HotTOPIC

Technology for Teaching and Learning

Technology has undoubtedly had an impact on the way we live and work, and on the way teach and learn. We pause to consider what ICT has brought to the classroom—and what it has taken away.

The unprecedented changes in technology have been mirrored in our schools, both in pace and substance. Dr Cheah Horn Mun has been actively involved in integrating ICT into teaching and learning, both in NIE when ICT was in its infancy, and currently at the national level. He helps us to understand some of the implications for teaching and learning, beginning with the historical context.

Q: How do you see technology changing the classroom?

A: When ICT was first introduced in the form of the Internet, its use tended to be more *efficiency-based*. That means it was easier to gather information. It means I can use productivity tools like word processing or PowerPoint to make editing easier, to make my presentation nicer. But I have not really changed the teaching/learning interactions very much. The fundamental pedagogy is more or less the same—it is still an "I talk, you listen" kind of engagement.

The Internet gradually moved into a Web 2.0 environment. It's no longer just about information download; it's also about building a community where I co-create knowledge within a community. I don't just take, I put back. Parallel to that, the kind of usage in the classroom started to shift to more *transformation-based*. In other words, I can fundamentally change the way in which teaching/learning interactions take place in ways that I cannot do so without the support or use of technology.

At this point in time, we're beginning to move to a Web 3.0 environment, where the tools you use begin to learn about you as a user—they track your key strokes, your searching pattern, the way you go about solving a problem. And the tools can feed this back to the learner and teacher. This provides the ability to make the thinking process of the learner explicit to both the learner and the teacher. The teacher will now be able to know where he or she can focus on, in terms of correcting misunderstandings or catering to different learning styles.

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>
> *- Dr Cheah Horn Mun,*
> *Educational Technology Division,*
> *MOE*

In this issue

Technology and Learning

>> How is technology changing the way we teach and learn?
>> How can smartphones make learning Chinese seamless?
>> How can computers support learning in the science classroom?
>> Is technology changing interactions in the math classroom?
>> How can teachers be supported in the use of technology?

All these and more at http://singteach.nie.edu.sg

> As educators, we need to rethink not just the role—the role is quite clear—but within the role, what exactly do I need to do?

- Horn Mun on the role of the teacher in a connected environment

Cheah Horn Mun is currently Director of the Educational Technology Division at the Ministry of Education (MOE), which co-drives the implementation of the 3rd ICT in Education Masterplan. He was a member of the NIE committee that drew up its first IT Plans in 1996, and was later involved in implementing these plans. He was also a member of the MOE Task Force for IT Strategy in 2001 and the MOE ICT Masterplan 2 Steering Committee in 2003. Before his current appointment to MOE, he was Dean of Foundation Programmes, overseeing all initial teacher education programmes at NIE.

Q: Is there a downside to the increasing use of technology for learning?

A: We need to realize is that while technology brings a lot of things to the table, we must also be cognizant of what we are losing. You gain something in a teaching/learning interaction but you can also lose something else.

For example, the nature of the Internet is such that we may be losing our ability to read in depth. We are no longer reading per se, we are browsing. We tend to let new information be replaced by newer information rather than dive deeper into the information and try to understand it.

As an educator, if I do not want my students to lose the ability to read deeply and analyse deeply, I will have to structure my learning and teaching interactions to provide for that.

Q: What is the role of the teacher in this new learning environment?

A: We've been talking about how the teacher needs to move from being a deliverer of knowledge to a facilitator of learning for years, even before IT became the rage. It has become even more important because the environment is upon us.

One characteristic of the technology environment is that people are getting increasingly more connected. Kids are connected to sources of information beyond what the teacher can offer, and the teacher may not be able to have full control of the learning outcomes.

The irony is that we can become increasingly disconnected in the connected environment. Because if I tend to be connected to like-minded people, I can potentially be very siloed in my worldview. This means that it is important to structure the teaching/learning interactions to provide a good balance of exposure, so that students get a balance of perspectives.

As educators, we need to rethink not just the role—the role is quite clear—but within the role, what exactly do I need to do?

Q: Personally, what would you like to see in terms of teaching and learning in this new environment?

A: I would say a fundamental rethink about what education means in today's context is important. Because underlying all these are important questions regarding the nature of education—questions regarding the kind of skills and curriculum we need to design, and recognizing that talent is more diverse than academic skills.

We have both the formal learning spaces as well as informal spaces, but the connection between the two needs to be carefully thought through because we could be in danger of the two being disconnected. When it comes to learning for an individual, there may be three layers.

One layer is the *fundamental skill sets*. These skill sets should enable the kids to engage in learning. To me, that includes having English, having Mathematics and having digital literacy. I need the language capability to engage. I need the mathematical capability, not just about counting but the kind of logical thinking that the subject matter brings into the equation. I need digital literacy so that I am able to negotiate the environment I'm in—to search, to analyse, to participate in the environment.

My next layer of skills is career-defining, and will have to take into account a broader definition of talent, to include things that are academic and non-academic. For the first layer, a formal school structure can deliver very well. The second layer may be a combination of a formal structure and informal structure, including some practice element. Once I have my fundamental skill set, the second layer helps to define my career and my ability to engage in the economy.

The third layer is my *continuing education*, whereby I want to be able to continue to learn, to have the platform to learn, and also to have the opportunity to be connected. That layer is most likely delivered through the informal platform.

I'm simply laying down what I would like to see for future education. You'll notice that learning within all these three layers would need to be mediated, and I would imagine it to be mediated very strongly by technology.

Learning Chinese Idioms on the Move

Like many other subjects, language learning is heading down the path of creating authentic learning experiences. This encompasses the idea of bridging in-class and out-of-class learning, connecting formal and social learning. Now, with the widespread use of smartphones, learning can be on the go.

Utilizing mobile phones is one way to enhance pupils' interest in learning the Chinese language. A school-based research study called *Move, Idioms!* was conducted with this outcome in mind.

Move, Idioms! is a learning model initiated by Assistant Professor Wong Lung Hsiang from the Learning Sciences Lab at NIE, in collaboration with the Singapore Centre for Chinese Language. It is an idea that has been greeted with enthusiasm and excitement by pupils.

Making Language Learning Seamless

Lung Hsiang. and his research team wanted to make Chinese learning as mobile and seamless as possible. They saw the potential of mobile phone in capturing images, surfing the Internet, sharing information—all with a single device—as an answer to mobile-assisted language learning.

"We are trying to facilitate students' learning across different contexts," he explains. "We want students to learn anytime and anywhere, which is why we are making use of mobile technology in a one-to-one setting to assist our students' Chinese learning."

Piloted at Nan Chiau Primary School, pupils were each given a smartphone for access 24/7 throughout the 9-week period of the study. They were taught to treat their phones as both a fun lifestyle gadget and a learning device.

Deep Learning of Chinese Idioms

From the study, not only were pupils seen to be more communicative, they were also able to associate what they had learned in the classroom with their daily lives. This implied success in contextualizing their learning of specific Chinese idioms.

But that is not all. "They also need to de-contextualize their learning through generalization," adds Lung Hsiang. "They need to look at how other pupils use certain idioms and determine whether the idioms are used correctly in that context."

The sharing of photos and sentences, as well as the constant revision and interaction, has encouraged deep learning of the idioms.

Article highlights

How can language learning be made more seaml ess?
- Why should technology be integrated into language learning?
- How can mobile phones be used to aid the learning of Chinese idioms?

> We want students to learn anytime and anywhere, which is why we are making use of mobile technology.
>
> - Wong Lung Hsiang,
> *Learning Sciences Lab*

Learn Chinese In and Out of Class

Activity 1: In-class contextual learning
Pupils are shown animations featuring modern fables that illustrate the meaning and usage of the Chinese idioms. The context in which these idioms can be used is discussed in class, giving pupils the basic idea and knowledge of the idioms.

Activity 2: Out-of-class exploratory learning
Pupils are then asked to associate the idioms they have learned with real life. Using the smartphones, they are tasked to capture relevant images or scenarios found in their daily lives to give the idioms a context. Following this, pupils write sentences using the idioms they have learned to describe the photos and post them on a class Wiki space.

Activity 3: Out-of-class online peer learning
Pupils are asked to conduct peer reviews on the Wiki space by commenting on, correcting or improving their peers' sentences. Here, pupils get to learn *from* their peers as they are able to either learn from better sentences or identify and correct their classmates' errors.

Activity 4: In-class consolidation
To further consolidate their learning, pupils can be engaged in discussions as a class or in small groups. These activities provide opportunities for them to learn *with* their peers.

Wong Lung Hsiang is Assistant Professor and the Principal Investigator of *Move, Idioms!*, a research study aimed at promoting a mobile-assisted learning enviornment. The project is in collaboration with the Singapore Centre for Chinese Language and Lu Feng Technology in Taiwan.

Capturing Interest in Chinese Learning

Lung Hsiang emphasized that his project is more than just learning Chinese idioms. He notes, "Taking pictures while learning has increased pupils' interest and attention in Chinese learning."

With the presence of smartphones 24/7, pupils' motivation to learn is seen to extend outside of school. The variations of photos and sentences reflect pupils' greater attention to their surroundings and show conscious attempts to associate their daily experiences with the idioms.

"Pictures are not just a creative, productive tool, but it is also connective. Being able to see the pictures at another time can elicit other different thoughts in a pupil."

Looking Forward to Learning

Mobile technology has provided pupils with a holistic language learning experience, making learning seamless between the physical world and cyberspace. Such a seamless language learning experience is in line with the vision of MOE's ICT Masterplan 3 of promoting self-directed learning and collaboration learning among the pupils.

Lung Hsiang and his team hope to increase the consistency of Chinese learning by developing a technical platform with both technology-driven and pedagogy-driven goals. To meet these goals, the first step is to integrate technology-enhanced learning into the formal school curriculum. Our tech-savvy pupils will definitely look forward to this.

ScienceED

Let's Talk More about Science

In science learning, we have to seize every opportunity to let our students discover and make meaning of scientific concepts collaboratively. Learning science is now made easier with the increasing opportunities for social interaction offered by modern technology.

The advent of technology brings about many possibilities for us to facilitate collaborative science learning environments. *Computer-supported collaborative learning* (CSCL) technology is one promising way to support the process of collaborative investigative discussion.

A Knowledge-building Science Community

Associate Professor Tan Seng Chee, Head of the Learning Sciences and Technologies Academic Group at NIE, believes a knowledge-building community is fundamental to achieving meaningful science learning. He has been actively involved in the application of CSCL tools to support knowledge building in science classrooms.

Comparing this to a community of scientists, Seng Chee notes that there are two key objectives of such communities. The first is to develop the habit of inquiry among its participants.

"In other words, we want to motivate our students to ask questions in their attempt to understand the things around them, find out more information to answer their questions, and discuss their understanding with peers," he explains.

The second goal is to create opportunities for epistemic discussions. "What I mean is the ability to engage in meaning making, in assessing the value of an idea, in combining ideas to synthesize better explanations. This is different from social chats or searching the Internet for answers to merely complete a worksheet."

A Knowledge-building Pedagogy

To create a knowledge-building community for science students, Seng Chee uses an asynchronous online discussion forum called *Knowledge Forum*.

Article highlights

- Why are student discussions important for science learning?
- How can computers support collaborative learning in science?
- What roles do teachers play in a technology-supported science classroom?

"It is a forum specifically developed to support knowledge-building pedagogy, which focuses on getting students to discuss and deepen their understanding about a particular science phenomenon."

Science laboratory activities act as a trigger for students to build their knowledge online. For example, for the topic on "energy", students are asked to light a candle with a spiral hanging above the candle which spins as the candle is lit.

The teacher then spends time pulling knowledge together with the students before asking them to go online to illustrate their ideas and observations with graphics. To make sure students stay on track with their learning, teachers provide scaffolds to guide them.

Using *Knowledge Forum*, the students' inputs are made visible to their classmates. The online interactions help deepen their understanding of the science topics.

Why Do We Need a Discussion Forum?

Seng Chee admits that the use of such a forum raises questions like: "Why do we need to use a discussion forum? Why can't students just meet and discuss?"

In response, he says that technology acts not just as a platform for discussion. "In posting a note in a discussion forum, it requires students to articulate their thoughts in the form of text or diagrams. By doing so, their ideas are 'captured'."

"We have tried the process without using *Knowledge Forum*, by asking students to post their ideas using post-it pads. We soon ran into the issue of where to keep the post-it notes so that there is a continuity of discussion between lessons," Seng Chee says.

The *Knowledge Forum* also highlights the value in meaning making through both classroom talk and online discussions.

"Our research introduces a pedagogy that engages students in collaborative meaning making and idea improvement. At the same time, we also develop their motivation and knowledge-building activity to pursue deep understanding of a topic," he explains.

Pivotal Role of Science Teachers

Even though technology can easily enhance both the learning and teaching processes, it is crucial not to overlook the role played by teachers.

As the culture of Internet chats and mobile messages is so deeply entrenched in students, the scaffolds provided by teachers on the online forum greatly reduce the tendency of students to engage in social chats.

To fully leverage the affordances of technology, teachers must first possess sufficient in-depth knowledge about a topic, know how students can learn that topic, and understand how technology and teachers themselves can further support students' learning process.

Seng Chee's research has found that the type of inquiry tasks set by a teacher could influence students' questioning behaviours in an online forum.

"Since questioning is an important part of inquiry, teachers could use the findings from the research to guide them in the designing of inquiry tasks so as to maximize the possibility of achieving intended learning outcomes."

Talking Science with Technology

CSCL enables students to engage in collaborative work and discussion while providing a record of the development of ideas. "Our experience underscores a few important roles of technology—to capture students' ideas, to make the ideas public, and to allow the students to improve on the ideas and organize them," says Seng Chee.

"Another important element lies in evaluation," he adds, referring to the need to assess the learning process. "As a teacher, I must know how my students learn and whether they are learning well. To do that, I need to identify the relevant indicators about the learning process. Listening to student talk is important; it reveals a lot about their thinking and learning."

With a little help from technology, science students can build their scientific understanding and investigative skills through active inquiry, both on their own as well as with their friends and teachers.
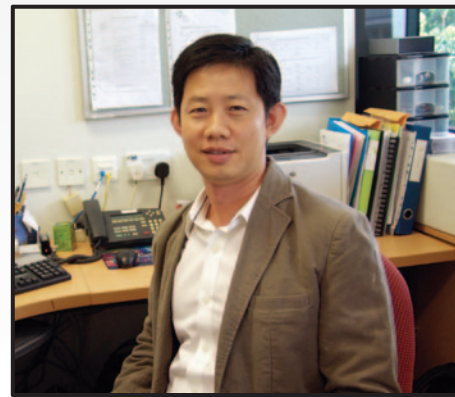
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> - Tan Seng Chee,
> *Learning Sciences and Technologies Academic Group*

Tan Seng Chee is Associate Professor and Head of the Learning Sciences and Technologies Academic Group at NIE. He also holds a concurrent appointment as Assistant Director in the Educational Technology Division at MOE. Seng Chee is the Principal Investigator of the research project "Fostering Scientific Inquiry through Computer-supported Collaborative Learning (CSCL)".

Transforming Math Lessons with New Technology

Traditional math classrooms typically see students quietly working hard at solving problems as the teacher makes her rounds to check that they are on task. What happens when we do away with the problem solving and start with the solutions instead?

Technology is part and parcel of the daily school life for students at the School of Science and Technology (SST). But it isn't just the technology that is transforming the way they learn.

A team from NIE's Learning Sciences Lab (LSL), led by Research Scientist Sarah Davis, has been exploring how we can foster critical thinking and deep understanding of math concepts with the support of highly collaborative technologies.

They are particularly interested in seeing how interactions between the teacher and students change with the use of new technology.

"What we are focusing on are the types of activities that teachers can leverage to improve students' talk and dialogue, communication and critical thinking, and what the classrooms will start to look like when technologies are being used," says Sarah.

Dynamic Math Learning

Sarah has introduced the use of a program called *NetLogo* for teaching Math at SST. The use of *NetLogo* enables teachers to transform Math classes into dynamic learning platforms through networked classroom activities.

The software is currently being applied to graphing type activities. It also has the ability to produce real-time synchronous feedback and interactions between teachers and their students.

With *NetLogo*, students can now generate their own graphs with ease and produce immediate visual representations. It has simplified the process of computation, and allowed students to focus on the mathematical explanations behind the calculation.

Changing Classroom Culture

While still in its pilot phase, the math teachers at SST are already seeing how technology can change classroom interactions. One of the most significant changes is a shift in the classroom culture.

Jason Ingham, Subject Head of Mathematics, has noticed that his students now ask more questions—and he is glad for this.
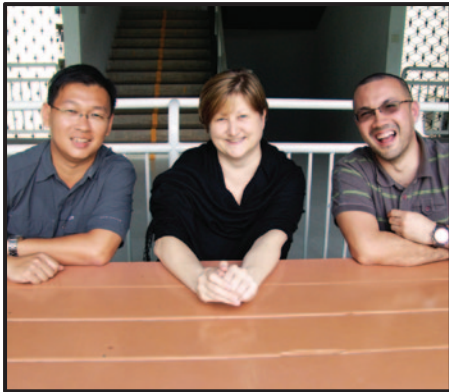
"I have yet to go into a classroom without any questions raised. A lot of time is spent on discussing math concepts and reinforcing one another. Students get to reinforce their understanding of math concepts by spending time talking about it," notes Jason.

Fellow math teacher Edmund Ng has also observed this in his classes. He notes that the quality of the interactions among the students has heightened.

"Often, in a conventional classroom, you will find it very difficult to engage your students in interactions because of the classroom size and the amount of control you want to exert over the class," explains Edmund. "Using the network tools and activities, you could have simultaneous interactions at the same time."

Changing Learning Habits

Such a shift in classroom culture has been possible because the use of technology drastically cuts down on the time needed for tedious and repetitive work. This includes plotting graphs and drawing representations, which Jason describes as procedural.

> **I have yet to go into a classroom without any questions raised.**
>
> - Jason Ingham,
> *Subject Head of Mathematics,*
> *School of Science and Technolgy*

"The emphasis of the lesson can now be on the analysis of the graph rather than plotting it so a lot more time will actually be spent on looking at the conceptual aspect of things rather than the repetitive work of getting the graph right," says Edmund. "So technology really helps with this."

And because students have more time to explore, experiment and learn by themselves, they are able to pick up concepts by themselves. Jason notes, "Technology helps my students and me to look at math concepts from the high level first before moving down to the details."

Learning with Purpose

In addition to saving on time and gaining on understanding, Edmund says students need to find purpose in their learning, where they can relate math learning to the real world. Today's technology makes it easy to bring up practical examples to interest and excite the students.

Technology can also be extremely powerful in improving students' math learning because of the sense of ownership students have over their work.

"To them, this is something that they have created rather than forced on by their teachers. They see a purpose in using the product that they have created," explains Edmund. "This part is important for them to really progress in their learning."

New Pedagogy for New Technology?

Math lessons have never been so exciting. Technology offers choices for content and pedagogy never experienced before. But while software like *NetLogo* allows us to save a lot of precious lesson time, offering more opportunities for spontaneous conversations and activities, we have to remember it is also just a tool.

Sarah says that the key to improving learning in a math classroom still boils down to the pedagogy, how teachers orchestrate their classes, and the types of questions they ask their students.

"Technology is more like a scaffolding and directing tool," says Jason. "You can introduce ICT into your math lessons but you can also do it didactically, so it is down to the questioning techniques. Are the teachers able to know what to ask? When and how to ask questions in a way that scaffolds learning?"

So while the technology may be new, the goal of learning really hasn't changed. Students need to feel that they can ask any question with no shame, say Jason and Edmund—technology has only helped to make this a little easier.

> **The key to improving learning in a math classroom still boils down to the pedagogy, how teachers orchestrate their classes, and the types of questions they ask their students.**
>
> - Sarah Davis,
> *Learning Sciences Lab*

The research featured here is part of the GenSing project led by Sarah Davis, a Research Scientist with the Learning Sciences Lab at NIE. The project seeks to broaden curricular activities, applications and classroom management tools in the Singaporean school system, affording powerful methods for teachers to enhance math understanding.

TeacherED

Supporting Teachers in the New Learning Environment

How does changing an environment influence teaching practices and learning opportunities? Ngee Ann Secondary School shows us what happens when every effort is made to build a technologically supportive school environment.

Classrooms at Ngee Ann Secondary School (NASS) are every technology-forward teacher's dream. White walls transform into interactive whiteboards. Classroom lessons may be viewed from multiple angles on a single console. And every innovative idea is given careful consideration and strong technological support.

These are just a few things that help to transform the learning and teaching environment at NASS. Principal Adrian Lim believes that reconfiguring students' learning space is as important as changing teachers' instruction and pedagogy.

"The infrastructure and environment also have an effect in translating research," explains Mr Lim. "The environment affects teachers' ways of teaching and will also influence teachers to perform to a higher standard and rise to the occasion."

Article highlights

- What does the physical environment have to do with teaching and learning?
- How can teachers be supported in the use of technology for teaching?
- How can technology support teachers' own learning?

Learning Differently in the Virtual World

According to Mr Steven Wong, Head of ICT at NASS, blending ICT into the learning environment allows both students and teachers to have a deeper learning experience.

"We still support traditional learning as we want a balanced education," says Mr Wong. "Technology actually gives students and teachers a different taste of learning—a more holistic type of learning. They can do more in the virtual world and thus expand beyond the linear way of thinking."

In fact, virtual learning is taken so seriously that the school has bought an "island" on Second Life, a virtual world where residents can interact as they do in real life. This was first used for Art but has since been extended to Civic and Moral Education (CME) and Physical Education.

"We came up with a super hero game-based learning environment for CME which draws on scenario-based learning. Students will role-play in the virtual world, where they have to deal with legal and moral issues," explains Mr Wong.

Offering Support for Innovative Ideas

"We always advocate a pedagogy that will lead the technology," says School Staff Developer Mrs Theresa Lai. "Technology facilitates our pedagogical approaches."

Teachers can bounce their ideas off teachers in an ICT Think Tank team, comprising teachers from each department who are more IT savvy. Alternatively, they also have the option of approaching the resident ICT trainer, a technology expert hired by the school to provide guidance to teachers.

"Whenever teachers have an idea, we don't turn them away. Rather we ask them how they could share this idea with other teachers to promote teaching and learning," says Mr Wong. "A lot of ideas are shared during meetings, and every time an idea is raised, we try to build on it and find out whether there is any value-add in these ideas. Many times, we have cross-breeding of ideas."

As a result of such strong support, NASS teachers are very open and forthcoming with innovative ideas. Adds Mrs Lai, "When you see other teachers get involved in technology-supported lessons, you get inspired. And the beauty of it all is you don't work alone as there is always support. This kind of collaboration is very effective."

## Building a Collaborative School Community

Of course, technology is also used to promote staff development. The school has harnessed the use of Web-based applications to develop a collaborative school community.

As part of their professional development, every teacher in the school belongs to a Professional Learning Team, which together make up the school's professional learning community (PLC). And each week, teachers will share their reflections in response to a question posed by Mrs Lai.

Aside from fortnightly face-to-face sessions, NASS uses Microsoft's Live@Edu for their PLC sessions. This blended approach to implementing a PLC not only allows a teacher to log in anytime, anywhere, the most powerful rationale behind this is that it gives every teacher "equal air time" and "every voice is heard".

"For face-to-face PLC, it might be difficult for everyone to contribute as the session only lasts for an hour. With the online PLT, Mrs Lai can get feedback from teachers who are very quiet but have very good reflections," notes Mr Wong.

For NASS, the road to teaching excellence begins with providing constant support for teachers and their ideas. Building a school culture that promotes creative and innovative use of space and technology is not an easy feat but NASS has shown that small steps can result in huge gains for learning.
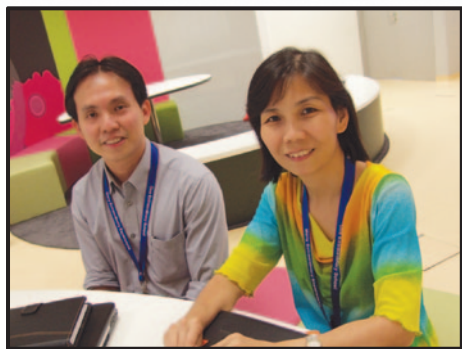
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- Steven Wong,
Head of ICT,
Ngee Ann Secondary School

NASS is a Microsoft "Mentor School", the highest level of recognition given by Microsoft to schools. It has also recently joined the ranks of FutureSchools in Singapore.