

“But I have not started teaching!”: Knowledge building perils

TAN Aik Ling

TAN Seng Chee

National Institute of Education

ABSTRACT

Scardamalia (2002) discussed the knowledge building notion as one which is built on social cognitive principles of learning. She proposed 12 principles focusing on collaborative knowing among students gearing toward building a community of learners in classrooms. However, how teachers become the key mediator for fostering knowledge building in classrooms is not fully explored. This study aims to contribute to the knowledge building research in terms of teacher professional development. Set in Singapore, where the dominant pedagogy is teacher-centred and routinised (Luke, Cazden, Lin & Freebody 2005), this paper examines the journey taken by two biology teachers trying to reform their classrooms by incorporating knowledge building principles. In one of our email exchanges with a teacher, she was exasperated with her attempt to bring knowledge building into her classroom. After a few sessions, she exclaimed “*But I have not started teaching!*” This prompted us to seek answers to the research question “What are the factors that will impact knowledge building efforts in a Singapore science classroom?” Interviews and transcript analysis of classroom lessons are used as data and interpretive methods of data analysis are used in this paper. The beliefs of the teachers are elicited through a semi-structured interview which takes the form of a post-lesson dialogue in this paper. The results of this study revealed three key areas of concern in adopting knowledge building principles, namely, renegotiation of institutional authority, changing beliefs about teaching, and learning and building students’ capacity for epistemic agency. In order for teachers to transform their practices in the classroom, there needs to be a structured and concerted understanding of these factors.

Key Words: *Knowledge building; Leading in science classrooms; teachers’ beliefs*

INTRODUCTION

In recent years, the traditional view of science education as transmission of scientific knowledge and development of a set of science process skills is being questioned. This approach focuses on measurable learning outcomes, but ignores the social cultural aspect of doing science. Some researchers argue that in lieu of learning *about* science, science education should be about learning *to be* scientists, in other words, developing in students the skills, attitudes, and knowledge of how scientists do science (Fusco & Barton, 2001; Barab & Hay, 2001). In order to achieve that, science learning in schools must emulate authentic practices of science, where students can assume the agency of knowledge constructor, and interact with phenomena in the world in informed, reflective, and critical ways (Rogriguez, 1998).

However, we argue that there is incongruence between a scientist’s community and a school science learning community along several dimensions, including culture, practice, beliefs and goals (Caravita and Hallden, 1994). Instead of emulating a scientist’s community in schools, science learning communities in schools should be fostered with their distinct goals, beliefs, social cultural practices and activities. For example, not all students aspire to be scientists, but we could help students develop appropriate scientific attitudes and possess the skills and knowledge to do science

and make meaning of science knowledge so that they can become informed consumers of science. One approach that is consistent with our view on science education is the notion of knowledge building, proposed by Scardmalia and Bereiter (2003).

Knowledge building may be defined 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.

Scardamalia and Bereiter (2003, p. 1371)

While this definition may appear deceptively simple, there are many challenges of fostering a knowledge building classroom. Scardamalia (2002) proposed 12 design principles for a knowledge building classroom and much research effort in several countries has been devoted to these principles. In this paper, we focus on two principles that are not well studied in the local context – Democratizing Knowledge and Epistemic Agency. To democratize knowledge is to give legitimate rights to all students as contributors of knowledge in the learning community. Each student should have an ownership of the knowledge advancement in the class. As epistemic agents, students should be able to put forth their ideas in public space to be negotiated and debated, and such effort should be sustained so as to achieve continual knowledge advancement.

It is not difficult to imagine the challenges of achieving these ideals of knowledge building principles in Asian classrooms. In Singaporean classrooms, like in many other Asian countries, there is deep-rooted respect for teachers as the authority and source of knowledge, which can be antithetical to the notion of democratizing knowledge and empowering students as epistemic agency which involves relinquishing some power to the students. In this case study, we explored the attempt of two teachers in their initial journey of bringing knowledge building into their science classrooms. The conflicts between their innate ideology and beliefs with that of knowledge building philosophy help to surface some critical issues we should be cognizant of when introducing knowledge building into Singaporean classrooms.

The key purpose of this paper is to provide evidence to illustrate the urgency to examine existing classroom practices in Singapore before two aspects of knowledge building can be fulfilled. The research question that guides this paper is "*What are the factors that will impact knowledge building efforts in a Singapore science classroom?*"

METHODOLOGY

This is an exploratory case study carried out in an average rating school situated in a lower-middle class neighbourhood in Singapore. Students in the study belong to the top fifteen percent of their cohort as evidenced from their performance in the Primary School Leaving Examination (PSLE), a national placement examination that all students sit for at the end of six years of primary school education for placement in a secondary school. The class understudy comprised of 39 students with an average age of 14 years old. The two teachers in the study are Eilly and Rose (pseudonyms). Eilly is an experienced teacher with eight years of teaching experience. She is passionate about her work and is constantly working to improve her practice. Rose is also an experienced teacher who has more than ten

years of teaching experience. She has a wealth of experience working with lower ability students in the school.

The school was chosen for this study upon invitation by the school science department as an effort to introduce knowledge building into the science curriculum. The science department in the school had an earlier experience with knowledge building when one of their colleagues used knowledge building. The lower secondary science curriculum in the school is designed on a modular framework with the different teachers teaching the physics, chemistry and biology components. Each of these modules runs for four to five weeks in a school term.

Data collection

In the first phase of the study, we had face to face meetings with the teachers as a department to introduce knowledge building and to discuss the how principles of knowledge building can be incorporated into the existing science practices in the school. In the second phase of the study, we worked specifically with the biology teachers to plan lessons using knowledge building principles. Three lessons were planned and observations carried out for these lessons.

In this study, lesson conducted by Eilly, both in the classroom as well as the laboratory were observed. Field notes, video recording and audio recording were collected for each of the lesson. A post-lesson dialogue was carried out after each lesson observation. Post lesson dialogues are used as a means of data collection as they serve as a platform for clarification, reflection and provide a way in which the ideas in Eilly's head can be sought and examined. The dialogues offer a means of accounting for actions taken by different individuals. Email exchanges among Eilly, Rose and the researchers also serve as data sources for this paper. All audio recordings were transcribed for analysis. For this paper, only the data from one lesson observation, one post-lesson dialogue and one email exchange are presented and discussed. The lesson, post-lesson dialogue and email are chosen as these present one of the most comprehensive and complete data set that is able to illustrate what actually happens in classrooms.

Data analysis

The data analysis is set out to surface issues which will impact knowledge building in a science classroom. The transcripts of classroom instructions, post-lesson dialogue and email exchange are analysed using interpretative data analysis methods (Erickson, 1996). The unit of analysis here is a single turn of talk. For each turn of talk, we analyse what has been said and relate this to the overall context and structure with which the talk takes place.

FINDINGS AND DISCUSSION

We discuss the main findings of this case study using three themes that were surfaced through our analysis: (1) renegotiation of institutional authority; (2) change in beliefs about teaching and learning and (3) building students' capacity as epistemic agency.

Renegotiation of institutional authority

To begin our discussion on institutional authority that is placed upon teachers, let us examine excerpt 1. Excerpt 1 is taken from Eilly's lesson where the students

are engaged in the process of building knowledge of the structure and function of the reproductive structures in males and females.

Excerpt 1: Can I finish my summary first?

1.	T:	If the sperm duct is blocked the sperm cannot come out. Agreed? Agree or not? But let's say for some of us, if let's say for me, I don't know about this topic. I know sperms come out from the name sperm duct. Actually how do I know sperms actually come out from there? (4) ah. Connected to the? Ok, we don't call it the balls. We call it the testis. The sperm duct is connected to the testes. Ok, if let's say somebody could have asked the question. It's connected to the testes. Somebody ask what is the testes? What does it do? Testes produces sperms. Some of us don't know about that here. So testes produce sperm and the tube connects the testes to the where? To the where? (3) It connects two parts. One part connects to the testes area, the other one? To the penis. Ok. And actually what is the function of the penis? Urine is one. For urination. It's the male organ that is erm, inserted into the female vagina during sexual intercourse. So which means that for Shrek and Leler, so now do we have a better idea of what could have been the problem?
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.	S:	Yes
17.	T:	Let me summarize ah. You say possibly the sperm duct is blocked. I understand that the function of the sperm duct, testes produce sperm so when there is a blockage, the sperm is not coming out, so during sexual intercourse, (3) it won't. ok?
18.		
19.		
20.		
21.	S:	If the testes overproduce the sperm how?
22.	T:	The sperm will just disintegrate inside your body. Nothing will happen to you. Can I finish my summary first? So during sexual intercourse between Shrek and Leler, there is no sperm deposited because the sperm duct is blocked, so Leler cannot get pregnant. Ok. That is one way we could have developed it. Ok.
23.		
24.		
25.		
26.		

The exchange presented in excerpt 1 took place at the end of the lesson where Eilly summarised for the students what they have learnt. From this excerpt, we raise the issue of institutional role and authority. Driver, Newton and Osborne (2000) defined two forms of authority that are evident in classrooms – rational authority and traditional authority. They defined rational authority as one where the teachers is the one who supply reasons and evidence for knowledge claims while traditional authority is one where teachers draw on their institutional positions for support. From the lengthy turns of talk by Eilly, it appears that this is a highly teacher-centred and teacher-controlled session with minimal input from the students. This highly structured teacher-centred and teacher-controlled form of instruction is almost characteristic in the Singaporean classrooms. In a recent large scale study carried out by the Centre for Research in Pedagogy and Practice, it is found that the dominant pedagogy in most Singaporean classrooms is teacher-centred and routinised, (Luke, Cazden, Lin & Freebody 2005). It is hence not surprising that Eilly embraced this traditional institutional authority which is bestowed upon her to carry out the duty as a teacher.

This institutional authority allows Eilly to 'play' the role of the 'controller' in the learning process. Earlier in the same lesson, Eilly gave very specific and structured

instructions what the students should do to get the knowledge she intended for them to learn by telling the students “*I want you to read a particular page from your textbook. 61. Can you go to page 61. ok this one we do individual reading first. We will just all read our textbook page 61.*” Consistent with the authority and role given to her, in line 17 of excerpt 1, Eilly declared that she will be the one summarising what the students had learnt, instead of having the students collectively summarise what they learnt, she regained the control of the lesson back from the students. She decides, and is likely to be an expectation made of her, how lessons should be conducted, what questions she wants to ask, when the questions can be asked and when opportunities can be created for students to speak. This form of socialisation into the role of the teacher shapes Eilly’s practices in the classroom. Both the students and the teacher are aware of these institutional expectations and roles and behave accordingly.

In line 21, we see some ‘authority trouble’ brewing. The student asked a question which interrupted what Eilly intended to tell the class in this concluding segment of the lesson. In line 23, we see Eilly almost dismissively tell the student to allow her to complete the summary before asking any questions. Eilly is using her authority as a teacher to regulate the speaking patterns of the students. The students have no institutional authority to regulate or control the progress of the discussion.

In light of the above discussion, we argue for a need to renegotiate institutional authority before knowledge building principles can be introduced in the classroom. It appears that the classroom we observe above gives little room for students to decide when and how they can present their ideas. There appears to be an unequal division of power between the teacher and the students - there is little authority given to the students and the authority given to the teacher appears to be inflated. This goes against the grain of the knowledge building principles of democratizing knowledge where all participants in the community are viewed as legitimate contributors with authority to the shared goal of the community. The regulation of discussion appears to be done by the shared community goals and norms rather than by a single individual. Clearly, to have true knowledge building in the classroom, the traditional authority of the teacher and students needs to be examined and renegotiated to enable a more balanced distribution of power in the knowledge building process in the classroom.

Change in beliefs about teaching and learning

Beyond renegotiating the issue of institutional authority, another factor that requires attention is beliefs about teaching and learning. Beliefs are deeply edged notions which people hold and they will influence the actions of the individual. Teachers’ ideas about teaching will impact how they teach (Tan, 2006) and similarly, students’ ideas about learning will determine how they respond in the learning process. In excerpt 2, we provide evidence of how teaching can possibly be perceived and argue for a need to re-think what teaching is before efforts at knowledge building will pay off. Excerpt 2 is part of an email exchange between Rose and us. Rose is working with knowledge building for the first time.

Excerpt 2: But I have not started teaching!

1. at the end of the lesson, groups write down what they have learnt in this
2.	lesson. (I will type out what they have learnt if you need to see it.)

3.	Am I doing the right thing? I do not know how to continue from here as there is
4.	no clear structure on how it should be. What do I do next? <i>I have not started</i>
5.	<i>teaching, should I do that the next lesson?</i> If I teach the content next lesson,
6.	is that KB?
7.	Please come to my rescue.

Rose had in the lesson, divided the students into groups and presented the students with two articles on biological cleaning agents. Each group was asked to read the articles and discuss the two questions set by Rose, namely 'what is the product?' and 'how does it work?' The students are then to present their answers with evidence from each of the articles. As the students present, Rose would ask questions and the other students in the class would also ask questions. After the lesson, Rose sent an email as in excerpt 2 expressing her doubts and fears of what she was doing. It is evident from the email the anxiety and uncertainty that Rose felt having deviated from her usual form of instruction - the teacher directed transmission of information as highlighted above. Her perception of teaching and her role in the process is likely to be influenced by the institutional authority and role which is bestowed upon her. She has revealed here in her email that teaching to her is likely to mean that she needs to be actively telling the students the contents of science. Facilitating and guiding them to build the knowledge themselves appears to her to lack structure and hence raise her doubts about the students' learning.

Similar to Rose, Eilly expressed her own beliefs about what teaching in excerpt 3. Excerpt 3 is taken for a post-lesson dialogue after Eilly's lesson on reproduction. In lines 6- 9, Eilly expressed her concerns about the lack of time if she used knowledge building in her class. She felt that she would '*need to make up in some ways*' if she was to use knowledge building in her class and time may not permit her to do so. It appears that for Eilly, knowledge building classes need to be supplemented with more formal and tested instructional method. Knowledge building cannot be used on its own for students' learning to take place.

Excerpt 3: I need to make up in some ways

1.	R2	So how do we intend to move on to the next lesson? You want to give
2.		them an open book quiz right?
3.	T	Erm because, I want to do two things lah. One again is forcing them, today
4.		I gave them reading time but some did not bring their books.
5.	R2	Didn't bring their books yah.
6.	T	<i>Because when I don't have much time with them in terms of</i>
7.		<i>curriculum, if I use it for KB ah, so I need to make up in some ways.</i>
8.		<i>So I was wondering of using the open book test to force them to read</i>
9.		<i>and assess them at some level lah.</i>
10.	R2	How many lessons you have for reproduction?
11.	T	Ok we can have them for the next 3 weeks. So 3 weeks, That would be 6
12.		lessons. But I have one more topic on contraceptives.
13.	R2	after the next 3 weeks is it? Or within?
14.	T	Within the 3 weeks.

Clearly, both Rose and Eilly share some commonalities in their beliefs of what teaching and learning is. To Rose and Eilly, teaching must be an active process

where they are personally involved in relating the information to the learners. Learning is hence the reciprocal action to teaching – a process which receives what is being taught. This belief of teaching and learning can simply be summed up as teaching is an active process of transmission while learning is a passive process of receiving – a largely unidirectional process. It appears to us too that there is a belief that the teacher and the textbook is the only authoritative source of knowledge and that the teacher is the only legitimate contributor of knowledge. The students are perceived to be lacking in knowledge and hence have limited contribution to the knowledge building process. Teachers not only exert their institutional authority in classrooms, they also exert their epistemic authority of knowledge. Knowledge hence needs to be built *for* the students and not *by* the students.

Drawing from the discussion above, it would appear that there is an urgent need to examine teachers’ beliefs about teaching and learning and also their personal epistemic beliefs about how knowledge is constructed. Unless their beliefs are perturbed and reshaped, knowledge building principles of democratizing knowledge and students’ epistemic agency will not be fulfilled. . In fact, Edwards and Mercer (1987) found that most of what students learn in schools is predetermined by the curriculum, and hence, education is merely a process of socialisation into the pre-existing epistemological world. If teachers and students have been socialised into the pre-existing ideas of what teaching and learning is already, to think teachers’ beliefs and practices can be changed simply by telling and informing them about knowledge building principles is a highly romanticized idea. Changing teachers’ beliefs is a slow process which requires persuasion and probably immersion in a culture where the norm is not actively transmitting information as part of the teaching process. We argue that one of the first steps to embracing knowledge building is to examine teachers’ belief system, an area which much work can be done.

Building students’ capacity as epistemic agency

Reformulating institutional authority and changing teachers’ beliefs alone are unlikely to yield much success for knowledge building if the learner’s factors are not considered. Here, we present evidence to argue that it is essential to build students’ capacity as epistemic agents before changes can take place in the classroom. Excerpt 1 presented the tight control which Eilly maintained throughout her lesson. As a consequence of this, students are ‘schooled’ into learners who are often passive and ready to be supplied with information from the teacher. The expectation of them as learners in a teacher-centred classroom is to listen to what is presented to them. Excerpt 4, also taken from Eilly’s class on reproduction shows how Eilly has to coax the student to participate in the process of building the knowledge on the male reproductive system. The excerpt demonstrates a student’s lack of confidence to be active agent in their learning.

Excerpt 4: Can I write?

1.	S	Cher [colloquial reference term for teacher], <i>pink color write what ah?</i>
2.	T	The answer. (30)((Teacher walks away to the board)) Help me put this one here.
3.	S	I need to know why Shrek and Leler cannot conceive. <i>Can write his sperm dried up?</i>
5.	T	Ok, let’s move on from here. We mentioned that, we understand that the sperm duct is blocked right? Ok. These 3 groups here. Fally. Go back to your own group. Sirage. Come. This group here, come. (4) You go to the
6.		
7.		

8.		middle one. (3) Don't swap the answers. (3) There's no name anywhere. I
9.		am going to tear it.
10.	S	Ok ok I write...

Eilly had instructed the students to respond to their friends' questions posted on the walls around the class by writing their responses on coloured sticky paper. In line 1, the student tried to get Eilly's attention to clarify what he has to write on the paper. After being told what to write, the student went on to confirm what he can write on the paper (lines 3 and 4). It is evident from here that the student is uncertain about the process of knowledge building. He is also not confident in presenting his ideas and constantly looks to Eilly for affirmation and reassurance. Later in the lesson, Eilly was overheard saying this to another student: "You want to ask but you don't want to find out. So lazy. Come on. You go and read the question. I am sure you will be answered. (8) go and look at your textbook."

The students are comfortable in their passive role as recipients of information and having to react to a new way of learning requires different skill set as well as different set of rules to adhere to. Without the confidence and competencies, even if the opportunities are presented to them to be epistemic agents, they would not be able to embrace the opportunities – hence an urgency to build students' capacity as epistemic agency.

Further to evidence observed in the classroom about students' capacity to act, Eilly also expressed in the post-lesson dialogue her concerns about the students' capacity.

Excerpt 5: Not much depth

1.	T	So for them who actually they bothered to think, they bothered to write on, I thought that we didn't go very far but at least we moved. Some were really not there lah. They couldn't even be bothered to read. Too lazy to even put a post.
2.		
3.		
4.		
5.	R1	What do you think of the discussion that was gathered by the students?
6.		Like the posting of the students?
7.	T	Not much depth leh. (...)I mean I didn't get to see more but the group that I saw more on, not much depth?
8.		
9.	R2	How is it compared to normal lesson?
10.	T	Normal lesson ah
11.	R2	Let's say.
12.	T	Ok normal lesson is me feeding, so I could feed a lot but how much they registered I don't know. And their attention span is short lah, even for normal classroom, we have to break up into normal discussion lor, they want to ask all their whatever then we just answer one by one then like towards the end when they cannot take in anymore content, then we just chit chat lor, chit chat about the topic.
13.		
14.		
15.		
16.		
17.		

In excerpt 5, Eilly spoke about the students' lack of participation and interest in the knowledge building process. In her opinion, the students' passivity and indifference affect the collective knowledge building process. One possible reason for the students' lack of involvement in the process could be due to the lack of recognition for a collective goal which the students as a community can achieve. The students are not primed how to behave to fulfil their responsibilities as Eilly moved from a rather

individual way of learning to a way of learning which harness collective social responsibilities and participation. This is in fact one of the 12 key principles of a knowledge building classroom – community knowledge and collective responsibility. This is yet more evidence to show that for classroom reforms to take place, time needs to be spent in understanding and building the learners' capacity.

SUMMARY

We have examined and presented evidence to show that incorporating knowledge building principles into a classroom which is steep in traditional instructional methods can potentially be an uphill task. The three findings that we presented here, (1) renegotiation of institutional authority; (2) changing teachers' beliefs about teaching and learning and (3) building students' capacity as epistemic agency are all important but difficult areas to address. Although we have deliberately presented the three aspects in a linear manner, attention needs to be given to the three areas concurrently.

The two teachers in this study are convinced and courageous to make an attempt to use knowledge building to help their students learn science. Although their personal epistemic beliefs appear to be antagonistic to the proposed knowledge building principles and despite their struggles with their traditional institutional roles and authority, the journey which they began enabled them to reflect and question their current practices as teachers. Their learning trajectory appears to deviate from the original linear map that was drawn. The complexity of changing beliefs and social norms for knowledge building demands for a concurrent, lateral and multifaceted learning roadmap for teachers and students. Primarily, the three areas highlighted above must be assimilated by the teachers and students or else two of the key knowledge building principles of democratizing knowledge and epistemic agency will be sorely missed.

REFERENCES

- Barab, S.A. & Hay, K.E. (2001) 'Doing science at the elbows of experts: Issues related to the science apprenticeship camp', *Journal of Research in Science Teaching*, Vol. 38, No.1, pp. 70-102.
- Caravita, S., & Hallden, O. (1994). Re-framing the problem of conceptual change. *Learning and Instruction*, 4, 89-111.
- Driver, R., Newton, P., & Osborne, J. (2000). Establishing the norms of scientific argumentation in classrooms. *Science Education*, 84(3), 287-312.
- Erickson, F. (1986). Qualitative methods in research on teaching. In M. C. Wittrock (Ed.), *Handbook of research on teaching*. (pp 119-161). New York: Macmillian.
- Edwards, D., & Mercer, N. (1987). *Common knowledge*. London: Methuen/Routledge.
- Fusco, D., & Barton, A.C. (2001) 'Representing student achievements in science', *Journal of Research in Science Teaching*, Vol. 38, No. 3, pp. 337-354.
- Rodriguez, A.J. (1998) 'Strategies for counterresistance: Toward sociotransformative constructivism and learning to teach science for diversity and for understanding', *Journal of Research in Science Teaching*, Vol. 35, No. 6, pp. 589-622.
- Scardamalia, M. (2002). Collective cognitive responsibility. In B. Smith (Ed.) *Liberal Education in the Knowledge Age*. (pp. 76-98). Chicago: Open Court.
- Scardamalia, M. & Bereiter, C. (2003). Knowledge Building. In James W. Guthrie (Ed.). *Encyclopedia of Education*. (2nd ed.). pp. 1370-1373. New York: Mcamillan Reference, USA.

Tan, A. L. (2006). *The discourses of secondary school biology: Inter-relating interactional features and teachers' theories*. Unpublished doctoral dissertation: Nanyang Technological University.