Introduction

Why should I use Knowledge Building in my classroom?

As educators, I believe it is our fundamental role to prepare our students for the uncertainties of life in the 21st century. The rate of technological advancement is rapid and many of the jobs that exist now did not exist 10 or even 5 years ago. In order to cope with these changes, the challenge is upon educational institutions to find new pedagogical and cognitive models that are relevant and responsive to the needs of society. There is a growing demand for schools to produce a citizenry with 21st-century capabilities. Among these 21st-century capabilities, the ability to create knowledge is paramount (Zhang et al, 2009). Patrick Basset, former President of the National Association of Independent schools (NAIS) summarized the characteristics of 21st century learning into '6+1 big shifts in education'. They are: 1) From knowing to doing; 2) From teacher-centered to student-centered 3) From the individual to the team 4) From consumption of information to construction of meaning 5) From schools to networks (online peers and experts) 6) From single sourcing to crowd sourcing; 7) From high stakes testing to high value demonstrations of learning (Bassett, 2012). It is interesting to note that the Knowledge Building model of learning encapsulates all these characteristics. It is in this light that I have decided to undertake this research, which revolves around the design and implementation of Knowledge Building (KB) in the lower primary classroom. The goal of this research is twofold:

1. First, it is my professional goal to enhance my ability to design and implement this learning innovation and, in the process,
2. Develop my students' competencies in the knowledge creation process.

Taking inspiration from Professor Chan's paper on KB within the HK school setting (2010), I wish to find out:

- How to implement the new pedagogy of the KB approach in a multicultural and inclusive international P2 classroom with a wide range of abilities;
- What aspects of the new pedagogy represents, in any respect, Knowledge Building principles as defined by Scardamalia (2002).

LITERATURE REVIEW

According to Chan (2010), schools in the 21st century need to focus on helping students to improve their ideas, develop ways of thinking and advance collective learning. This collective learning, which is at the very heart of Knowledge Building, is also one of one of characteristics of 21st century learning: from the individual to the team (Bassett, 2012). Helping students to engage in collaborative inquiry and work creatively with ideas is now a major educational goal (Chan, 2013).

With the advent of the knowledge-based era, Scardamalia and Bereiter, (2006) argue that the goals of school need to go beyond the acquisition of knowledge. This brings forth the idea of knowledge creation. Lipponen (2000) advocates that educators should take seriously the idea that knowledge is not merely something that resides in the mind of the individual knower, and nor is something that exists only in practice (Lipponen, 2000).The need for knowledge creation pervades work in most fields, driving the need for education in which students are able to work with ideas creatively and productively (Zhang et al, 2007). Taking collective responsibility for the advancement of knowledge is the essence of knowledge building theory, pedagogy, and technology (Scardamalia, 2002, 2003; Scardamalia & Bereiter, 2003). Scardamalia and Bereiter have proposed the concept of knowledge building: social process through which people work collaboratively to create and improve ideas of value to their community. It is through this process that research groups produce increasingly powerful explanations about the world, and high tech companies address challenging problems and develop new technological products (Sun, Zhang, Scardamalia, 2010). It is clear that there is a need to further investigate the impact of Knowledge Building in an inclusive, multicultural lower primary classroom in the Hong Kong Context.

On computer-supported collaborative learning

Technology is a crucial player in a more complex process of change (Lamon et al, 2001). Emerging technologies are vital elements of innovative educational environments and can be used to inform and enhance the design of new assessments that are aligned with changing conceptions of teaching and learning (Resendes, 2014). Philip (2007) states that online learning environments, which helps students create new knowledge and new understanding in a collaborative manner and through diverse media, can prepare them to work in the

distributed, virtual workplaces of the future. Application of collaborative networked technologies computer supported collaborative learning or cscl can greatly facilitate the process of building community among learners, in the form of virtual community by extending opportunities for social interactions supporting learning that are not dependent on the time and location of the school day (Dede, 2000; Jonassen, 1999). I am keen to experience the affordances that asynchronous discourse provides especially considering that I do not get as much whole-class interactions as I would like during class hours.

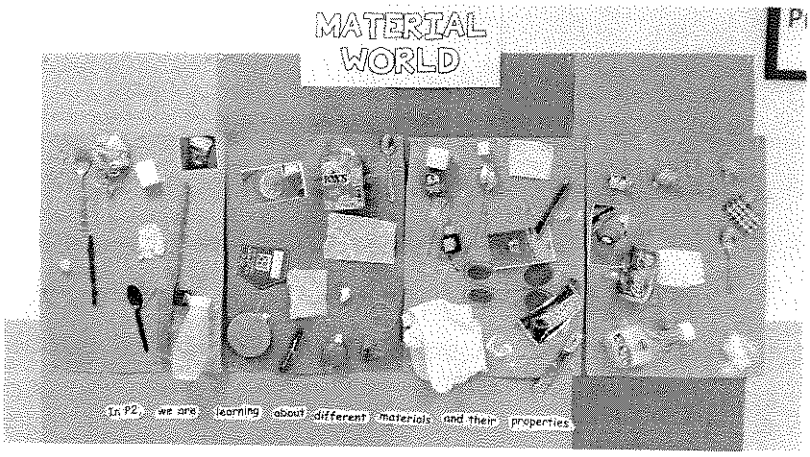
Design Principles and Analysis

Overview

This study takes place in a Primary 2 classroom which is comprised of 8 different nationalities and varying levels of ability. The new KB pedagogy will be adapted during the International Primary Curriculum (IPC) inquiry units. Much like Hong Kong's General Studies or the IB PYP, IPC encompasses Science, Technology, Geography, History, and ICT. The current unit is 'Material World' which focuses on identifying different materials, learning about their properties, and understanding why and when to use certain materials. This is a comprehensive unit with an estimated running time of 8 weeks. With no assigned textbook, nor strict guidelines for delivery of the unit, there is a rich opportunity for self-initiated research and collaborative learning. I prepared a Unit Plan (Appendix I) on top of what is provided by the IPC to help me manage this inquiry better.

Design

The provocation stage

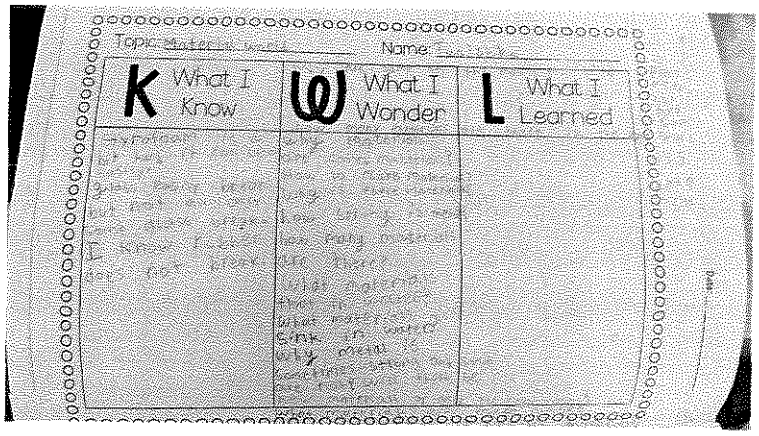


This unit takes place right after an 11-day Easter Break. For their holiday homework, I asked the students to collect different materials, put them in a box, and bring to class without explicitly telling them what they were for. On the first day of the unit, I was delighted that everyone had a bag-full of

materials ranging from rubber to plastic to glass. As a group, I asked the pupils to create a collage using their materials which I later asked them to present to the whole class. I noticed that some students grouped and labeled their materials without being asked. I thought this was interesting and gave me an insight to their prior knowledge and motivation level.

The knowledge harvest stage

After the presentation, I asked the students why they think they had to do this activity to which they promptly responded, "because we are learning about materials". Through a whole class discourse, we learned about students' prior knowledge and what we might be learning in this unit. I then asked them to fill in a K-W-L chart. These charts came back with a lot of interesting misconceptions. A lot of students also struggled to come up with questions.



After the class, wondering questions were collected and posted on the IPC board to serve as a reference point throughout the unit.

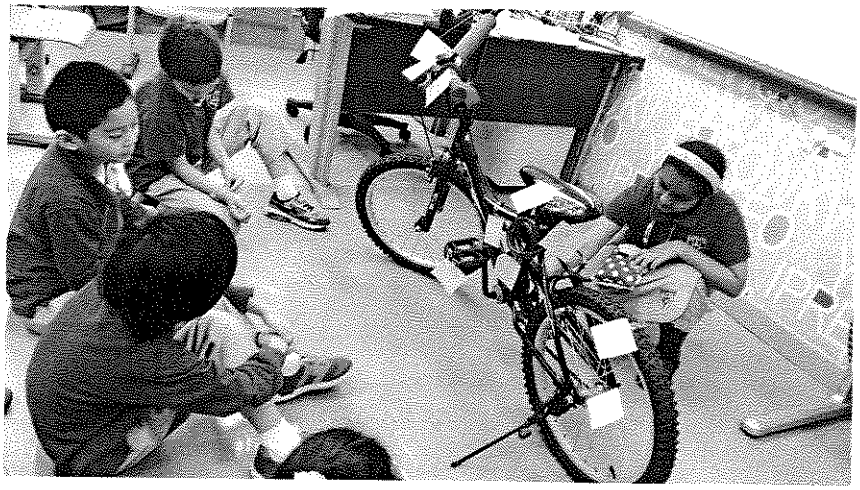
Presentation of the unit and the 'Big idea'

The 'big idea': Hundreds of different materials are used to make everyday objects. Some materials occur naturally, e.g. wood from trees while others are manmade in factories, e.g. plastic. Some materials are magnetic; some allow heat and electricity to pass through them. But with so many different materials to choose from, how do we decide which to use?

Activating prior knowledge and sharing wonderings helped in determining learning objectives. This sets the stage for epistemic agency (Scardamalia, 2002) After which, the unit 'Material World' together with the 'Big Idea' were introduced.

Developing a collaborative classroom culture

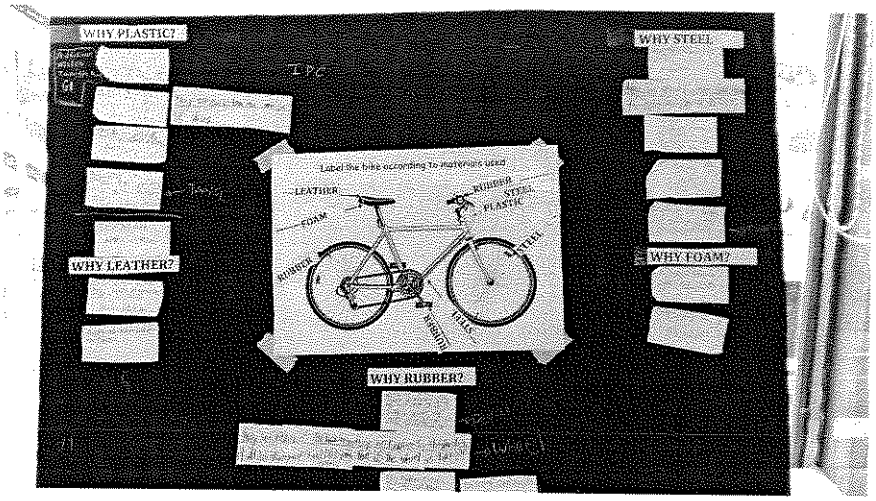
For the first task, I brought in a bike to school for the students to study. A bike is an ideal springboard for this unit as it is made up of different materials. This also lends an authentic experience for then students as they all have bikes at home and having a tangible object in front of them is much more interesting than looking at pictures or watching videos. I then proceeded to ask students to stick material labels on the bike.



'Think-pair-share' and first collaborative project

After studying the labeled bike, students were asked to consider why these materials were used. They were then asked to pair up to share their ideas. I gave the pupils 5 minutes for this activity. This stage is actually in preparation for their first collaborative task (pictured).

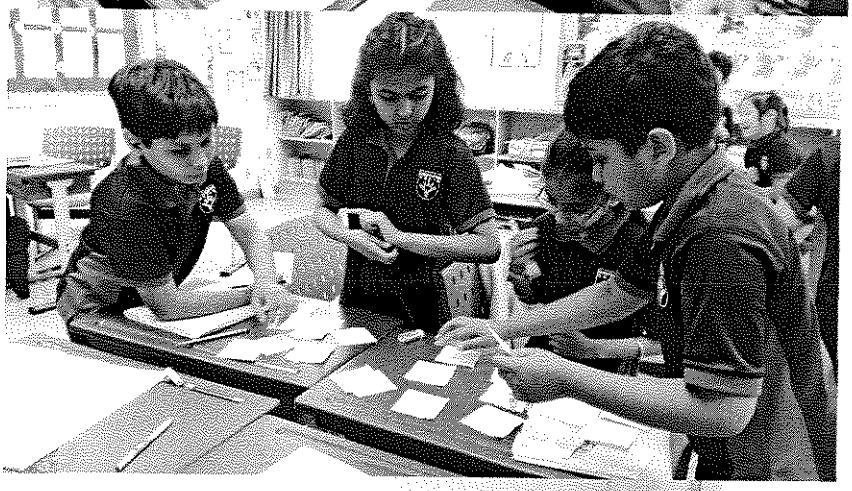
As a group, students were asked to label a bike diagram on a board and put up their ideas on why certain materials were used for certain parts of the bike (e.g. rubber for the handgrip so their hands don't slip). After the task, I asked the students if they think their ideas are adequate to which they said yes. Looking at the finished products, it was easy to see that ideas were very limited as expected. I emphasized that these boards were a work in progress and they will have to go back to them periodically as they improve their domain knowledge.

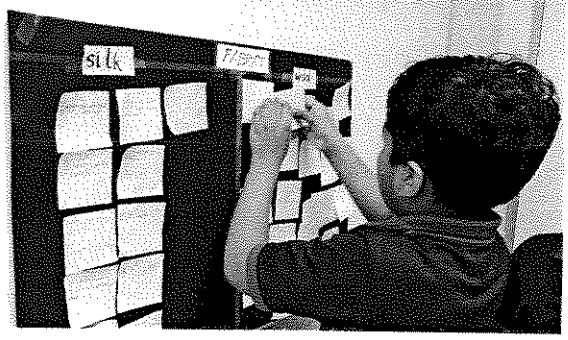


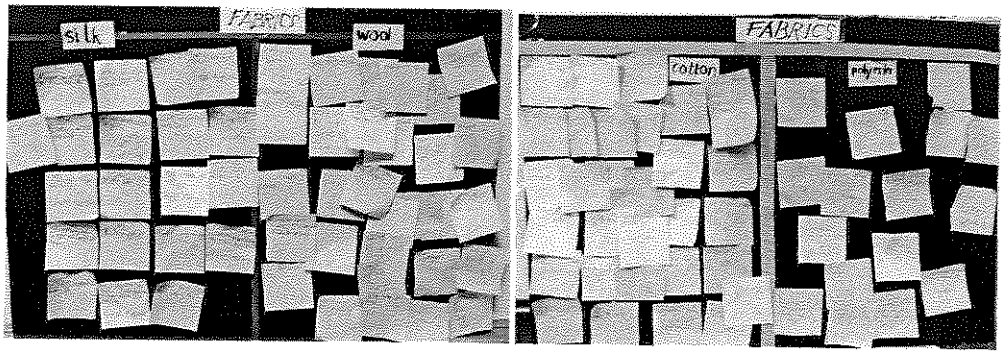
'Jigsaw'

On the 4th week of the unit, the pupils tried Jigsaw learning. Jigsaw is a collaborative grouping strategy wherein the class is divided into small groups and each student is given a number. Groups are then re-formed according to student numbers (e.g. all number 1s group together) to form expert groups to investigate particular tasks or topics. They then go back to their 'home groups' to share their findings.

Each child was assigned one fabric material to research on over the weekend: cotton, wool, silk, and polyester. One the day of the activity, the class was divided into 4 groups and moved on to form 'expert' groups. Expert groups shared their findings and jotted down post-it notes. After the note-taking stage, higher order thinking skills were activated by studying their notes and grouping them into 3 categories: origin/history/source, properties, and common uses. They were also asked to remove redundant notes. Notes were then posted on the board for everyone's reference.







They then moved back to their home groups and each person shared all the information they have gathered with their original groupmates.

Developing Knowledge Building Inquiry using CSCL

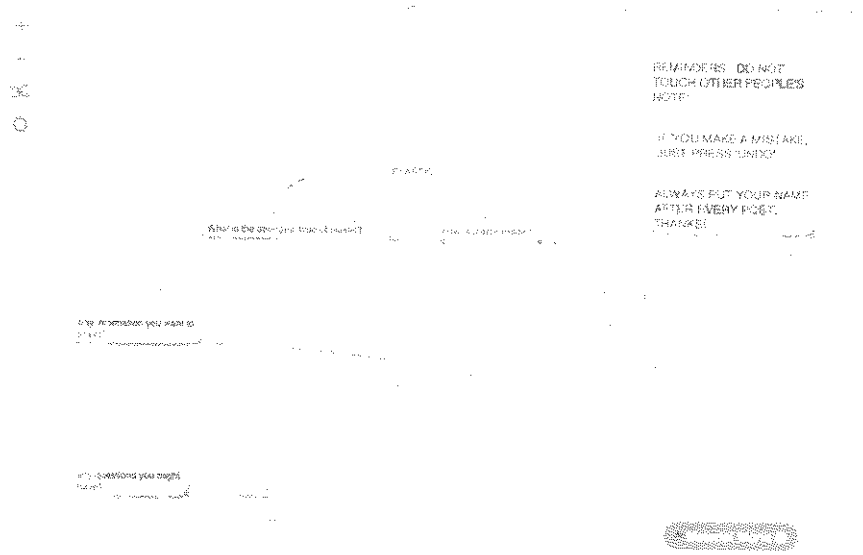
For computer supported collaborative learning (cscl), I chose to use the mind mapping software MindMeister. Apart from its provision for collaborative learning and asynchronous discourse, I chose this platform for its user-friendly features and interesting interface. During their stand-alone IT lesson, students were introduced to the software. Prior to this, I have already registered using a common account for the students to share as they do not have their own email accounts yet. Students were taught to log on and post notes. They were so excited to use the program and to see their posts on everyone's screen.

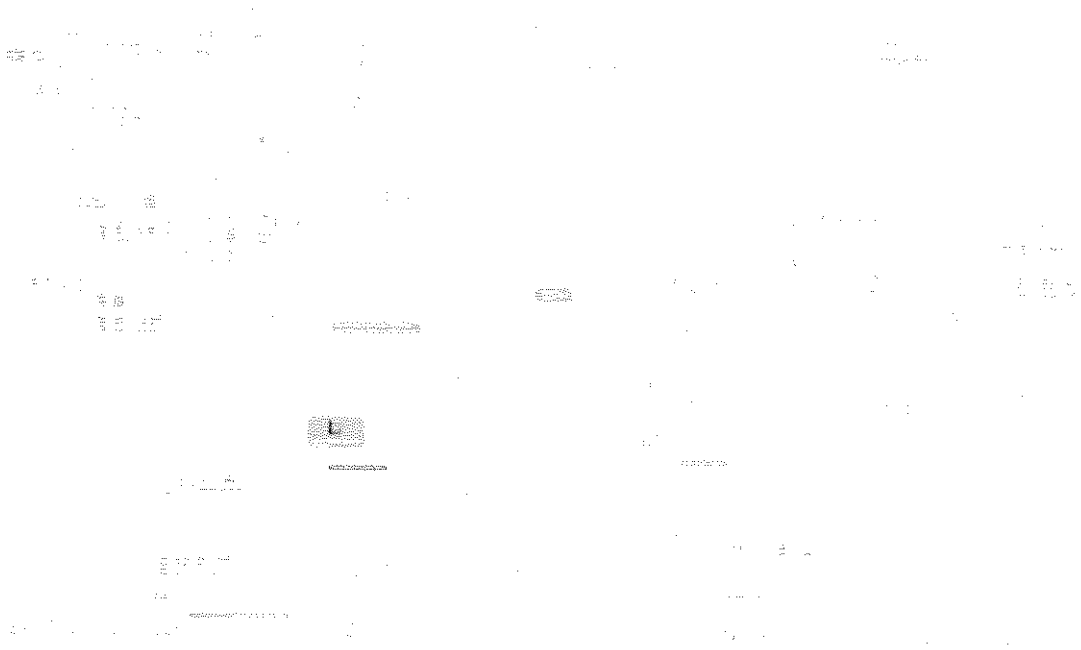
After going through the guidelines, students were told that they could continue discussions, post questions and any new learnings on MindMeister. I started with a single view and scaffolded discussion by posting one heading for 'plastic' which was our topic at that time. I also posted 2 questions:

a) Any information you want to share?

b) Any questions you might have?

My role after this was to help organize their misplaced notes and create connections as students found it difficult to control the connecting arrows. Below is a screen capture of the first day of implementation of MindMeister:





This is our space at the time of writing – 18 days after it was launched.

Curriculum adaptation

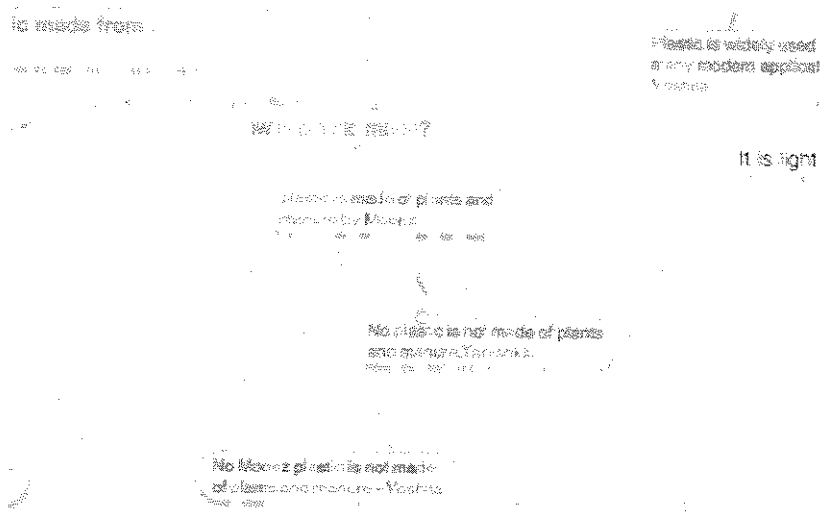
Posting on MindMeister was incorporated into students' homework. After every lesson, they were encouraged to post new information or questions after school. They were also assigned additional reading materials and asked to discuss them online. In order to get the most out of their virtual discourse, we regularly accessed MindMeister during lessons to talk about our collective knowledge advancement. We also attempted to answer unanswered questions in class which somewhat blurs the line between home and class work.

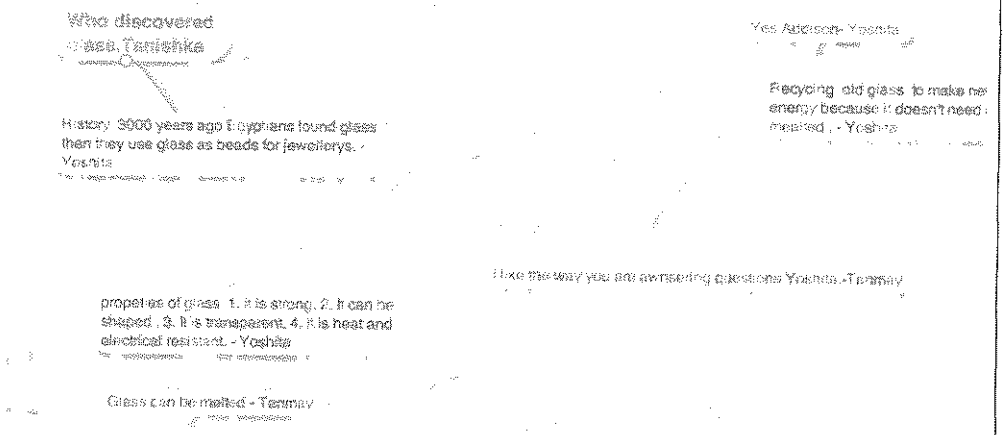
Analysis, Discussion and Conclusion

We are now halfway into the unit and students' motivation level has stayed high throughout. The implementation of the new KB pedagogy has been a real turning point this year and has definitely enriched the learning environment for my students. I have not seen them so keen to work together to 'share' and 'build' their knowledge.

Evidence of knowledge building principles

When I first encountered the 12 KB principles (Scardamalia, 2002), my first thought was they were too advanced and unrealistic for the lower primary school classroom. However, after my experience of implementing KB in my class, I have come to some realizations. One of them being that young learners are indeed capable of upholding knowledge building principles. Below, I created a table highlighting episodes that manifested KB principles:

Epistemic agency	It is all too easy for teachers to over manage students' education. Particularly in the field of early education as students are perceived to be too young and inexperienced to take control of their education. Scardamalia (2002) says agency is evident when individuals set forth their own ideas and negotiate a fit between personal ideas and those of others, and take charge of their knowledge advancement. When I first launched MindMeister, I was not sure of how successful it would be or how much impact it would have on their learning. I started the discussion with 'plastics' because this was our topic at the time. I noticed however, that students started posting about other materials a well, which led to other students responding and posting questions about them. I used these discussion points to guide the forthcoming lessons. In this sense, students were taking control of their knowledge advancement.
Improvable ideas	Projects such as the bike diagram and MindMeister show that ideas can be improved constantly. They are encouraged to post further ideas on the bike diagram. I have also seen evidence of improvable ideas on MindMeister such as when one student posted that plastic comes from plants and manure: 
Community knowledge, collective responsibility	To what extent can students take over goals typically assumed by the teacher? Scardamalia (2002) states that of particular interest in this regard is *collective cognitive responsibility*, which requires taking responsibility for the state of public knowledge. When students post information on MindMeister, they are well aware that each contribution is for the benefit of everyone. Hence, they are all working towards knowledge advancement for the whole group. Also, having briefly talked to them about knowledge building, students seem to have taken to heart what they have learned about sharing and building knowledge. Whilst doing the Jigsaw activity, I heard comments such as, 'We have to put our knowledge together!' and 'Wow! Our

	knowledge is growing!' as they saw the number of notes they have collected. They are no longer working as individuals but as a team with a common goal.
Idea diversity	This was manifested in several of their activities where students had differing ideas and opinions which they all had to take into consideration. One example was when one child said that wool comes from New Zealand and the rest of the 'wool group' went quiet. Someone said, 'There are lots of sheep in New Zealand so they must have wool there, too.'
Symmetric knowledge advancement	In a true KB community, knowledge advancement is achieved for the mutual benefit of all members. Such is the culture that I have tried to cultivate in my class. No one should be left behind and that learning should be a practice of give and take. With support, even those with learning needs are able to contribute and gain from this pedagogy. For the Jigsaw exercise, everyone came with their findings which they shared with their groupmates. Everyone has been contributing to the asynchronous discourse on MindMeister as well.
Rise above	When we did the Jigsaw activity, students collected a vast amount of notes within their group. They were instructed to read each one and categorise and remove redundant notes. I thought they did quite well in using their higher order thinking skills in this exercise.
Knowledge building discourse	It was very interesting and insightful to monitor evidence of knowledge advancement on MindMeister. Each child had a 'voice' which is sometimes difficult to assert in the classroom. There was plenty of evidence of fact and explanation-oriented discourse. I also noted some social-oriented notes. One student said 'I like the way you are answering questions.' 

Areas for improvement and conclusion

There is plenty of room for improvement. Firstly, I believe virtual discourse would benefit from using scaffolds such as those used in Knowledge Forum as this will help them organize their ideas better. Secondly, instead of me organising notes, I should delegate that tasks to students to promote principle of 'rise above'. For students who do not have access to technology at home, more time should be provided at school for them to benefit from cscl. I can pull out some students during their silent reading time to log on to ensure symmetric knowledge advancement.

In 21st century learning, teachers do not need to be the sole source of knowledge and allow students to bring about knowledge advancement. The KB pedagogy allows teachers to enact change in the classroom though constructive discourse which is now possible in and out of the classroom with the affordances of cscl – the benefits of which I have learned to appreciate with this experience.

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Appendix A:

International Primary Curriculum
Unit Plan

Unit 4: Material World

Theme:		
An inquiry into different types of materials, their characteristics and how they are used in our every day lives.		
Big Idea		
Hundreds of different materials are used to make everyday objects. Some materials occur naturally, e.g. wood from trees while others are manmade in factories, e.g. plastic. Some materials are magnetic; some allow heat and electricity to pass through them. But with so many different materials to choose from, how do we decide which to use?		
Learning targets		
In Science, we'll be finding out: • How and why different materials are used • How to test the properties of a material • About the uses for glass and plastic • About the metals that are attracted to magnets • Which materials allow electricity to pass through them • Which materials allow heat to pass through them • How natural and manmade materials are different	**In Technology, we'll be finding out:** • How to design and make a product for a bicycle **KB Principles** • Democratizing Knowledge • Symmetric Knowledge Advance • Pervasive Knowledge Building • Constructive Uses of Authoritative Sources • Knowledge Building Discourse • Embedded, Concurrent and Transformative assessment • Rise Above • Real ideas, authentic problems • Improvable Ideas • Idea diversity • Epistemic Agency • Community Knowledge, Collective Knowledge.	**In International, we'll be finding out:** • Where materials come from **IPC Personal Goals** **Enquiry**: pupils will be working on their investigation and recording skills. **Communication**: pupils will be discussing and reporting their findings in small groups or to the whole class. **Co-operation**: pupils will get many opportunities to work together. Respect: pupils will learn to respect each other's POV and contributions to the group. They will also learn to appreciate how different objects are made and regard them with appropriate care and respect.

Transdisciplinary skills	
Research skills – planning a course of action. Finding out necessary information. Getting information from a variety of resources: understanding primary and secondary resources. Organising information. **Thinking skills:** **Synthesis** – combining parts to create a whole. Creating, designing, developing and innovating. **Dialectical thought**- viewing an inquiry from different perspectives.	
Summative Task	
Groups of students will be asked to design their ideal learning environment using different materials and be able to defend their design. Types of output: diagram, poster, written report.	
Stages of Inquiry	
Entry Point (Provocation stage)	Group work: Ss will create a poster of different materials that they have brought into class. Students will present their work to the whole class afterwards.
Knowledge Harvest	K-W-L chart. Think-pair-share to improve their KWL chart.
Science Tasks	Science tasks 1- 6 / Science Extension Task
Technology Tasks	Technology Task 1 & Technology Extension Task
International Tasks	International Task 1
Exit Point (Summative Task)	A poster, diagram, model or ICT rendering or written report of their ideal classroom. Ss should be able to explain the materials they chose and why they chose them.