novice databases engaging them in collaborative problem solving. In examining various examples at different levels of complexity, teachers may develop wider perspectives and have more opportunities to inquire about principles behind these different designs.

These workshops clearly addressed pedagogical aspects – They learned about Knowledge Forum functions and assessment tools and different pedagogical approaches. The technological aspects also went hand in hand with advanced pedagogical models. For example, the use of 'references', 'scaffolds' were discussed in the context of how they could promote student understanding. These workshops seem to address teachers' developing pedagogical practice. One teacher said:

> *I used Applets with my students after I attended the workshop – It is amazing how it affected them when they saw the graphics of their contributions. I learned to know more about my students…Um..There are also certain problems with the use of such Applet information because my students quickly learned ways to beat the system by clicking notes... I would have to think of ways to deal with them* (Mr W.)

Other remarks may suggest the beginning of some epistemological shifts of how this teacher sees the value of coming together with others in the knowledge-building community:

> *It is good to see other teachers and their examples… I do not know much about the network but I think it must be the way that teachers now need to learn….It will be the case in teacher learning in schools and we are now doing it here...*
>
> *For materials in the workshops and they look a lot - But among these many examples, there will be some that are useful and I can think about how they can be relevant to my circumstance. I can choose what I think is important; it is better than you specifying what I need to know* (Mr W.).

Despite being implicit, this teacher indirectly referred to notion of agency that teachers need to have. They need to take charge of what is presented and to make sense of the information. This may shed light on teacher learning for knowledge era –We may be designing environments in that teachers need to work on the artefacts, to select and to reflect -- the complexity may provide opportunities for teachers to consider deeper issues congruent to what their students face in knowledge-building classroom.

4) Symmetrical Knowledge Advances and Connection with Wider Communities

We design an activity structure for the teacher community so they are connected to the wider communities. Some of the teacher participants have participated in an international collaboration. The connection with other communities working on knowledge building provides further impetus for community growth. One of the network teachers was working with another teacher in Barcelona establishing links across the communities. Upcoming activities have entailed different communities of teachers working on the same topic of 'global warming' in different countries. It would be very interesting to see how teachers might come together to discuss and build knowledge about explanatory coherence.

Currently, this aspect of connecting to the wider world and expanding the community is still in an exploratory phase. Again, much concern is given to technological aspects of connection with other teachers in multiple sites. Discussion on pedagogical aspects is yet to emerge. However, teachers are conscientiously tackling the problems. How we can design in ways which the community can see the benefit of this wider collaboration, and how they can transcend difficulties beyond contextual factors needs continued exploration.

To summarize, knowledge-building principles are embedded into the knowledge building pedagogy and classroom practice. There is some emerging growth in community knowledge and understanding emphasizing agency and collective work. We also witness a gradual developmental trajectory of professional growth at technological, pedagogical and epistemological levels. How the community may emerge and develop will be tracked in our continuing work.

Emerging Principles and Knowledge-Building Practice

Although there were no specific efforts to directly convey the knowledge building principles to members, there was a gradual emergence of principles in the evolving community that influenced classroom practice.

Epistemic Agency

From the interview data, a growing sense of emphasizing student agency was expressed by some teachers. They believed that students could take on more cognitive responsibility when commenting on others' work on knowledge building. Some common responses were:

> *I really did not know my students could do this; such as xxx who usually used minimal efforts; I did not know he could be so thoughtful; I began to see them differently*. (Mr L., Grade 7 students)

> *Frankly speaking, I was a little worried if my students could [really] do that.. I was afraid it would get into a mess.. But interestingly they could really come up with things I didn't expect.. It is a difficult way of teaching.. because I had to give up control and let my students do that.*. (Ms. H., Grade 12 students)

Another teacher (Ms F.) came up with another account of what might be characterized as collective epistemic agency. She discussed the incident of collaborative work in Liberal Studies and how their Grade 12 students were writing on Knowledge Forum about the election in Taiwan as it was frequently reported in the news.; and from there she recalled how amazed she was that these students ended up reflecting on the problem they had during the student election in their own school. On Knowledge Forum, they inquired into the problem and designed a mini-survey to understand how election worked in their school, and from there they arrived at some new understanding of 'democracy'. This latter inquiry activity was very much initiated by students on their own accord. In the descriptions of these various incidents during the teacher meetings, we can identify the principle(s) that guided the teachers' work through the emphases they made.

Improvable Ideas and Deepening Discourse

As expressed in several occasions earlier in this paper, teachers in this community were attracted to the notion of deepening discourse that may be reflected in their focus on the notion of "improvable ideas". In one expert teacher's sharing, he noted that the key difference between online learning and knowledge building was that the latter enables deepening discourses among students. How to help students deepen their discussion so they can rise to a higher level of understanding has become topical among expert teachers and a key theme in the second workshop. Different teachers came up with various examples and instances of how they used different ways to help students to move to higher levels of discussion. Examples included use of 'references' and 'summary notes' and 'learning diary' that can be seen in various databases. A number of teachers

discussed how they emphasized 'knowledge-building talks' in the classroom where students could further synthesize their work.

Even for the new teachers, there seemed to be this growing realization about the need to have students improve and deepen their discourse, as gleaned from the interview data. For example, when asked about his plan for the coming year, one teacher reflected on the need to move beyond technical matter so he can focus on helping students write better-quality notes. In another interview, the teacher (first year in using KF) put the role of a teacher in a knowledge-building classroom in this way: "The teacher needs to help students to reflect on their work; she needs to help them synthesize and move to a higher level". At a pedagogical level, when teachers considered various strategies for deepening discourse, there may be a growing recognition of a problem of shallow discussion. This 'problematizing process' (Lai & Law, 2006) may prompt teachers to make some epistemological shifts to rise above with their students. There may be some growing understanding about the sustained and improvable nature of knowledge building.

Concurrent, Embedded and Transformative Assessment.

Another key emerging principle in this teacher community is the emphasis on concurrent, embedded and transformative assessment, selected as the theme of the third teacher workshop. Much effort is spent on using various approaches to use assessment to foster knowledge building practice. Almost all teachers had their databases analyzed using Applets or Analytic Toolkit; and the understanding varied. Some had the mentors run the ATK and Applet analysis for them but there were also mentees who, after attending this workshop, took up assessment of student databases on their own.

In addition to the quantitative analyses using assessment tools such as Applets, teachers in this community also took to the idea of understanding more about their quality of students' writing. They spontaneously asked questions about how to assess their students' understanding on Knowledge Forum. Some teachers also engaged in developing rubrics for understanding students' notes. More and more teachers were asking students to assess their own notes and the importance of transformative assessment was also spreading within this community.

We noted that certain principles seemed to develop more strongly in this teacher community. There were no explicit efforts to try out one principle at one time. However, some of these principles got spread among teachers probably by a couple of experienced mentor teachers who have deep understanding towards these principles and could show and explain to others. . Not only do they share a wider range of teaching and assessment strategies among themselves, they showed an understanding of why these practice is important. The spreading practice of certain ideas and practice also indicates interesting socio-metacognitive dynamics within the network.

Patterns & Trajectories of Teacher Understanding

Interview data from teachers were analyzed to examine teachers' understanding of knowledge building and innovations. We observed different patterns that might reflect

different phases of teacher growth in adopting innovations in classrooms. Three teachers are chosen to illustrate different patterns of understanding that may help illuminate teacher development in their understanding of knowledge building.

Teachers' Understanding of Knowledge Building

Initial Phase (Type I) – Struggling with Technology and Management

Ms Lee has taught language (Chinese) for over 20 years and she was Head of the Chinese language Department at her school. She knew about the project from various workshops and decided to join. When asked about her general experience with the project, she said:

> *I think if my IT skills are better, things would be much smoother. I sometimes have to tell students certain things and they go home and do that. So if I did not tell them correctly they might not get them right. I find it difficult to use KF and I don't have good IT skills.*

Ms Lee's concern with technological problems is quite common among teachers in an early phase. When asked if knowledge building has any influences on the students, the reply was, "I have not tried it for long enough so I really could not see much impact. But I guess it has to be good if students have more chances to express how they feel. I am a language teacher and I think writing and communicating must be good for them."

When asked of the teacher's and students' roles in a knowledge-building classroom, Ms Lee said:

> *The teacher would plan some good questions for students to address; the teacher discusses certain questions with the students. I think question and answer is very important – let students go and find the answer; the teacher helps students to understand why this is a better or not so good answer.*
>
> *A knowledge-building teacher needs to know what he or she is teaching; he or she then turns it into questions and then help students to address your questions. A knowledge building teacher should have enough time to read students' notes and then give feedback to the students. I think a good kb teacher needs time and skill..*

Not only was Ms Lee trapped by her perceived difficulties with technology, she had a limited understanding of the knowledge building approach.

Finally when asked what she expected from the project and her plan for next year, Ms Chan dwelled on technical issues again. She noted:

I will deal with my technical problem, and the most helpful advice now is that we can have some VCD and more practical advice as to how to use Knowledge Forum.

Nevertheless, Ms Lee is still positive about the use of KF and has decided to continue next year. Despite her limited understanding, she expressed some questions and concerns that suggested much potential for growth. Her case poses challenge as to how we can design in ways which will help teachers move beyond the initial phase of technological difficulties more effectively.

Emerging Understanding (Type II) - Focus on Inquiry and Pedagogy

Mr Wong has taught math for 10 years and has just begun to teach junior form Liberal Studies (equivalent to Social Studies). He was persuaded to join the project by his colleague Ms. Lam who has taken M.Ed. courses at the University and was much influenced by new models of collaborative learning.

When asked of his experience with the project, Mr Wong also referred to technological affordance at the start but he soon moved onto pedagogical aspects:

> *We have tried project learning and e-class before but did not think the platform was useful. When we first began using Knowledge Forum, we also felt it was not too user-friendly. But over time, I think the support from the project and interfaces are actually good, and surprisingly the effects were better than I thought.*

When probed on what he meant by unexpected results, Mr Wong replied:

> *Because of the packed syllabus, we've only got one period per cycle for junior form Liberal Studies. I did not expect the students would do so much discussion, but I was surprised to see high student engagement in the discussion.. much better than I thought. I think there are even depth and good ideas. My students went on their own to look up for information and what they wrote was quite acceptable. I also didn't expect that my students would like this approach.*

When asked what knowledge building meant to him? Mr Wong said:

> *I do not know what it is but I think new knowledge comes from good questions. Students may need to tackle new problems; they need to develop deeper understanding. For knowledge building teachers, I think we need to provide the environment for students to engage in inquiry. It is important that teachers help students learn how to think… I like Knowledge Forum because I can look at students' notes, and after I have seen their discussion, I have a certain understanding of what they are thinking…sometime I also build on a certain group's special points and contributions…*

Mr Wong is different from Ms Lee who focused still on question and answer. While Mr Wong focuses on aspects of thinking and inquiry, he did not mention much about the social aspects of knowledge building.

Mr Wong also seemed to be keen on describing his pedagogical approach and practice:

> *My colleague and I discussed and we decided to start small. We selected 10 students to start on Knowledge Forum. I think knowledge building is quite complicated and so we asked these students to try it out first. They then became the leaders of ten groups of students, and in this way, we can help more students to contribute. This grouping method seems good and we will try with more students next year.*

When asked about the aspects for improvement and how the project can be of help in the coming year, Mr Wong said:

> *I have a good experience this year when compared with my other experiences. At first I was quite worried about asking students to discuss online because it might be very difficult to control. For next year, I hope we can improve the approach. I also hope the students can have better substance in their discussion; and we can focus more on teaching and learning and need not bother with technical aspects.*
>
> *Ms Chan is the one who shows me this new approach and I've tried it and found this quite OK. We are planning to do this with more students. I also hope maybe next year I can try that with another teacher in the school.*

Mr Wong was in his first year of using Knowledge Forum and he was enthused by what he saw, what his students could do in knowledge building. Mr Wong was interested in inquiry-based aspects of learning and how students could develop better thinking. He was concerned with pedagogical design and he thought about how to group students to embark on the innovative approach. However, there was relatively little indication of a focus on the communal aspects of knowledge building in Mr. Wong's case.

Principle-Based Understanding (Type III) – Focus on community growth

We also examined Ms Lai who showed a different pattern in the developmental trajectory. Ms Lai has used knowledge building and Knowledge Forum for a few years. She stopped for a year and resumed upon joining this teacher community.

When asked about her experience with the project, Ms Lai pinpointed straight to the principle of community knowledge:

> *I started using Knowledge Forum again around January. We started with some classroom work because we wanted our students to realize the importance of working in a community…Then around March, I extended the use of Knowledge Forum to after school and emphasis was still on helping students understand the importance of learning in a community [beyond school]. It seems useful to let students know explicitly what is important and so they know more about what they*

need to do… I feel my work on knowledge building is more fruitful this year as I understand the approach more deeply …

Ms Lai (Type III) here has a remarkably different approach from Ms Lee (Type I) and Mr Wong (Type II). Ms Lai highlighted the epistemological aspects of student learning in a community, which was absent from the other two. She seemed aware that she needed to capture the essence of the knowledge approach herself before she can effectively facilitate students' knowledge building work.

When asked what principles in general influenced their teaching (pedagogical choice) most, all three types of teachers stressed different aspects of student learning in their responses. Ms Lee (Type I) indicated that motivating students towards learning was her fundamental principle towards teaching. Mr Wong (Type II) believed that making sure that students had learned something was the driving principle. It was Ms Lai (Type III) who mentioned that the knowledge-building principles were her guide in her pedagogical deliberations. She said:

Unlike my mentor who can articulate the set of principles that I can't, still, I will use these principles to remind myself… Sometimes when I asked students to do certain work, I may doubt if that would work. Then I think about some of these principles and remind myself that community learning is possible…. Students can indeed be able to develop new knowledge when they work together.

When asked to explain further how such principles influenced her, Ms Lai said:

For the last few years, ideas that have influenced me most are that: if everyone contributes and puts forth something [within a community], then the knowledge of the community will extend and grow. So I try to make this happen with my students. It does not matter how they group themselves or how they produce their reports, I need to see that they all contribute…..I will make it explicit by telling them that we must all contribute to the understanding of the whole class... I also find ways to do that... when I see that someone is contributing useful knowledge.. , I will point that out to students saying.. 'See! This is what I mean and how it works…' I am actually working with my students using evidence to explain what they are doing.

Ms Lai's reference to knowledge-building principles suggests that there is a shift from pedagogical to epistemological perspectives. Her emphasis on community knowledge explains how the principle underpins her understanding and practice, to the extent that she will make such important principle salient to her students.

When asked about her understanding of knowledge building, Ms Lai said:

I would like to consider both individual and community aspects of knowledge building. The community aspect refers to contribution and improvement of community knowledge. As a teacher, we often think of our students individually.

> *That particular student may not grow at a specific point in time but he will still have the opportunities provided if the whole community is moving forward. Sometimes one student may be contributing and another receiving at different times, but there needs to be an extension and improvement in knowledge.…… knowledge building is the growth of knowledge within the community. What matters is if the whole class move forward, different students will benefit at their own pace.*

When asked what the project could do in assisting her knowledge building work, Ms Lai kept to her principle-based notion:

> *In a teacher community, there are teachers of different expertise, some are more experienced and others are just novices. I think the knowledge building principles may need to be more catered [for teachers in this community]. Even though many do not think so, I still believe that teachers need some principles… although the knowledge building principles may be quite complex.*

When probed if she meant that only the experienced teachers needed the knowledge building principles, Ms Lai added:

> *I think all teachers, experienced or not, need principles. But perhaps you need to think of ways to help us understand these principles and make them useful for teachers who are engaging in knowledge building in different stages.*

Responses from these three teachers generally reflect different phases of development for knowledge building along the trajectory of growth.

Relationships between Teacher Understanding and Student Views

Research on innovations and teacher networks has indicated the importance of making the links between teacher professional growth with student learning in classrooms (Fishman, 2000). Teachers may espouse certain ways of understanding that is not connected with what they accomplish in the classroom. This study is still at a very preliminary phase and data collection is still-ongoing. When comparing our analyses of teacher interviews with the student questionnaire surveys, some interesting phenomenon appears.

Data collected from the 18 items constructed to reflect student views about collaborative knowledge building derived from the set of twelve principles were analysed. Factor analyses (principal component analyses) showed that 14 of these 18 items loaded on the same factor; the other four items were thus excluded. A scale was formed called collaborative knowledge building computing the sum scores of these 14 items. The scale reliability based on Cronbach Alpha is 0.84 and is acceptable. We did not have all pre-post questionnaires and we examined posttest questionnaires on students' views on collaboration in knowledge-building and non-knowledge-building classrooms. Specifically, students were asked to compare their engagement on collaborative knowledge building in classrooms using knowledge building and those with regular

teaching.
Data are still being collected; we included findings from six teachers with both interview and questionnaires data (Table 1). Using the three prototypes, we classified teachers into Types I, II and III based on the interview findings. We then examined their students' scores on the questionnaires on collaborative knowledge building in regular classroom versus classroom with innovation of knowledge building.

Table 1: Students' Views on Collaboration Comparing Learning Context with or without Knowledge Building

Teacher	Type	Grade & Responses	Collaboration (Regular classroom)	Collaboration (KB Innovation)
Ms Lee	I	10 (n= 38)	3.17	3.16
Mr Ku	I	7 (n = 34)	3.35	3.22
Mr Wong	II	7 (n= 35)	3.04	3.29(*)
Ms Chan	II	7 (n= 34)	3.34	3.36
Mr Chung	II	12 (n= 11)	3.46	3.74*
Ms Lai	III	12 (n = 18)	3.18	3.44*

Note: *p<.05; (*) p<.10

Students' responses suggested some general patterns. We found no differences in students' mean scores between classes taught by Type I teachers. Results were mixed for classes taught by the Type II teachers - Mr Wong was one of these Type II teachers and his students also showed more favourable views. Mr Chung was another teacher, coded as exhibiting Type II belief, he only started using Knowledge Forum in this year in collaboration with one of the mentor teachers who works in the same school. Their students also appeared to show more favourable views with the highest scores. The type III teacher's view was most sophisticated and correspondingly the students' also indicated differences in how they viewed working on collaboration. With the current data collected, individual teachers' development seemed consistent and may have impacts on students' perceptions of their understanding. The typology of teachers may have potential in showing different levels of teacher development along a knowledge building trajectory.

Implications and Lessons Learned

This paper describes our initial efforts in designing for knowledge building in a teacher community: We aimed at examining how teachers understand knowledge-building innovations and to explore how knowledge building dynamics can support teacher growth.

Our preliminary work suggests that there are some contributions of the knowledge-building community on teacher growth emphasizing knowledge building principles. There is a gradual shift from procedural to pedagogical focus with implicit

epistemological notions in teacher discourse. There is some growth and spread of principles and practice emphasizing student agency, improvable ideas, and embedded assessment. Teachers work together in developing collective artefacts and some establish contact with the wider knowledge building community. The number of participating teachers have increased in the network and almost all indicated they would continue in the coming year; some indicating they would invite their colleagues to join. Although there is no clear indication of overall increases in students' views of collaboration, there are patterns suggesting that teachers with deeper epistemology seem to have students holding more favourable views.

Designing for Principle-Based Understanding

Our preliminary results suggest that having a group of expert teachers working together to support new teachers in an evolving community is beneficial. One key notion is that we try to design teacher development in ways so it mirrors knowledge-building practice. Although the activity structures seem to be common-place, we attempted to embed knowledge-building principles into the activities. Teachers of diverse expertise make valuable contributions; they identify common goals and tackle problems collectively, and they create and refine collective artefacts as they improve on principled understanding and strategies. They are working at the cutting edge creating new ideas about knowledge-building practice and not just reproducing existing repertoires or skills.

There were differences in focus on technological, pedagogical and epistemological perspectives in teachers' discourse. We observed that at an early phase of the community, teachers were mostly discussing procedural and management issues. Teachers gradually moved onto examining pedagogical aspects discussing how knowledge building database can be designed, and at times signalling epistemological shifts towards an emphasis on student agency. We propose that these different levels are useful for examining teacher growth in communities. We suggest teachers may go through these different phases but these phases need not be sequential; they can be overlapping dimensions and levels. We will continue to explore how teachers develop epistemological perspectives as they reflect on their pedagogical practice with evolving technology.

Although principles are not explicitly developed, we found that there were emergent community understanding connecting principles and practice. In this network, particular emphasis is given to epistemic agency, improvable ideas and embedded assessments. These spreading principles and practice in the community seemed to develop with strong classroom examples, explanation and modelling from more expert members. New teachers did not merely copy the examples; they made adaptations and new creations in their own context. It is important to continue to examine how these principles and practice spread in the community. Specifically, whether these principles and innovative practice will stay with certain teachers only and how these emerge and grow as community knowledge will be examined.

As with the scaling up of any innovation, there are difficulties and tensions with focusing on procedural matters versus principled approach. Teachers are faced with the problem of day-to-day management in classrooms. In a network with a large number of teachers, it would be easy to be contented with teachers carrying out the procedure and

activities. However, focusing on tactics while overlooking principles will be inadequate for sustained innovation. On the other hand, focusing too much on the introduction of knowledge-building principles may make it remote and appear irrelevant to teachers. While epistemological shifts are important, it would be difficult to make the shifts without developing appropriate pedagogical strategies as they may just be some espoused theory. In our design, we strive to intertwine principles and strategies and we work towards helping teachers to internalize the principles. We will continue with our design efforts to address these tensions for principled understanding and sustained innovation.

Patterns of Understanding and Trajectories of Growth

We also found different patterns of understanding among teachers in the community in the first year of the study. These different patterns seemed to reflect different phases of growth focusing on technical issues, pedagogical tactics and epistemological understanding. It is interesting that these different patterns of teacher understanding, with our preliminary data, showed some connections with students' views of collaboration. Further analyses will be conducted to examine the roles of the teacher community on teacher practice and student growth. We are also conducting ATK and Applet analyses as well as collecting data on domain knowledge to see relations among teacher and student understanding.

The different prototypes identified seemed consistent with early versions of Teacher A, B, and C with different manifestations. Whereas some teachers were concerned with procedures (Type I), others were concerned with teaching strategies (Type II) while some others seemed to be developing an epistemological perspective focusing on principled-based understanding (Type III)- They see that new understanding and practice need to be guided with principles. We do not intend to merely identify these different prototypes; these various prototypes of teachers may show different phases suggesting the trajectories of knowledge-building growth. We are continually examining further design in helping teachers to move along improvable understanding and practice in the teacher knowledge-building community.

There are several issues that have emerged. Primarily, there is the tension between principles and a strategy-based approach. In efforts to scale-up and disseminate the innovation, it is easy for knowledge building to be merely considered as online learning. There are issues of sustained efforts – many teachers seem to be contented that students can do some online writing rather than considering sustained inquiry. As we move to Year 2 of the study, we will continue to examine how we can develop principled-based understanding and support teacher growth for advancing community knowledge.

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