Towards a Principle-Based Approach for Knowledge Creation in Teacher Professional Development

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Abstract

Despite knowledge building as an educational approach advocated in classroom innovations, little attention has been paid to professional development regarding how to develop teachers to understand and to engage in such innovations. This paper reports on an ongoing 2-year research into teacher development in knowledge creation work adopting principle-based design approach under a framework of Principles-Collaboration-Reflection-Practice. A variety of data sources were drawn from a group of 9 teachers, including teacher interviews, reflective notes and artifacts, video clips on classroom discourse, reflective journals and discourse on knowledge forum – a computer-supported collaborative learning environment. Data analysis focuses on how principle-based approach worked on knowledge building practice in teacher development. The research findings show that the principle-based approach was conducive to teachers' changes in conceptions of principle-based understanding, and changes in their knowledge building practice, which reflected in changes in collective knowledge advances in classroom.

1 Introduction

Although there is now widespread interest in developing knowledge creation model in classroom, a major challenge exists as to how we can develop teachers to understand and to engage in such innovation. To date, many large teacher networks have focused on providing support for teachers' knowledge and sharing good practices through tasks and activities (e.g. Lieberman & Mace, 2008). Although the practice has already been widely recognized, questions remain as to how we can understand and foster teachers' *understanding for innovation* in classroom. In addition, "Lesson study", a common practice of teacher development in Asian countries, is gaining popularity in the West. Despite its increasing popularity in providing the potential for improving existing practice, Oshima and colleagues (2004) point out that "Lesson Study" has exerted limited impact on empowering teachers to understand educational innovations. If our goal is to develop students as adept knowledge workers in the knowledge era, it is important that teachers themselves become knowledge builders – they need to engage in progressive inquiry working towards improvable ideas and collective advances. Hence there is an emerging need to develop new models of and approaches to examining how teachers create knowledge collectively for 21st century new educational goals.

We propose that teacher learning need to be *congruent* with the processes of progressive knowledge building, and teachers need to work together to *inquire* and create knowledge about new visions of learning in innovative classrooms. A major challenge for teachers working on knowledge creation model is to shift from tasks and activities common among teacher development practices to principle-based

understanding to make knowledge advances and sustained classroom innovation. Scardamalia and Bereiter (2008) discuss the challenge of fostering a principle-based rather than a procedural-based approach to teaching. At classroom levels, reform-based approaches may degenerate into project activities and shallow constructivism when students are "researching on" or "collecting" materials for completing project tasks and activities. Such phenomenon is labeled as "lethal mutation" by Brown and Campione (1996) to describe the problem when teachers merely focus on activities without understanding the key principles. For other examples, reciprocal teaching is often carried out following the routines; and the knowledge creation model may involve students writing on the Knowledge Forum yet merely engage students in "knowledge sharing" discourse (van Aalst, 2009).

A key idea for principle-based approach is that teachers and students need to attend to cognitive and epistemic goals. Apparently teachers may be concerned with day-to-day demands of classroom management and need for organizing activities, yet a principle-based understanding is to provide the basis for continued growth and knowledge advances. Reform efforts have considered the need to develop generative teachers who will continue to grow - from deep changes towards knowledge creation, teachers need to make changes in epistemological perspectives, reflect on their understanding of knowledge creation, and examine their conceptions of classroom practice. Scardamalia (2002) has developed a set of principles pivotal for examining and designing knowledge-building inquiry and practice (Zhang et al., 2007). Although the system of knowledge-building principles seems complex for teachers, there is evidence that principle-based understanding can help sustain teacher growth (Zhang, Scardamalia, Reeve, & Messina, 2009). In our earlier study, we found that teachers in the knowledge-building network varied in their emphasis on principles versus activities (Chan et al., 2008), and those inclining towards principles had their students indicating more of experiencing a productive collaborative classroom culture.

Our previous research on student insights into knowledge-building principles via assessment (Lee, Chan, van Aalst, 2006) further indicates the great potential of a principle-based approach to teacher development. This paper reports on our design work to help teachers develop a principle-based understanding for collective knowledge advances. We also discuss how teachers' changing conceptions towards principles are aligned with changes in student engagement towards community growth. The research questions addressed are:

(a) Did the teachers make changes in their knowledge-creation work as reflected in their students' Knowledge Forum participation patterns over the two years? In particular, were there any increases towards community awareness and connectedness?
(b) What characterizes teachers' change from individual to more collective views of knowledge creation as reflected in their practice?
(c) What was teachers' understanding of principle-based approach in particular in the area of assessment of knowledge building? How were teachers supported in changing procedural to principled-based understanding?

The rest of the paper first presents the research methods, followed by research results. Finally discussions are made and conclusions are drawn from this research.

2 Methods

2.1 Context and Participants

The context of the study is a knowledge building teacher network established upon an EMB[1]-funded teacher secondment scheme in Hong Kong. The project first started as a 2-year project (2006-08) and then continued to be funded as a 3-year project (2008-2011) for developing a knowledge-building teacher network. With a large network, there is much variation in teachers' understanding and practice of knowledge building although preliminary evidence indicates gradual growth of the teacher network over the years. The teacher network has provided opportunities for us to work closely with teachers in knowledge creation and classroom innovations. We also include data from their students over a 2-year period to document their growth. Among these 9 teachers, most are beginners to the knowledge creation approach when the study started with the exception of 3 teachers with 1-3 years of experience. The 2-year study aimed at developing principle-based understanding among a group of 9 teachers by tracking their growth and changes under a framework, which is presented in the next section.

2.2 Design for Principle-Based Approach

In this study, we adopted design-based research in developing an understanding of the teachers' advancement and changes under a framework termed Principles-Collaboration-Reflection-Practice. Consistent with Putnam and Borko (2000)'s conceptual themes that emphasizing teachers as learners and learning in discourse communities for reflection and collaboration, and with our understanding of principle-based approach to teacher development, we sought to develop knowledge-building practice among teachers while they worked together to build new knowledge about how innovations worked in classroom under the framework consisting of four interacting elements: principles, collaboration, reflection and practice. The implementation of the framework in the teacher development is elaborated as follows:

(a) Principles – The teachers were interviewed on their initial ideas about knowledge building and their goals for advances. The teachers' beliefs and understanding of principles were addressed through explicit emphasis on principles in the orientation workshop as well as through weekly discourse in teacher community. Teachers' improved principle-based understanding was mediated through discussion using classroom episodes and Knowledge Forum discussion threads. Aligned with constructive use of authoritative information, teachers also engaged in reading academic papers to extend their principle-based understanding.

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

From a broader aspect, we designed workshops that provided not only opportunities for teachers to "know-how" to carry out knowledge building practice, but also opportunities for them to understand the underpinning principles. To be specific, in the orientation workshop, we explained a set of knowledge building principles for refreshing the teachers' minds. Later, in a chain of workshops, we focused on different principles from improvable ideas and rise-above to concurrent assessment principles in different workshops. These principles were not delivered as declarative knowledge but examined and abstracted through various examples and instances. Contrary to providing a few strategies stripped from context, we provided contextualized examples from various student knowledge building databases and teacher practices by engaging them in collaborative problem solving. In examining various examples at different levels of complexity, teachers could have more opportunities to inquire about principles behind these different designs.

(b) Collaboration - As with other teacher communities, the research focus was placed on how teachers developed new understanding collaboratively in monthly workshops, weekly face-to-face discussions, reciprocal teaching, and discussion on knowledge forum. These teachers engaged in knowledge creation process similar to that of their students: posing questions, co-constructing theories and explanations, and refining their collective ideas. Through an emphasis on the community, the teachers had to work together to produce new ideas and products as "collective artefacts". Everyone contributed to the growth of knowledge in the community.

(c) Reflection - Ample opportunities are provided for teacher reflection. The arrangement of secondment provided time and space for expert teachers to participate in various discussions about theory-practice integration for "reflection-on-action" (Garcia, Sanchez, & Escudero, 2007, p. 1). For instance, as one focus was placed on developing teachers' understanding of assessment for knowledge building, in seconded teacher meetings, authentic student individual and group portfolios on knowledge building database were presented so that they could reflect on how students assessed their own knowledge creation individually and collectively. They also discussed and reflected the assessment methods collaboratively as the basis for their further collective advances in understanding knowledge building assessment "just-in-time". Teacher reflection is also supported with the use of Knowledge Forum and weekly individual interviews for providing sustained reflection.

(d) Knowledge-Building classroom practice – Teacher growth was grounded in their reflection framed by principles and practice. We found a more effective way to foster teacher growth by integrating principles into discussion about their practice with a focus on student advances. Instead of discussing strategies and pedagogies out of context, the emphasis was placed on what knowledge-building principles should be incorporated into curriculum design and how students demonstrated knowledge-building advances in terms of principles and through qualitative and quantitative indicators.

2.3 Data Sources

Data sources were drawn largely from 9 teachers, including semi-structured in-depth interviews and weekly interviews, teachers' reflective diaries and reflective notes on Knowledge Forum, teaching plans, artefacts, and video clips of classroom episodes. We also included their students' knowledge building discourse on knowledge forum to analyze their participation patterns and collective knowledge creation over the two years.

3 Results

3.1 Student Knowledge Building Participation Indices

All the 9 teachers underwent intensive professional development practice focusing on principle-based understanding over the two years. In the meantime, the teachers co-constructed classroom practices with students to create collaborative learning environment conducive to knowledge creation supported by Knowledge Forum. Zhang et al. (2009) discussed varied key knowledge-building indices that included community awareness and connectedness based on reading and build-on indices over 3 successive school years for sustained knowledge creation. These indices showed that all those teachers that were exposed to more principle-based approaches made continuous progress from Year 1 to Year 3 mirrored in students' knowledge advances. Our findings were in line with those of Zhang et al's study. Table 1 shows the ATK and Applets indices of the group of 9 teachers' student knowledge building participation indices in the years of 08-09 and 09-10. The indices show that after two year participation in the knowledge building discourse, the student participation and collaboration had generally improved. This indicates that students had developed community awareness and connectedness in their knowledge building work.

Table 1 The 9 teachers' student knowledge building participation indices in the years 08-09 and 09-10

Name	Year	ATK Features							
		Write	Read%	Link%	# KW	#Revise	#Scaf	App-Read%	App-Build%
Teacher A's students	*Year 1*	5.5	21.1	48.6	1.5	3	6.5	41.66	13.76
	Year 2	19.2	30.3	94	1.1	5.1	19.8	85.71	32.63
Teacher B's students	*Year 1*	19.9	11.2	69.4	24.8	2.9	19.8	94.21	27.36
	Year 2	25.2	21.1	60.7	26.1	9.2	14.5	95.38	33.23
Teacher C's students	*Year 1*	12.2	27.5	88	0.1	6.2	16.8	96.15	33.28
	Year 2	12.5	55.6	86.3	0	6.8	10.7	100	37.98
Teacher D's students	*Year 1*	10.1	22.4	77.8	0.5	2.4	9.6	82.07	17.63
	Year 2	4.2	53.5	87.1	1.1	1.1	2.6	97.89	26.84
Teacher E's students	*Year 1*	6.7	20.0	40.1	0	3	11.1	66.31	16.29
	Year 2	17.7	24.1	95.9	2.4	7.9	21.5	90.64	31.41
Teacher F's students	*Year 1*	4.5	28.9	70.5	5.4	1.5	6.1	79.73	18.56
	Year 2	8.7	23.6	82	14.4	3.6	8.3	90.57	42.52
Teacher G's students	*Year 1*	8.7	32	80.7	11.9	3.9	10.2	84.48	29.23
	Year 2	12.8	42.2	81.2	13.8	2.2	12.4	99.86	32.65
Teacher H's	*Year 1*	5	28	82.4	0.2	3.3	19.66	80.55	19.66

students	*Year 2*	14.8	27.9	89.8	0	11.3	34.4	88.06	43.37
Teacher I's	*Year 1*	13.9	27	85.1	0.2	16.9	43.2	95.96	49.19
students	*Year 2*	18.2	30.9	95	1.1	11.6	37.5	91.37	38.42

We are also in the process of coding student discourse to examine if there is also improvement in term of quality of knowledge building discourse.

3.2 Changing Practice - Individual to Collective Work in Student Reflection

Scardamalia (2004) discussed concurrent-embedded assessment as one of the principles with individual and group portfolios to show knowledge advances. In our study, it was also common for teachers to ask students to do portfolios in knowledge building practice. We found that in the earlier year, teachers tended to focus more on individual aspect of reflection such as the use of reflection notes (See Figure 1). This was helpful for students to reflect on their own knowledge and put self-assessment into "evaluative accounts" (Scardamalia, 2004, p. 189).

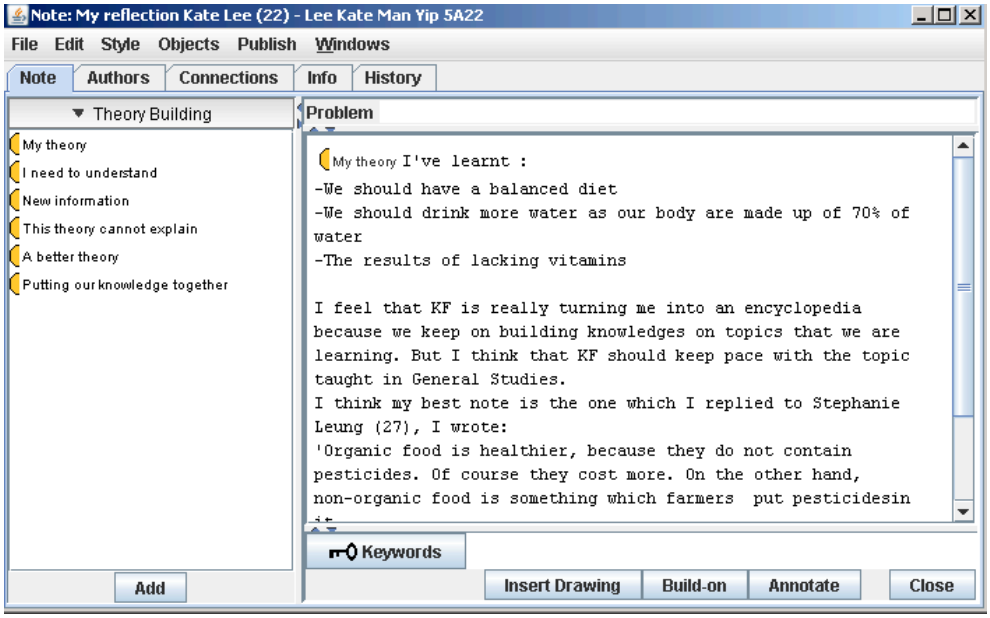

Figure 1. Screenshot of a student reflection note on Knowledge Forum

One teacher went a step further to ask the student to reflect on what he/she had learned building on his/her own learning diaries over time (See Figure 2). Although it helped the student do deeper reflection on learning, learning and reflection still remained an individual matter.

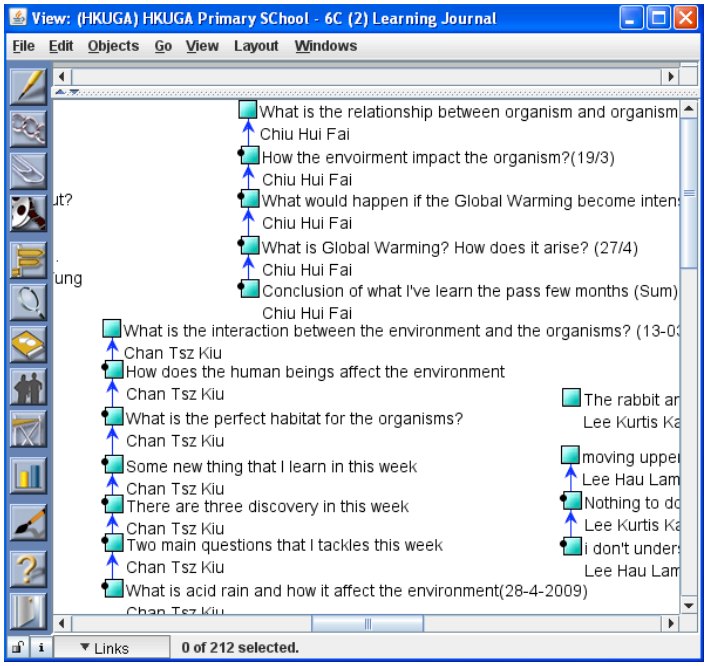

Figure 2. Screenshot of a student portfolio of reflective diaries

In the second year, we put more focused design efforts on teachers' understanding of principles of community knowledge advancement by reciprocal teaching using related academic papers and by discussing student reflective portfolios on worksheets and Knowledge Forum. As a result, teachers demonstrated much wider practice of reflective assessment to include community learning and reflection. This change was reflected in the teacher's students to create portfolios on their own – students incorporated others' notes as reference notes in their reflection; students gained agency in evaluating collective progress by referring to other's ideas contributing to the community (See Figure 3).

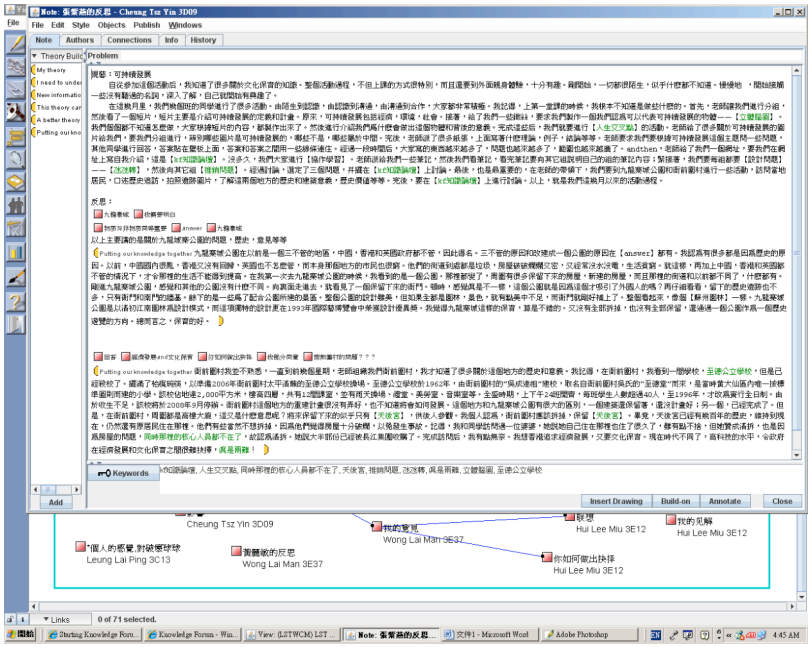

Figure 3. Screenshot of a group portfolio including reference notes

The changing practice was also revealed in another teacher's practice of providing knowledge-building principles for students to do their reflections (see Lee, Chan & van Aalst, 2006). Students identified episodes in the database that exhibit knowledge-building advances illustrating the knowledge-building principles (See Figure 4).


最出色的部份，討論「何謂精神食糧」，及「是否必須在人與人之間才可以實現到」這兩個子題最為出色，因為同學積極回應別人的意見，及表達自己的看法
例如：精神食糧一定是指具體的事物?
非具體的精神食糧？有疑問！！何謂非具體精神食糧？是否必然在人與人之間實現？精神食糧具體不具體？又是否一定要2個人實踐?
.....

(原則一：引用資料，推陳出新)
精神食糧指什么？
打機vs吃飯 精神生活vs物質生活

前者引用「棋王」主角王一生以下棋成精神食糧作例子，後者則利用告子的說話，「食、色，性也」來鋪陳自己的論點。

(原則二：公開分享，共同探究)
2.1 充份回應彼此的意見
例如：非具體的精神食糧？有疑問！！「我挺贊成詩姐的看法。」
精神食糧具體不具體？又是否一定要2個人實踐?「我認同 詩詩 的說法, 精神食糧不一定是具體的東西。」
我同意小鳳的看法

2.2 展示多元觀點，正反意見
例如：我個人認為是人人都會選擇物質食糧!
抗議，文新龍不代表我。
打機vs吃飯 精神生活vs物質生活「我認為人更有高崇的精神，人有理想，人有追求，人生存不只是為了吃飯。不然人和禽獸有何分別？.....所以精神生活比物質生活更重要。」

2.3 各組員貢獻自己的看法 (並引用例子論證自己的觀點)
例如：非具體的精神食糧？有疑問！！「我認為精神食糧其實是指一個人的理想的追求、渴求的願望。當然、亦可以是不具體的事物。例如是愛情，有些人會想像愛情是美好的，自自然然便會希望自己能夠得到，這也可算是個精神食糧。」
精神食糧具體不具體？又是否一定要2個人實踐?「而碧鈴提出了一個問題, 就是 精神食糧是需要在人與人之間才可以實理到?
我認為不一定要在人與人之間的互動才動實踐。只是剛好碧鈴所說的例子是與人與人之間有關。舉例說, 一個人希望快樂。他的快樂是否一定要人相陪才可以滿足呢? 可能是可能不是。他的快樂可能是想找個人。他的快樂也可能是想自由自在。那麼精神食糧真的需要2個人實踐嗎?」
打機vs吃飯 精神生活vs物質生活
.....

Figure 4. Screenshot of a group portfolio embedded with principles

Another innovation was that students and their teacher co-designed an assessment view on Knowledge Forum in a way that illustrated collective community advances. Students collectively contributed to the view to show what idea advances they had achieved (See Figure 5).

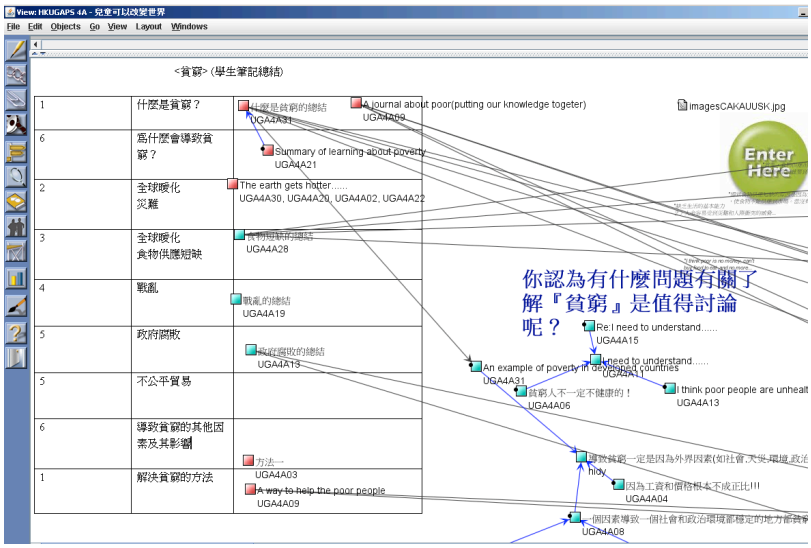

Figure 5. Screenshot of an assessment view showing collective community advances on the problem of "Poverty"

3.3 Teachers' Changing Conceptions and Progressive Discourse

This section describes the initial phase of teachers' understanding followed with an example of teachers' progressive discourse that may have facilitated their change, and finally on teachers' deeper understanding of a principle-based approach.

3.3.1. Initial Phase: A focus on tasks and activities:

In initial phase of teachers working on knowledge building practice, a common theme of teacher's conceptions was found focusing on tasks and activities. When asked about their experience of knowledge building and learning goals, one teacher noted:

> "The most important thing in knowledge building class is to find some interesting topics and issues for my students to discuss. The topics must be relevant to students daily lives - They will be more actively engaged and motivated to write to each other on the Forum" (Teacher D).

Another teacher mentioned:

> "My goal is to improve on curriculum designs of knowledge building. I do have concerns about the worksheets used currently in my school… I hope we can develop better materials for class activities" (Teacher A).

Some teachers were primarily concerned with knowledge building pedagogies or the use of scaffolds on Knowledge Forum:

> "When planning for knowledge building in my classroom, my goal is to know more about pedagogical strategies" (Teacher C); or "I would like to know how to use the various functions on Knowledge Forum. I really like the scaffolds and hope I can integrate them into my teaching and use them effectively for my students" (Teacher E).

The above quotes indicate that the general focus of planning knowledge building class was on what teachers could do rather than gave agency to students. When asked about their goals for their students, there was a vague sense of emphasis on developing student' learning skills. A teacher noted:

> "My goal for my students is that they can develop self-learning skill…Of course I hope they can acquire knowledge and skills related to the Ministry curriculum goals including those generic skills" (Teacher C).

It was not easy to put principles in the foreground of the teacher professional development. At the initial stage of teacher development, there were many misconceptions, tensions and struggles revealed in a teacher's reflective remark:

> "At the very beginning [08-09], I did not understand principles at all. I thought that as long as teachers used Knowledge Forum, it was knowledge building; and as long as there was group discussion, they were building

knowledge". She continued, "I focused on the scaffolds that might help students' thinking… I taught students all the scaffolds…" (Teacher F).

Even when the teacher is making progress, her focus was much about a procedure-based approach, for example,

In the beginning, I specified the number of scaffolds for students. Now I think it's important to teach students how to build on or make inquiries using scaffolds rather than focusing on scaffolds themselves as they would restrain students' knowledge when they used my scaffolds deliberately" (Teacher F).

3.3.2. Ongoing Development – Progressive Discourse

The gradual change towards more principled-based student agency and collective idea improvement were illustrated in the following episodes of teacher discourse in seconded teacher meeting. The discourse was framed in the context of teacher inquiry based on classroom practice. This discourse started with teachers viewing a short classroom video clip with students engaging in group discussion of a novel "Romance of Three Kingdoms". The sharing of and discussion about the video clip provided opportunities for the teachers to change from an early focus on how to design the curriculum to a later focus on the advances of student ideas; and student discourse in the episode provided objects for discourse for understanding knowledge building principles.

"I think the discussion is good… Students seemed to be working on the *development and improvement of the idea*. At the beginning, they simply talked about the character's personal ambition which that can be at the first level. Later, another student said that it was not just about personal ambition, but about the character's motivation to restore the Han's dynasty. From there, students raised a similar case of Japanese invasion concerned with the notion of ambition and restoration of country" (Teacher G).

"The episode is interesting because students seemed to be developing from some ideas that were vague into a *gradually better refined explanation and understanding*. There were also various ideas posed and maybe that can be *idea diversity*?" (Teacher B).

"I appreciated that….It seems that students could work on something ambiguous first. Later they built on different views to develop their own ideas and explain to each other to deepen the ideas collectively. They did seem to be working on improvable ideas." (Teacher C).

Although the principles were not explicitly stated in the above episodes, the teachers were referring to the notion of the principles of idea improvement and student agency. The teachers understood that it was possible for ideas to improve when students took charge. As with students took the agency to work on knowledge building, wonderment question played a pivotal role in advancing the discourse. Following some more discussion with this episode, there is another interesting turn in the discourse:

> "This is a very nice classroom episode… I am wondering how this episode can be related to our interest and the problem of assessment" (Teacher D).

Similar to the role of wonderment question in student discourse, this question by Teacher D played a pivotal role in advancing the discussion because it was this question that turned the focus on concurrent assessment and sparked the progress of the discourse.

Teacher E's response was a build-on to Teacher D's question in the pursuit for principle-based understanding

> "Um…I wonder…As students' ideas are continually advancing, is it possible for students to reflect on what they thought at the beginning… what they …thought in the middle and the end.. and maybe they can even show how they have deepened their ideas?" (Teacher E).

Teacher E began to wonder more about student agency in connection with student reflection and assessment for improvable ideas. She further noted:

> "If students' ideas are advancing… students may also be able to identify what they write at different stages, and they can find out if there are progressive advances" (Teacher E).

Initiated by Teacher E's move towards student agency regarding how students might be able to evaluate idea advances, conflicting ideas emerged:

> "It is difficult for students to find out their idea improvement. Maybe the teacher can write down important points that have been raised in class on the blackboard to make the idea visible so we teachers can also trace students' idea development" (Teacher A).

Here the teacher was grappling with the idea of making ideas public - a key principle of knowledge building. However, the notion of student agency for assessment was continually to be developed:

> "Yes it is useful for the teachers to note down the important points, or it may depend on the quality of the students. If the students in some classes are very bright, maybe they can reflect on what they have discussed" (Teacher D).

The above discourse suggests that to make the conceptual shift from tasks and activates to the principle of student collective agency was not easy. Nevertheless, it might be these struggles, tensions and multiple models that sparked the changes in the notion of idea diversity among this group of teachers. One graduate student joining the discussion posed the idea while acknowledging her lack of experience in classroom teaching:

"I wonder if it is a good idea that the teacher points out the important points. It may be better if the students themselves can find out what is important and make further inquires in their subsequent problem solving process" (Graduate Student A).

This response of a conflicting model triggered interesting turns in the teacher discourse:

"Students talked a lot about different things but they might not be clear about these ideas…*Maybe the teachers can work with students together* to find out the important questions and ideas they have raised…" (Teacher E).

"We talked about idea change and improvement… If students can identify these changes, it would be very useful. In my future teaching, I would focus more on students reflecting on what they know" (Teacher D).

The above pieces of discourse have shown how the seconded teacher meeting discourse and classroom episodes provided the avenue for teachers to move away from activities and tasks to principles. It was noted that questions raised by the teachers sparked deepened discourse, and the notion of student agency in assessment did not occur easily and directly. Yet it was these conflicts and interactions in the discourse that resulted in teacher's gradual change in principle-based understanding in the community.

3.3.3 Towards principle-based understanding

With an explicit emphasis on knowledge-building principles in teacher development designs, teachers had gradually made conceptual shifts putting more of principles in the foreground. In one of the teacher development workshops, a teacher made a presentation in front of the Ministry and other knowledge building teachers, elaborating explicitly why she continued to be involved in this scheme:

"Something that is special about the knowledge-creation approach is the emphasis on principles and theories. In most other teacher development programs, we are taught to do activities so as to teach better. This one is different because it has theories and principles to help us to think why we are doing and what we are doing" (Teacher F)

The above remark indicates that the teachers expressed overtly the need for theories and implies the importance of going beyond tasks and activities to focusing on principles in knowledge building practice.

Such views are further elaborated in teacher discourse. The following excerpts showed teacher views at the later part of year 2 when they were asked to discuss the role of principles.

"In the past, I did not think it was important for students to understand knowledge building principles. I thought as long as they could participate actively in the discussion, it would be fine. Now I consider it (understanding knowledge building principles) important because only when we understand the principles, can we focus on *idea improvement and focusing on the core problem"*. (Teacher C).

In order to convey her understanding in an explicit way, Teacher C cited an example to elaborate what she mentioned previously about her change:

> "Although we may be doing the same thing such as asking questions… I see the differences now about why asking question is valuable – It is about facilitating the whole community to make advancement. *There is also something key about ownership and agency as students are the ones who pose the questions, and (amazingly) they are the ones who can even assess their own understanding.* In knowledge building, there may be different principles, but for me the most important principle is about community advances. It is no longer about individual students' advances, but really community advances that are crucial…" (Teacher A).

Some teachers also expressed a broader view about why principle-based approach was significant. One teacher made that explicit as to how principles could provide her with explanations and that she could then make changes and adaptation of pedagogy across different contexts. She said:

> "I now realize it is important to work with principles – *They help me to understand why certain activities work in some contexts and not others. They also provide the purposes behind of what and why I am doing certain things*. From my experience I also know that teacher development work in China focused much on experience and action; these are useful but I also need something to reflect upon for growth" (Teacher E).

Another teacher made this even more evident. Relating to epistemic issues, he uttered:

> "We are doing something quite challenging. These principles help me to reflect on my passion and my teaching philosophy, on what I believe… they help me to reflect on what I think is fundamentally important in teaching and what I am doing" (Teacher H).

This section has depicted teacher's continuous changes in conceptions of principle-based understanding: from an initial focus on tasks and activities, to moving towards student agency and principled-based understanding through analysis of teacher discourse, and finally towards a deeper understanding of the role of principles in knowledge building practices.

4 Discussion

4.1 Principle-based approach and student knowledge advances

A number of studies on examining innovative classrooms using a principle-based design approach to support student knowledge creation have produced positive results (e.g., Hong & Sullivan, 2009; Zhang et al., 2009). However, rarely explored are studies aiming at adopting such an approach in teacher professional development. Our study employs the results from ATK and Applets indices suggesting that teachers' developing principle-based understanding and practice might also have impact on students' participation and collaboration. Although further data analysis needs to be conducted to examine whether there is improvement in student knowledge building discourse, this research extends the inquiry on knowledge-building principles to the wider scope of principle-based design approach in teacher professional development and classroom practices.

4.2 Principle-based approach and changing practice and conceptions of principle-based understanding

A principle-based approach is considered to be crucial for developing knowledge-creation design for teacher development (Chan & van Aalst, 2006). In an earlier study (Chan & van Aalst, 2006), we found that teachers embracing a principle-based approach produced better knowledge building design in classroom innovations. This research, focusing on intensive teacher professional development, witnessed the gradual changing practice of the teachers from individual to more collective views of knowledge creation work. Nevertheless, it was not an easy task for these changes. Scardamalia and Bereiter (2006) pointed out that some teachers viewed principles as too abstract to be very helpful; and even considered that the principles were merely re-descriptions of what they had practiced. It is true that in this study, at the early stage of teacher development, teachers were particularly interested in designing worksheets, finding out appealing topics, using various functions on Knowledge Forum and the like, and they considered that these tasks and activities could help knowledge advances. It was encouraging that with adopting a principle-based focus and through teachers' progressive discourse, the teachers had gradually developed more sophisticated views shifting from an activity-based to a principle-based approach. Paralleled with it, their knowledge building practices, as reflected in design work on student portfolios, also showed a shift towards collective advances.

To conclude, over the 2-year period, this group of teachers changed their practices reflected in (a) the increase in their students' participation and collaboration on Knowledge Forum, and students' community awareness and connectedness; (b) the teachers changed from using individual to collective designs for concurrent assessment and student portfolio; and (c) the teachers made some gradual changes in their conceptions towards a principle-based understanding supported through knowledge-building progressive discourse. This study provides some preliminary findings examining a principle-based approach for knowledge creation among teachers. Ongoing analyses are undertaken to examine the alignment between teachers' changes towards a principle-base design approach and students' knowledge-building discourse.

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