

RESEARCH WITHIN REACH

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THE BIG IDEA

Knowledge Building: Collaborative and Intentional Learning

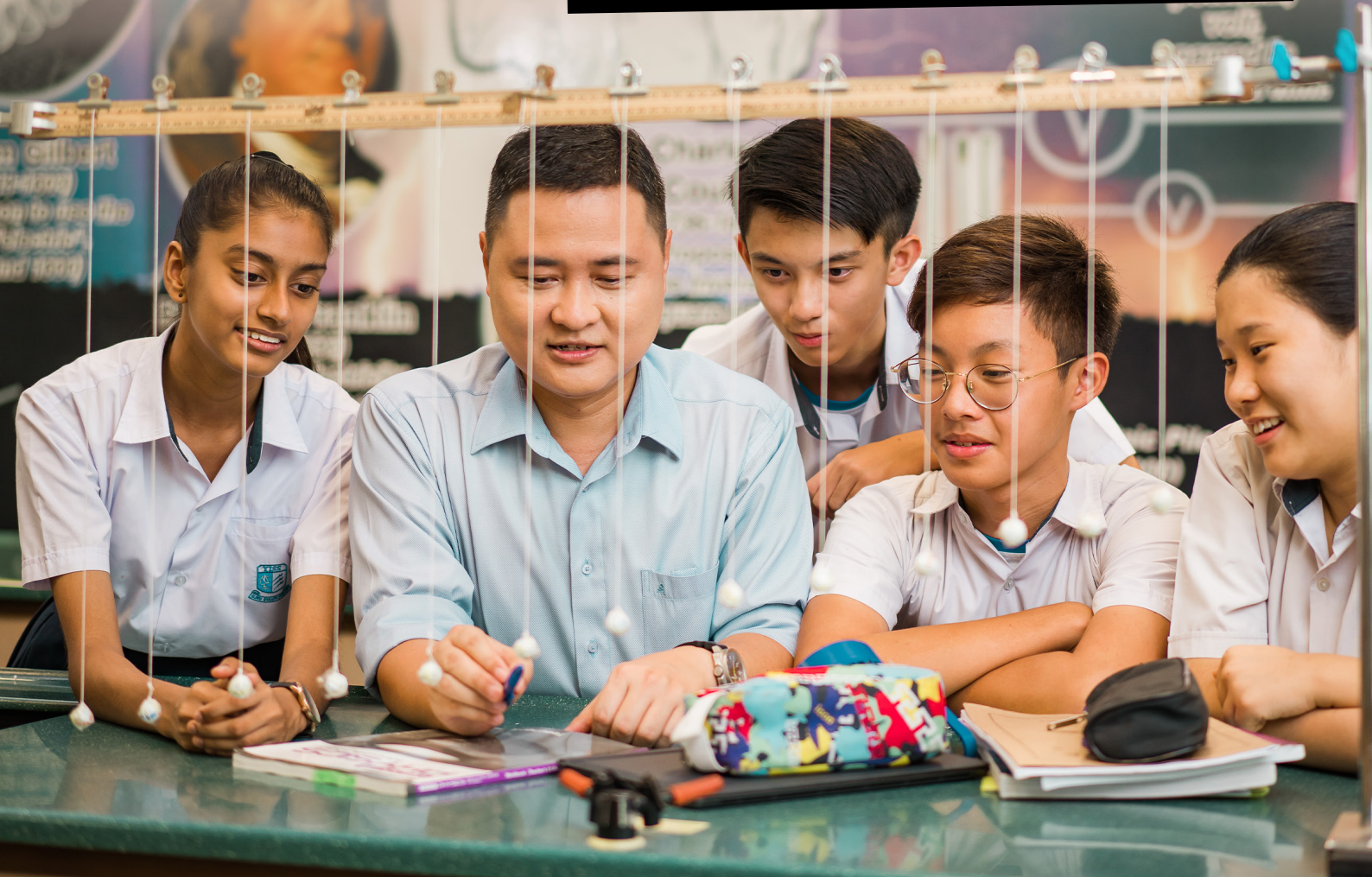
CLASSROOM PERSPECTIVES

Developing Co-Constructors of Knowledge

IN THEIR OWN WORDS

A Community of Knowledge Builders

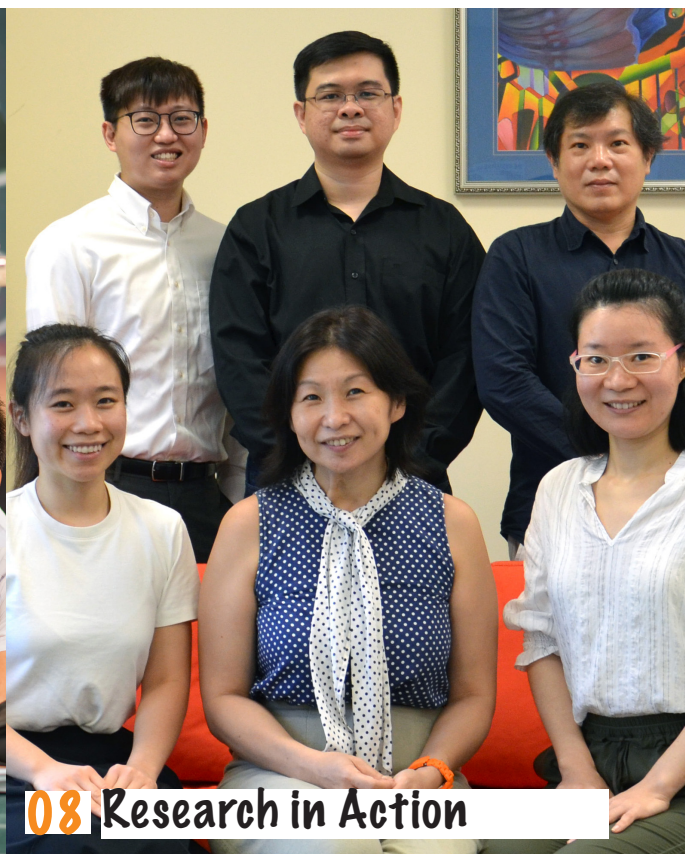
KNOWLEDGE BUILDING IN SINGAPORE CLASSROOMS



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Published quarterly by the Office of Education Research at the National Institute of Education, Singapore, *SingTeach* is an e-magazine dedicated to improving teaching and enhancing learning. Each article is crafted with teachers in mind.

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THERE IS DEFINITELY A TIME FOR **KNOWLEDGE BUILDING** IN ANY CLASSROOM.

Studies across the globe have shown that knowledge building (KB) boosts students' achievements and KB teachers continue to find new energy in their work. To understand how KB works, we need to first acknowledge that as a student engages in classroom discussion, the dimensions of learning, thinking and experiencing emotions are intertwined within them. These dimensions undergo changes simultaneously and are susceptible to both classroom dynamics and things that happen outside of the classrooms. Much of these are not visible to even the very experienced teachers among us and acknowledging this fact challenges some of our deeply embedded notions of teaching and learning.

To many of us, it is difficult to imagine allowing our students to pursue their questions of interest in our classroom. Can we picture them spending an entire period observing the pet fish in class and coming up with questions instead of us just simply *telling* them about the fish? In relation, it is also difficult to conceive the notion of a classroom in which the typical routine of teachers taking charge of what and how to learn in class becomes the seemingly less efficient way.

This is what KB hopes to overcome—by providing a “thinking pedagogy” whereby learning occurs when a student starts to think hard about questions and problems. As a teacher, you can support by letting them know that their ideas are valuable and not making that “one right answer” be your only goal in classroom discussion. Keep creating situations in which students have to think hard.

It is not the most obvious thing to do, but it will definitely be one of the most rewarding endeavours for all knowledge builders. As one of my most experienced KB teachers reminded me as I was writing this editorial: *Knowledge building is a way of life!*

And so, I hope this issue on KB energizes you and seed new ideas for you as an educator.



Dr Teo Chew Lee

Senior Research Scientist
Office of Education Research
National Institute of Education

ONLINE EXCLUSIVES

CLASSROOM PERSPECTIVES

Nurturing a Love of Learning with Knowledge Building

A Learning Community of Students and Teachers in a
Knowledge Building Classroom



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KNOWLEDGE BUILDING

COLLABORATIVE AND INTENTIONAL LEARNING

In today's knowledge age, the extent of a nation's economic growth is increasingly dependent on its society's capacity to innovate. It is crucial that people are equipped with the skills that will enable them to work collaboratively and creatively to advance the knowledge of the community as a whole. This presents a larger question: How can we help to develop students who are not only knowledgeable but also active participants in the creation of new knowledge? The guest editor of this issue of SingTech, NIE Senior Research Scientist Dr Teo Chew Lee, sheds some light on why and how the knowledge building approach in schools can help do just that.

WHAT EXACTLY IS KNOWLEDGE BUILDING?

Knowledge building pedagogy focuses on teaching for deep understanding and community knowledge work. It builds on the basis that students have the propensity to work on and improve authentic and creative ideas.

"We often imagine idea improvement as great breakthroughs by geniuses but in fact, idea improvement happens in a small incremental way and it is almost always a collective effort," Chew Lee explains. "More importantly, research on knowledge building has shown that it is possible for young children of different abilities to advance knowledge when given the right support and environment. Everyone can be a knowledge builder."

The term "knowledge building" was coined about three decades ago by Scardamalia and Bereiter at the University of Toronto. The concept centres largely on two main

ideas: that learning is intentional and that it is done for the benefit of the community. This means that students who are engaged in knowledge building are conscious about their learning and they see purpose from doing it.

This approach to learning focuses on getting every child to be a contributor to the community. They may not start by being one who actively engages but as they immerse into a culture that values everyone's ideas and the hard work taken to improve these ideas, be it in brainstorming, identifying problems, researching for solutions and evidence, and discussing with their classmates, they will slowly see themselves as a changed learner. Such collaborative knowledge building brings about co-creation of new perspectives and advances current understanding of any one individual in the group.

"The heart of knowledge building practice lies in guiding students in developing their ideas in an authentic and careful manner, and representing them in writing, models or drawing. These ideas and questions are given a public life, in which students build on and watch them grow further. There is a whole constructive and productive conversation going on," shares Chew Lee, who is also the founder of *Knowledge Building Singapore*, a knowledge building community for practitioners.

ONLINE EXTRAS!

Read more about what *Knowledge Building Singapore* is in the online version of this article.



DISTINCTION BETWEEN KNOWLEDGE BUILDING AND INQUIRY-BASED LEARNING

The goal of inquiry-based learning is to engage learners in a systematic scientific process to proof or disproof something. The approach is often accompanied by a specific order of learning phases, most commonly: engage, explore, explain, elaborate, evaluate.

While the nature of knowledge building and inquiry-based learning might be similar in that it encourages learning through exploration, the latter tends to look at a more phased approach that follows a certain order. The knowledge building approach, on the other hand, is more flexible and organic; students lead the way forward in their learning, building on each other's ideas through talks, questions, discussions and experimentations that adhere to no specific order. "One knowledge building teacher once shared that 'even if there is an order, the order comes from my students' ideas'," Chew Lee shares.

A prime example of the difference between the two approaches lies in the science classroom. In one of the lessons, students explore and explain the concept of forces on *Knowledge Forum*, an ICT platform that facilitates knowledge building. Upon analysing the notes, the research team found not a single question from the students; instead, there were many pieces of information and explanation shared by students.

"For an inquiry-based science lesson to have no question, let alone authentic questions from the students, that is a big problem," Chew Lee shares. "Yet I think many of us would agree that this 'no-question, just explain' phenomenon is not too uncommon in many classrooms today that still target at students producing the model answers."

Chew Lee explains that another reason for such passive learning through inquiry-based learning is because "students tend to take the problem and experiment for the answer instead of questioning the issue and process." The latter is what the knowledge building approach encourages.

While the broad processes between the two approaches may be similar, for knowledge building, it really is the *why* that leads to the experiments, the *how* of the experiments and the *what* after the experiments. "These are the kinds of knowledge building moments and talks that set the knowledge building approach apart from inquiry-based learning," Chew Lee adds.





KNOWLEDGE BUILDING DISCOURSE AS A HABIT OF MIND

Knowledge building discourse focuses on idea improvement that can be achieved through the community's or in this case, students' collective efforts, more than on arriving at the "right answer". Research has also shown that a key to great classroom discussion involves students taking on diverse perspectives and different contributing roles.

Knowledge building discourse is made up of dialogue moves such as: theorizing, elaborating, synthesizing, making analogies, reflecting, proposing ways to test ideas, identifying promising ideas, questioning, searching for a better way, etc. These forms of discourse represent essential moves in knowledge work, and when engaged frequently, shape habits of mind.

As such, beyond just receiving formal training sessions, Chew Lee also adds that a successful knowledge building lesson lies greatly on the teacher's perceptions towards teaching and learning.

Citing an example, Chew Lee shares about a young child during a science lesson. The child told the teacher that the moon is made out of cheese. Most teachers would likely tell the child that he or she is wrong or ignore the comment and continue with the lesson. However, the child's knowledge building teacher, upon sensing his seriousness of the idea, engaged him further. The teacher then discovered how children literature tends to depict the moon in yellow and cheese-like visuals. The conversation between the child and the teacher was a knowledge building moment for the class.

"So knowledge building is very much how the teachers perceive students, their ideas and how they rally the class to find out more. It is about tuning in to your students' questions and ideas, and creating the space for them to engage and grow their ideas," Chew Lee explains. "Some teachers also start conversations with students with newspaper clippings, triggering a whole series of ideas and questions."

"Our research found that teachers who knowledge build displayed a solid epistemic shift in the way they think about students' learning. This is one thing that we found to be consistent across teachers engaging their students in knowledge building activities," Chew Lee says.

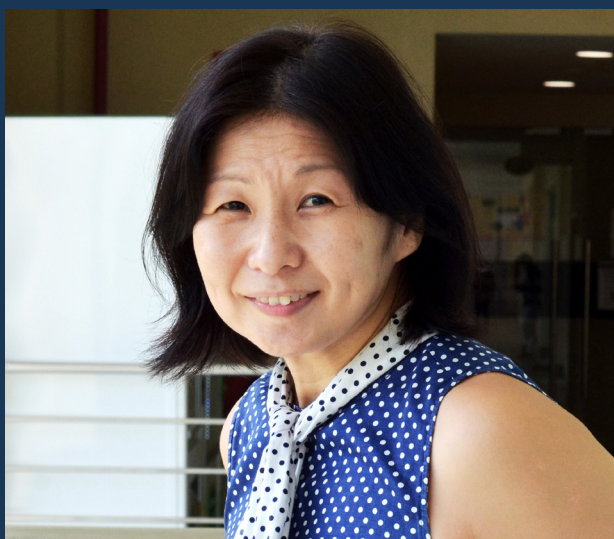
THE NEXUS BETWEEN RESEARCH AND PRACTICE IN KNOWLEDGE BUILDING

After years of research experience in the field of knowledge building, Chew Lee points out that the mindset and cultural shift does not happen overnight but when they eventually occur, the results often surpass the research team's expectations.

"The challenge is in seeing our research in knowledge building influencing the classroom work on a day-to-day basis. The challenge also is in convincing teachers with the notion that our students and their ideas are very powerful despite their age and their level of academic ability," she shares. "Again, this is related to the shift in mindset; that you see the potential in what students can do instead of the deficit in what they cannot do."

Chew Lee hopes that the knowledge building community in Singapore will remain to be a strong foothold for practitioners who wish to learn more, explore deeper and contribute towards the knowledge of knowledge building theories, pedagogies and technology.

At the end of the day, for Chew Lee and her research team, knowledge building is really all about making use of ideas and more importantly, realizing the value of hard work to improve those ideas. "The knowledge building community in Singapore is not of a grand scale but despite that, the amount of support and motivation within it is very strong," she shares. "We hope that bringing together education researchers and practitioners into this knowledge building endeavour will serve to strengthen the bridge between quality research and classroom teaching and learning." ■



About the Guest Editor

Teo Chew Lee is Senior Research Scientist with the Office of Education Research at NIE, Singapore. She founded *Knowledge Building Singapore*, a knowledge building community for practitioners. Her research interests include 21st century competencies, learning analytics, and scaling and translation.

How have KB pedagogies been useful in helping you understand your students, and their ideas and learning styles?

KB promotes diversity of ideas and allows students opportunities to share and build on their ideas and those of the classroom community through self-directed learning and collaboration. KB honours the student voice and each student is encouraged to share their ideas and responses to other students' ideas. Some of these ideas may not be new but they are authentic to each student.

I have witnessed how my students have grown in confidence in idea generation and learned how to navigate respectfully in an idea-centric classroom. My students always pleasantly surprise me in my KB classroom—be it quiet students sharing their ideas freely on the KB platform, or the maturity of ideas and questions that originate from my young primary school students! This has certainly shaped my understanding of each student in my classes better and led me to never underestimate my learners. I am heartened that my quieter learners have found a way to share their thoughts and ideas with others in an environment they find less intimidating.

Through KB, I am also able to discover my students' varying levels of understanding as well as misconceptions in various topics. With this information, I am able to design lessons and interventions more intentionally to cater to my students' needs and to differentiate instruction for them. As a KB facilitator in my students' learning, I have learned not to impose my idea of what "effective lessons" should be on them, but to design my lessons based on their ideas and the thinking behind them—which has challenged me to understand my learners and their ideas more keenly. Through KB, I have observed stronger student engagement and student-owned learning in my classes.

-Muhammad Ansar Bin Kamsan, Teacher, Haig Girl's School

The Knowledge Building Classroom

The use of Knowledge Building (KB) pedagogies in classrooms aims to help students acquire the ability to recognize, communicate, interrogate and apply knowledge in key subject domains. Two educators and KB-enthusiasts share some insights on how using KB pedagogies have benefitted both classroom teaching and learning.

How have KB pedagogies been useful for students and how do they support learning?

With my Literature class at Unity Secondary School, I chose to focus on the most relevant KB principles—Idea Diversity, Improvable Ideas, Epistemic Agency and Democratizing Knowledge. I wanted to build a classroom community where students have a strong sense of ownership over their learning and interpretations of texts, and are eager to work as a community to improve their collective and individual ideas. Thus, my pedagogical choices were heavily biased towards presenting literature texts as thought puzzles to be solved. I used the online discussion platform, *Knowledge Forum* (KF), to encourage students' active exchange of ideas in relation to the texts. I also provided students with feedback on their knowledge-building contributions through individualized reports generated using the learning analytics tools available on KF.

Students reported that KF empowered them by giving them a voice and allowing their views to be read by others online. This gave the class access to a wide range of ideas, including those which students may have been reluctant to share in a face-to-face setting. Students also found the responses from their peers energizing and liberating, as they saw these as validation of their ideas, and appreciated suggestions for improvement. The majority of the feedback students received came from their peers, rather than the teacher, thus empowering them to work together as a community to improve their collective ideas.

The archival function of KF supported students' learning, as all class materials and discussions remained accessible for revision. This also enabled discussions to be extended to other platforms such as *WhatsApp*—which better facilitated real-time communication among students. Easy access to class materials paved the way for on-going, student-initiated discussions. More importantly, students appreciated how KB pedagogies emphasised the development of skills in the affective domain such as communication and empathy and required students' active participation in personal and group learning. KB re-aligned students' focus to learning and self-development instead of academic competition with others.

**-Charmaine Tan, Teacher, Unity Secondary School (2019)
currently Academy Officer, English Language Institute of Singapore (ELIS), MOE**

The Impact of Knowledge Building on the PRESENT AND FUTURE of Singapore's Education System

Contributed by Teo Chew Lee, Aloysius Ong, Gabrielle Ong, Alwyn Lee, Ivy Zhao & Aaron Lim

Knowledge building theories, pedagogy and technology have been established for decades internationally. It recognizes that knowledge is socially constructed and helps develop a community of learners where every individual is a contributor and co-creator of knowledge. In Singapore, a group of researchers from NIE hopes to further build on existing knowledge building research to bring forth information and findings that are relevant and purposeful in the local school context.



Learning analytics are advancing our understanding of students' learning in collaborative settings. There is potential for analytics feedback to support teachers and students in knowledge building practices.

Collaborative learning is dynamic in that student-to-student interactions involve a myriad of learning processes. These learning processes include how they understand, and regulate their learning and emotions, to name a few.

Teachers can analyse and visualize some of these learning processes through the use of technological tools known as learning analytics. To support that, the research team develops two sets of analytic tools:

1. a "curriculum-idea-analytics" to represent growth of students' ideas in relation to depth and width of a big-idea curriculum; and
2. a multimodal learning analytics to understand students' emotions in collaborative learning.

"First, the research project 'Developing 21st Century Assessment and Environment for Teachers and Students: The Case of Knowledge Building Pedagogy and Technology' explores an analytic tool that generates visualizations (word cloud and networks) of connections between students' ideas and the ideas explored in a big-idea curriculum," NIE Research Fellow Dr Aloysius Ong shares.

"This big-idea curriculum are produced by mapping ideas across interdisciplinary topics from primary to junior college level curriculum documents to generate unifying themes or big-ideas." By visualizing and identifying ideas that are key to the topic, teachers can better support students in developing big-idea inquiries and understanding of the online discussion.

"Second, we posit that what is observable during collaborative learning sessions in the classroom is only the tip of the iceberg," Aloysius adds. These "unseen" interactions may often be equally, if not more, important in understanding students' learning.

To pursue this phenomenon further, the research team led by NIE Senior Research Scientist Dr Teo Chew Lee embarked on another project that explores advanced video and sensor technology and analysis of multimodal data to gain insights into students' different behavioral and speech aspects during collaborative discussions.

"This project, 'Multimodal Learning Analytics and Computer-Supported Collaborative Learning: Environments and Assessment in a New Continuum of Learning', looks at students' facial expression, head and body movements, verbal and lexical cues, and physiological data," Aloysius shares.

Teachers create and build knowledge about their practices through open sharing of ideas and experiences with other fellow teachers. This knowledge building community functions as a self-sufficient and sustainable socio-cultural community to support the constant professional development of teachers.

As knowledge building lies greatly on the concept of community learning and socio-constructivism, an ongoing NIE research attempts to understand how knowledge building communities among preschool educators can help to sustain teachers' professional development.

"We have seen huge potential of knowledge building enhancing the professional identity of teachers and the experiences of students. Both teachers and students showed incredible levels of knowledge building," Chew Lee, who is also the guest editor of this issue of *SingTeach*, shares.

"Having implemented knowledge building pedagogies in several schools, the research team expanded the knowledge building continuum to preschool communities in hopes of connecting them to primary school teachers and understanding the first transition year experienced by local children."

Members of the *Knowledge Building Community* (KBC) share ownership of such students' learning experiences and achievements. Knowledge building pedagogies also go a step further by guiding young students in their own exploration.

"In KBC, the teachers come together to share advances and challenges faced in the week. They practise evidence-based discussion by sharing and studying students' artefacts. They are given the agency to create their own brand of knowledge building practice undergird by its principles," Chew Lee says.

One recent example of evidence-based discussions is from student drawings on their understanding of gravity. Students had previously understood gravity as an Earth magnet that pulls all matter down. However, at the weekly meetings, teachers identified this misconception and worked together to correct it through various resources such as books. Coupled with knowledge building principles, students' drawings help teachers to identify learning gaps.

This allows teachers to better redesign the aims of upcoming lessons and also further build on students' interests in the classroom. For example, when planning lessons related to gravitational forces in the orbiting planets, teachers may consider a bigger-picture theme of solar system.

Neuroscience and knowledge building research stimulate critical thinking about information that can inform education and be interpreted for practice.

"Neuroscience is an emerging field that has the potential to inform educational theory and affect teaching practice," NIE Research Fellow Dr Alwyn Lee shares.

When students explore multiple ideas and different pathways during knowledge building lessons, it is similar to students' cognitive flexibility, which is a key executive function. "By combining neuroscience research with the knowledge building approach, teachers can better understand childhood development and adapt classes to facilitate learning and student progress," he adds.

In Singapore, research on adolescents is part of an ongoing and larger project collaboration between NIE and Cambridge University, under the Centre for Learning and Individualised Cognition (CLIC) and funded by the National Research Foundation. As one of the co-Principal Investigators of the project, Chew Lee shares that the project aims to characterize cognitive flexibility of adolescents in Singapore and study the impact of knowledge building pedagogy and cognitive training protocol on cognitive flexibility.

"This strategic and global initiative will involve at least 400 students in Singapore and we hope it will be impactful and beneficial to both teachers and students," Chew Lee concludes. ■



About the contributors

Teo Chew Lee is Senior Research Scientist and the guest editor of this issue of *SingTeach*. **Aloysius Ong** and **Alwyn Lee** are Research Fellows, **Ivy Zhao** is Research Associate, and **Gabrielle Ong** and **Aaron Lim** are research assistants from the Office of Education Research at NIE.

A Principle-based Approach TO TEACHING AND LEARNING

Knowledge building has provided a new approach towards teaching and learning in the 21st century. At least, this is the sentiment that resonates with Associate Professor Chen Bodong from the University of Minnesota and Mr Samuel Tan, Senior Specialist from the Singapore Ministry of Education's Educational Technology Division. They share with SingTeach how knowledge building is changing and influencing the way we teach and learn.

The knowledge building (KB) approach encourages students to think like experts, and learn by forming and building on each other's ideas, describes Bodong, whose research interests lie in the areas of ICT in education and learning analytics.

It brings students together to brainstorm and collaborate, which he finds very intriguing. "KB presented itself as an interesting educational approach that was very different from my experiences as a student back in school," he shares.

According to Samuel, KB is "a principle-based innovation where KB principles form the blueprint for teachers' design, strategies and facilitation." His current involvement in KB research, through the Ministry of Education's (MOE) Senior Specialist Track Research Fund (SSTRF), supports teachers to make sense of the KB principles through co-designing lessons, analysing and utilizing their students' ideas and theories to drive the KB process.

The Importance of a Knowledge Building Community

A community is important so as to help create an environment that allows KB to happen.

"Before KB can happen, we need to admit that it is an uphill task to create an authentic KB environment in schools," says Bodong. "It requires support from all the stakeholders in the school to be willing to adjust and to take risk; this includes principals, teachers, parents and students."

This KB community gathers perspectives from multiple fields of education research and envisage the possibility of what education could be, explains Bodong. "As such, the KB community views the school as a knowledge-creating organization that cultivates values such as critical thinking, problem-solving, interdisciplinary thinking, decision making, collaboration and leadership."

"The community that we have in KB extends to include students and other KB classes across different schools and even countries," Samuel adds.

As part of the KB community in Singapore, on top of connecting practitioners who are interested in KB, Samuel also actively knowledge build with these teachers as part of his efforts to bring knowledge creation practices into schools.

The MOE SSTRF helps him to carry out research to advance MOE's knowledge base and to fulfil its objectives, for example, by leading projects in KB science classrooms to improve scientific explanations and self-regulation amongst students.



Supporting Educators in Knowledge Building Efforts

Bodong believes that teachers should be encouraged to inquire about their teaching, to collaborate and to refine their teaching craft. Research-practice partnerships can also create productive spaces for teachers, researchers and engineers to co-design digital innovations and teaching strategies to support KB, he opines.

“These partnerships will be the drivers that introduce KB into schools, create technological innovations and conduct empirical research about teaching and learning,” explains Bodong. “By doing so, we are forming ‘hubs of innovation’ around the world that may lead to a series of meaningful changes in education.”

In the Singapore context, the *SkillsFuture for Educators* initiative supports teachers to develop higher levels of practice in e-pedagogy, which is the practice of teaching with technology for active learning. Samuel’s work as a senior specialist focuses on the design and pedagogical use of learning analytics and visualizations to support KB discourse and processes.

With home-based and blended learning set to be a regular part of schooling in Singapore, MOE hopes to develop self-directed and independent learners who are passionate and intrinsically motivated to learn. “KB, with its focus on community knowledge advancement, sustained inquiry and engaging students’ ideas, presents a compelling picture of what school and education could be,” Samuel shares.

The Future of Knowledge Building

Bodong and his research team work closely with educators to co-design new technologies that extend students’ capabilities in areas such as data science, and invite them to solve complex issues like climate change. Rigorous studies are also conducted in the classrooms to evaluate the effectiveness of such initiatives.

“Currently, KB research has entered its third decade and it has shown that we need to invest in building research-practice partnerships to make sustainable improvements in education,” Bodong shares.

When asked about the digital environment in relation to KB research and practice, Samuel is confident that KB is able to transcend the various digital platforms that may surface over time, including the Student Learning Space. “The design principles enable teachers and students to bring their practice and adaptability into any platform, and be effective in improving ideas and applying that knowledge in multiple novel contexts,” he says.

Through KB, students not only develop deep conceptual understanding, but also participate in the practices of knowledge creating communities regardless of the platform used.

Bodong adds that the Singapore education system is innovative and forward-looking, having met Singaporean scholars who are important leaders in the KB international community, such as NIE Senior Research Scientist Dr Teo Chew Lee, who is also the guest editor of this *SingTeach* issue.

As Bodong affirms: “Singapore has started writing its own KB stories that can contribute to education research.” ■

About the interviewees

Chen Bodong (pictured) is Associate Professor in the Department of Curriculum and Instruction, and Co-Director of the Learning Informatics Lab at University of Minnesota. **Samuel Tan** is Senior Specialist at the Educational Technology Division, Ministry of Education, Singapore.





Developing

CO-CONSTRUCTORS OF KNOWLEDGE

Traditionally, classroom teaching and learning have been dominated by pedagogies that are largely teacher-centred which often result in passive learning for students. In the past decade, however, the notion of education has shifted to one that greatly emphasizes the importance of student-centeredness. To reinforce the shift, St Hilda's Primary School turned to an online platform that facilitates knowledge building inquiry called the Knowledge Forum. The school's principal, Mrs Daphne Yeoh, shares some insights and the challenges that come with this new approach to teaching and learning.

ADOPTING KNOWLEDGE BUILDING AS A SCHOOL

In the past, students rely heavily on their teachers as their source of information and knowledge, and that is something Daphne hopes to move away from. It is important to her that every student has a hand in his/her own acquisition of knowledge. For her, this can be done by adopting knowledge building pedagogies that encourage active and collaborative learning in classrooms.

Originally backed by the school's former principal, the implementation of knowledge building was a ground-up initiative by the Gifted Education Programme (GEP) department headed by Mr Andy Ng. In continuing her predecessor's support for this initiative, Mrs Yeoh believes that KB principles bring about many benefits. This pedagogy was also aided by the use of an online information and communication technology (ICT) tool.

"We adopted the *Knowledge Forum* (KF) as a viable ICT tool to promote collaborative learning among students," Daphne shares. "And as the teachers

explored the use of KF and began to understand knowledge building better, they saw its intrinsic worth as a pedagogy that engages students in co-constructing knowledge."

The KF also exposes teachers to various knowledge building principles that act as yardsticks for them to design, execute and evaluate their lessons better. Mrs Yeoh however cautions that: "A successful lesson is not one that covers all knowledge building principles, but instead translates one or a few into creating a learning ecology that supports the students' co-construction of knowledge with their peers and their teacher."

Now in its infancy stage at St Hilda's, knowledge building theories are situated as "pedagogical directions" in which the head of the GEP department weighs students' needs, teacher readiness and the school's direction to determine which approach is most appropriate for the year's work plan. "This approach is then re-positioned to fit the school's context and adopted by subject teams which translate them to projects that solve a specific problem in their classrooms during implementation."

Failure as Fuel

The knowledge building implementation approach in St Hilda's Primary School is similar to that of the design thinking process when problem-solving.

First, with the year's pedagogical direction in mind, teachers in their respective subject teams identify a "pain point" that they face collectively in their classrooms, ranging from difficulties in teaching a particular topic or component to challenges when engaging students.

Then, "rapid prototyping" occurs where teachers ideate and design a lesson to solve the identified problem, try it out, and review it quickly to make improvements for the next round.

Once the lesson is refined, these methods will be scaled up through peer mentoring and workshops led by teachers and/or key personnel.

Therefore, in this process, failure is used as fuel. Mrs Yeoh explains, "Teachers *fail fast* by designing a prototype to test in class, *fail mindfully* by reviewing the areas for improvement in depth after testing, and *fail forward* by using the ideas from the review to quickly improve the initiative toward success."

IMPORTANCE OF LEADERSHIP SUPPORT

At St Hilda's, teachers are encouraged to explore the use of new pedagogies, tools and platforms to facilitate, engage and enrich student learning. "Our school leadership encourages ground-up initiatives and teachers are given the autonomy to decide on the kind of approach to use in their classroom teaching."

Teachers are also given the opportunities to participate in innovative projects, research as well as professional development opportunities, such as attending workshops and conferences on knowledge building. For example, as part of the Knowledge Building Network Learning (International) Conference in 2019 which was organized by the Office of Education Research at NIE, Daphne and her team of teachers engaged the conference participants in a variety of activities on knowledge building in her school. This includes classroom visits, workshops, poster sessions facilitated by students as well as a plenary discussion.

"Ideas and pedagogies that are successfully implemented in one department in the school are then shared and may be adopted by others, thus scaling up the practice in the school," Daphne shares. However, the successful implementation of knowledge building at St Hilda's did not happen without its own challenges.

OVERCOMING SCHOOL CHALLENGES

"As knowledge building is a principle-based learning approach, the difficulty lies in making the theories and principles palatable to teachers, who already have a lot on their plates," Daphne says.

The fact that knowledge building also involves a radical rethink of what learning can be in this new "knowledge age" also contributes to the challenge of exciting teachers with this new approach. As such, Daphne feels that some individuals who are used to more conservative approaches to teaching—especially if they already have existing methods that work—may struggle to adapt.

So how can the knowledge building then be positioned in a way that addresses the needs of students and teachers in the classroom and aligns with the direction of the school and nation, all while retaining the essence of the theory? "Start small and use knowledge building to address existing challenges in teaching and learning, with future learning in mind. After all, the school envisions its students to be changemakers of tomorrow," Daphne advises.

Action research naturally followed as part of teachers' efforts to improve their skills. "This is one effective way in which teachers can hone their own craft, crystallize their learning, and share it to help others to hone theirs as well."

Through the process of working on knowledge building research, St Hilda's practitioners became more cognizant of the principles behind their pedagogy and are better able to close practice-theory gaps. Ultimately, this translates not only to quality professional development of self and others but also more importantly, an improved quality of learning for students. ■



About the interviewee

Mrs Daphne Yeoh is Principal of St Hilda's Primary School. As an educator of more than 30 years, SHPS is the third school she is helming in her 12 years of experience as a school principal.



A Community of Knowledge Builders



To further enhance the Knowledge Building (KB) experience, the KB community conceptualized KB Design Studio (KBDS) sessions that focus on a more active design of KB activities for students. These collaborative sessions bring together a group of students from different schools to work alongside teachers, scientists and education researchers on real-world problems. At its inaugural session held in November 2019, students worked in groups to build a prototype that can be implemented in cities to promote sustainable living. Senior History Teacher from Teck Whye Secondary School Mr Melvin Chan and two of his students share with us their KBDS experience.

How did the KBDS session help in bridging research, practice and learning?

Learning is social—as they say, TEAM stands for Together Everyone Achieves More—and the KBDS reinforced how every child is valuable in negotiating, dialoguing and advancing each other's thought processes and reasoning capabilities within a collaboration-driven, community-orientated learning environment. For example, students were able to make use of different modes and forms of thinking (such as divergent-convergent model, part-whole method and content-concept approach) facilitated by the KB scaffolds to spark, strengthen and synthesize ideas within and across groups. Indeed, as voiced by a student of mine, "One plus one is always more than two. Together, we progress more than what we can imagine."

Learning is also emotional, where emotion affects and shapes our journey of learning and discovery. The KBDS saw numerous episodes of organic rotational leadership where students (of varying ages) each took the initiative to lead their respective group in capturing data, conceptualizing prototypes, connecting ideas, consolidating pointers and/or challenging assumptions to advance the group's hypothesis and proposition via the use of KB Conversational Stems. Additionally, some of my students expressed how the presence of the multi-modal technological tools increased their consciousness towards their emotions and helped them realize that frustration could be productive and positive for their learning—with the help of cognitive flexibility and emotional intelligence, of course.

By emphasizing the social and emotional nature of learning, the KBDS has shown its potential in cultivating students who are able to confidently exercise their critical and creative dispositions within a collaborative community setting.

**-Melvin Chan, Senior Teacher,
Teck Whye Secondary School**



The next KB Design Studio session is scheduled for November 2020. For more information, visit their website at www.kbsingapore.org

What were some of the highlights of the KBDS and how have you benefitted from it?

I enjoyed the part where my group discussed the design of our prototype and I saw how subjects such as Science, Design and Technology, Geography, and History relate to one another. I also remember how an adult thanked me for helping him to see that it is important to consider the culture of a nation in creating the prototype.

After the KBDS, I am now interested in exploring and thinking of possible ways different subjects can be connected. For example, I discovered that we could use mathematical graphs and geographical maps to talk about the changing history of a nation. Alternatively, we could also use the changes in fashion or food recipes (under Food and Consumer Education) to trace the rise and fall of nations and empires. My classmates were amazed when I shared this information with them!

**-Pey Zhi Xun,
Teck Whye Secondary School Student**

Just like History lessons in school, I was delighted that the professors at the KBDS listened to our ideas and refrained from sharing their opinions until my group requested help to clarify some of our thoughts. This gave my group many opportunities to share, build on and think of ways to improve our design. Because of this, I feel so proud of my group's product because it is truly our own creation! There were times my groupmates had different ideas which seemed contradictory, however, this was not a major issue. I think this is because as knowledge builders, we are familiar with the idea of active listening (like how diplomats work in ASEAN and the United Nations) and the use of KB scaffolds to combine our ideas and make them better. I think this is what fun and real learning should be like!

**-Isyraf Nur Irfan Bin Borhanudin,
Teck Whye Secondary School Student**



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