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reined

research in education at the National Institute of Education, Singapore

pedagogies

contents

Editorial

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PEDAGOGICAL RESEARCH is at the heart of research at NIE, particularly pedagogies that would develop 21st century skills and literacies. With such goals in mind, researchers in this issue delve into the sciences of learning that would bring about changes in classroom learning and teaching experiences. They challenge the status quo, create new learning technologies, and experiment with "bottom–up" pedagogies with a focus on students' activeness in learning.

In this second issue of **ReEd**, we would like to share some of our research efforts towards this end. Manu Kapur challenges the concept of failure and argues that "failure" to attain the canonical solution does not necessarily lead to failure in learning, if we can make the learning process productive.

Looi Chee Kit argues that "noise" in the classroom is not necessarily unproductive. Using a software called *Group Scribbles*, his research team has enabled students to share ideas in the classroom instantly. Students and teachers can then make use of those ideas to further construct knowledge.

Kate Bielaczyc challenges the traditional conceptions of "teaching" Science. Her research demontrates that students can learn by themselves, if we value their "Ideas First" and give them an opportunity to be engaged in scientific thinking. Likewise, Foong See Kit has developed materials for "Physics by Inquiry" to enable students to learn via a discovery process.

Other NIE researchers have used learning technologies that can change the landscape of the classroom. For example, Sarah Davis' *NetLogo* allows teachers to engage students in more interactive classroom discussions, and to record and organize the classroom discourse with the view to generating more knowledge.

Kenneth Lim has tapped into the *Second Life* virtual environment as an exploration space for Geography students to experience authentic learning. These virtual environments enable students not only to learn *about* Geography, they *do* Geography. They get to experiment with tasks such as constructing river basins in actual scale in a 3D space.

Wong Lung Hsiang's *MyCLOUD* allows students to learn Chinese vocabulary, using mobile technology to bridge formal and informal settings. Students can construct and apply idioms whenever they find opportune situations for real-life usage of the language.

More generally, the knowledge construction process requires the ability to articulate tacit understandings into knowledge. This can be done through formal and informal learning. It is thus important to bridge between the two. To this end, David Hung is investigating how to form anchored experiences through informal learning such as CCAs and create bridges to the formal.

The excitement over these projects shows our efforts to bring about "bottom–up" pedagogies—student-led, discovery-based, collaborative and self-directed learning—to facilitate an engaging classroom where knowledge construction can take place. ■

EDITORIAL TEAM

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Re Productive Failure in Math

PROJECT TEAM

Principal Investigator Manu Kapur, *National Institute of Education, Singapore*
Co-Principal Investigator Ng Yew Hong, *St. Joseph's Institution, Singapore*

"FAIL EARLY and fail often" is something that Dr Manu Kapur believes in when designing opportunities for students to generate solutions to complex, novel problems *before* teaching them the concepts required to solve those problems. They may not get the "right" answer at first, but this floundering can pave the way to deeper learning.

Productive Failure Manu coined the phrase *productive failure* to refer to a pedagogical approach where students get to generate, explore and refine their own solutions to complex and ill-structured math problems before they are taught how to do so.

"We know they would not be able to magically come up with the canonical or standard textbook solution because obviously they've not learned it yet," says Manu. But this process of generating and testing out their own solutions helps them to develop critical 21st century skills.

"One thing we know about learning is that the more you integrate it into prior knowledge, the better it is and the deeper the understanding," he explains. So instead of assuming students know nothing about a new concept, we should tap into their existing knowledge, be it formal or informal.

Affective Support Generating solutions to complex, novel problems can be frustrating, so students often still look to teachers for support. "We leave students to their own devices but provide them with a proper set of expectations—we call it *affective support*."

Manu believes students can learn better through productive failure.

Manu elaborates: "We tell the students: 'We're not interested in you providing *the* correct answer.' We keep pushing them; we keep reminding them that it's OK to generate different ideas. Some of these won't work but it's OK because we are looking more at generating more ideas and improving them."

The teacher's role is to keep reinforcing these expectations and urge students to test their solutions out in different conditions.

Closing Learning Gaps The results of Manu's research have been very encouraging. The students subsequently did better for both structured and higher-order problems than those taught by direct instruction.

Even more interesting: "If you take students who are very far apart in their Primary School Leaving Examination scores and look at their ability to generate solutions to novel problems, we find that they're not as far apart in the ability to design solutions. In fact for some cases, there were no significant differences at all."

Effortful Teaching and Learning Teaching students the solution is straightforward, but getting them to generate and improve on their ideas, and then seeing how all these connect to each other is a different game altogether—especially for the teacher.

Strong subject expertise is key, and teachers will find themselves becoming learners along the way. Some teachers say they understand the concepts better now than when they first learned them at university, so "it's not just students who're learning better mathematics, but teachers, too."

Teaching and learning have always been "effortful" work, says Manu, and productive failure makes it even more so. But in exchange, we achieve deeper learning by building on what students already know. As he sees it, "You spend more time but you also gain more." ■

Networking in the Classroom

Re

PROJECT TEAM

Principal Investigator Sarah M. Davis, *National Institute of Education, Singapore*

AT THE School of Science and Technology (SST), we have a glimpse of the future of education. Every student has their own computer and every classroom is networked.

For Dr Sarah Davis, a faculty researcher at NIE's Learning Sciences Lab, this is the perfect environment to study how the use of classroom network technology can impact student–teacher interactions.

"When people hear about network, they assume it's the Internet, but this is different," explains Sarah. "It actually allows collaboration and data within the classroom."

Synchronous Learning The advantage of a networked learning environment is that it allows real-time synchronous feedback and interaction between the teacher and students.

Using a network software like *NetLogo*, for example, teachers can find out what students know or don't know at any point in the lesson. This is currently being trialled in SST Math classrooms.

The teacher asks a quick question verbally and students type the answers into their own computers. The teacher can see all student responses at once—how many were right or how many gave a particular answer.

This data can also be displayed for the whole class to see. "In real time, everyone gets asked a question, everyone answers, and a histogram will be exhibited for all to see," Sarah explains.

It allows both teachers and students to receive instant feedback. This also gives teachers a quick snapshot of the difficulties students are facing and they can address them immediately.

A Learning Revolution Sarah is particularly interested in what happens in a classroom that uses network technology.

"What we are focusing on is the types of communication that get fostered by the group display and what teachers can do to leverage it to improve students' talk, dialogues, communications and critical thinking," says Sarah.

There is already a pool of research that shows how classroom network systems can change classroom interactions. There is greater student engagement and understanding, class discussion and interactivity, as well as reflective and critical thinking. "The technology lets students look at things that are impossible to do it on a pen-and-paper level," says Sarah.

A Learning Network While there is evidence of gains in learning, Sarah emphasizes that the technology is only a tool. She describes the role of the teacher as "hugely vital".

"Just using *NetLogo* is not going to improve your classroom tremendously. It is the pedagogy; it is the questioning," she stresses. "The important thing is how teachers are orchestrating the classroom and the types of questions they ask."

She adds, "With network activities, you either need to have an exhaustive knowledge or the willingness to say, 'I don't know'. It is the kids who are creating things, and as a teacher, you don't have control over what is coming in."

For Sarah, it has been exciting to see the different activities that have been done and the interactions that are taking place in the classroom. This is a picture she seeks to share with other teachers.

"Teachers can look at that and say, 'My class has that and I am not using that software,' or 'I would like to start seeing that in my classroom and maybe these network activities are a way to foster that.'"

It's not about the technology—it's the teacher. ■

Sarah, with SST Math teachers Edmund and Jason.

Ed When Kids' Ideas Come First

PROJECT TEAM

Principal Investigator Katerine Bielaczyc, *National Institute of Education, Singapore*
Collaborator John Ow, *Innova Primary School, Singapore*

A SMALL revolution has been taking place in a little corner of Ang Mo Kio. For the past 6 years, teachers at Townsville Primary School have been experimenting with a whole new way of teaching and learning Science.

Science classrooms here are run on the same principles as a scientific community. The Primary 3 and 4 Science curriculum has been completely redesigned into a coherent 2-year programme to enable this.

Katerine Bielaczyc, Deputy Head of the Learning Sciences Lab, has been working with the school on a project called "Ideas First". The goal of this pedagogical approach is to enable pupils to build knowledge on their own, just as real-world scientists would.

"The focus is on creating classrooms that work similar to Science communities," she says.

Diverging from Convention As they embark on each new topic, these 9- and 10-year-old "scientists" are presented with a problem. They engage in an extended investigation of the problem—looking for evidence, doing library research, making field notes, carrying out experiments—working both individually and collaboratively.

"The idea is that the students work as a whole class on problems of understanding in Science, and the strategies that they use for advancing their understanding are very similar to what scientists use."

"It's a very different pedagogy," says Kate. "You need a sense of possibilities and how to encourage and to see how to advance knowledge."

Converging on Learning In practical terms, this means that a teacher might be faced with up to 40 different ideas in response to the problem to start with. What was found, however, has surprised both teachers and researchers.

"It turns out that when kids work on problems, even though initially there might be a great divergence, the evidence converges on the same things as it does for an adult, if you were to follow the way that the Science discipline works with ideas and works to advance understanding."

Kate is thrilled about the future of education.

In this community of knowledge-builders, the classroom culture is very different. The kids are engaged and they understand that they can play an active role.

"The research shows that if you engage kids in meaning-making discourse, this leads to deeper understanding and a more flexible understanding as well as a deeper sense of how and what counts as evidence in Science."

Advancing Knowledge "What we are witnessing at Townsville Primary is really a model for the future of education," says Kate. "Ideas First is really about systemic change and fostering a brand new culture."

It is a culture of empowerment—of the teachers as well as the teachers' belief in empowering their pupils. "We need to socialize children into a world where they are able to work creatively with knowledge," says Kate.

Kate attributes the success of this project to the teachers. "The teachers at the school are amazing. They have a deep belief in the possibilities of their children and the future of education here in Singapore."

"The teachers love what they see happening with the children," she adds. "That makes a difference." ■

PROJECT NUMBER R8019.735.PM07
START DATE Apr 2008 PROGRAMME 2

PROJECT TITLE
Spreading Ideas: Creating Point-at-able Models of 21st Century Education

PROJECT TITLE GroupScribbles: Flexible Collaboration for IWB Classrooms

PROJECT NUMBER NRF2007-IDM003-MOE-001 START DATE Sep 2007 PROGRAMME 2

Transforming Classroom Culture

PROJECT TEAM

Principal Investigator Looi Chee Kit, *National Institute of Education, Singapore*
Collaborators Chen Wenli, *National Institute of Education, Singapore*;
Jeremy Roschelle, *SRI International, USA*

IS THERE value in collaborative learning when students are ultimately assessed individually? Professor Looi Chee Kit and Dr Chen Wenli believe that there is.

"This project is about introducing collaborative practices in the classroom in a routine way," explains Chee Kit. "Classroom teaching is mostly teacher talk; we want to foster student-centred learning, so they learn how collaborate as well as learn more deeply about the subject."

Routine Collaboration Their research project hinges on the use of a software called *Group Scribbles* (GS). Pioneered in the United States, the software is simple to use, but its potential lies in its ability to empower collaborative learning.

Using GS, teachers can quickly transform classroom learning into a wide range of co-operative activities. Students make notes or sketches on their laptops. They then share their work with the whole class by moving their "scribbles" from the private to the public space. Once made public, ideas are critiqued and refined based on feedback from each other and the teacher.

They do this every week or two, until learning together becomes a regular classroom activity. "Cultural change is our ultimate goal," says Wenli. "We want to promote a culture of collaborative learning in the classroom."

Rapid Knowledge Building GS has been tested in both primary and secondary schools and found to be effective for all subjects. The technology promotes students' individual thinking as well as taps on the collective intelligence of the class.

Wenli points out, however, that this is not a software development project. The design of the software is informed by pedagogical principles, working in close collaboration with teachers.

Underlying the software design is what the team calls Rapid Collaborative Knowledge Building (RCKB). As the "scribbles" are instantaneously reflected once dragged into the public space, collective knowledge is very quickly generated. The small "scribble" space also means that their thoughts need to be clear and concise.

Every student can contribute to the discussion. But because their initial ideas are posted in their private space, they can be as bold as possible. And as the ideas are shared, they can choose to be as engaged in the discussion as they want to.

As a result of such "participatory engagement", students are more involved in learning and have more control over their learning.

Productive Noise The classroom is now abuzz as students engage in "productive interactions". "It's a joy to see the classroom transform into a buzz of activity, with a lot of productive noise," says Chee Kit.

"It's no longer a class where only the teacher talks, but where students are very engaged in their tasks, doing things together and learning. With easy access to student work on GS, the teacher can orchestrate teaching appropriately."

For Wenli, satisfaction comes from knowing that they've made a real difference. "It's not just in terms of number of publications, but we really impacted the school practice. We really helped the kids, and the teachers feel good about us. I think that's the most exciting part."

Wenli notes, "The schools we've worked with have continued their own journey even though we are no longer with them." It looks like GS has truly become a routine part of the classroom culture, as the research team had hoped. Adds Chee Kit, "We just started the journey for them." ■

Chee Kit and Wenli are excited about combining pedagogy with technology.

Ed Learning Physics by Inquiry

PROJECT TEAM

Principal Investigator Foong See Kit, *National Institute of Education, Singapore*
Collaborators Paul Lee, Darren Wong, Yau Che Ming, Lau Chor Yam, *National Institute of Education, Singapore*; Lillian C. McDermott, Alexander Yeung, *University of Western Sydney, Australia*; Peter S. Shaffer, *University of Washington, USA*

See Kit (third from left) and the Physics by Inquiry team.

MANY OF us might have this memory of school: How we would listen closely to follow the teacher's reasoning, wait for answers to rhetorical questions, and look forward to the occasional practical lesson where the teacher would carefully carry out an experiment while we watched intently.

That was the traditional model of teaching for much of the last century. A decade into the 21st century and the teaching of Science can no longer be confined to what researchers call "teacher talk"—where the teacher talks and the students listen.

Learning by Inquiry Professor Foong See Kit and his team have sought to redesign Physics instruction in schools to help students to develop a deep understanding of Physics concepts in a coherent manner through "Physics by Inquiry".

In this inquiry-based approach to Physics instruction, ideas are built upon each other in a logical progression through a series of hands-on experiments. For instance, in learning about buoyancy, students are first taken through the concepts of mass and volume, and finally the relationship of these concepts to density.

Through carefully sequenced activities, student ideas and pre-conceptions are first deliberately surfaced. Students are then guided to confront and resolve their learning difficulties through interaction with materials, data and their peers.

Facilitating Learning According to team member Darren Wong, the material is carefully designed to help students construct a common understanding. "By working in groups, they are able to discuss, manipulate the apparatus, collect data and form evidenced-based conclusions," he explains.

The role of the teacher in this process as a facilitator cannot be underestimated. By prompting students with appropriate questions, the teacher helps to guide students' discovery and, therefore, learning.

"Moreover, as students may embark on a variety of routes to achieve this end, the teacher needs to be well versed in the various lines of reasoning to guide them towards the intended outcome," says Darren.

Deep Learning The results thus far indicate that the students have been learning well. "They are not learning less than the traditional teaching group," notes See Kit. "In fact, from some preliminary results, there is an edge over the traditional teaching method."

Perhaps more telling is the change in the students' attitudes and reasoning process. The team observed that students have become more self-directed, proactive problem-solvers. They are more confident in handling equipment and conducting experiments in the science laboratory without an over-reliance on the teacher. They no longer ask the teacher for answers but ask instead to discuss their results.

Interest in Learning This manner of learning also seems to have increased students' interest in learning. The evidence suggests that interest, rather than competence, may have more lasting effects on students' learning in the long term.

"Through achieving the conceptual understanding in this way, and not just waiting for the teacher to tell them, we hope they will become more self-motivated learners in the longer term," explains See Kit.

He adds, "We hope that they will bring this kind of experience—of learning by themselves, through discussing with their peers in a group—with them into the future, into the workplace." ■

PROJECT TITLE PB1 @ School: A Large Scale Study on the Effect of "Physics by Inquiry" Pedagogy on Secondary One Students' Attitude and Aptitude in Science

PROJECT NUMBER OER 46/08 FSK
START DATE Apr 2009
PROGRAMME 4

Breathing a Second Life into Geography Teaching

Re

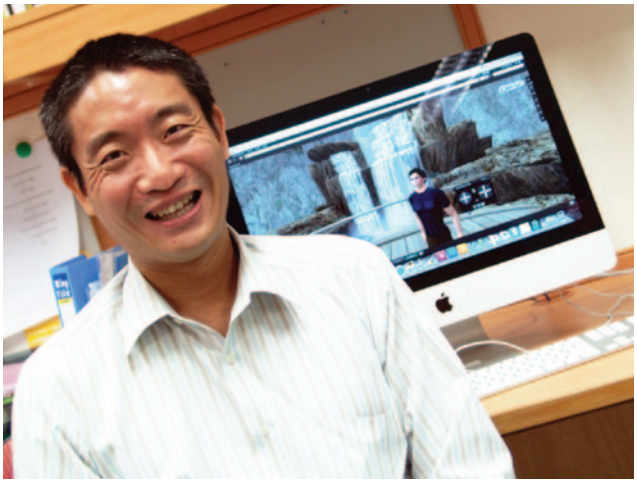
PROJECT TEAM

Principal Investigator Kenneth Lim, *National Institute of Education, Singapore*
Collaborators Hoe Kai Yee, Jimmy Seah, Kent Lo, *Ministry of Education, Singapore*

VERITAS RAYMAKER, a.k.a. Dr Kenneth Lim, was once a sceptic of *Second Life*. In fact, he had quickly dismissed it as a "glorified chat room" and closed his first account soon after creating it.

It wasn't long before Kenneth decided to give *Second Life* a second chance. Today, apart from his day job as Assistant Professor with NIE's Learning Sciences Lab, Kenneth is an active member of the *Second Life* community.

Kenneth has been exploring the affordances for learning offered by platforms such as *Second Life.* He believes the virtual environment has potential to breathe new life into classrooms.



Kenneth and his virtual persona behind him.

Virtual Possibilities For Geography lessons especially, the virtual environment promises to do away with the constraints of time, place and space—important considerations in the study of the Earth.

Students can get "up close" to landforms they could never have access to in real life. This is important for Geography teaching because Singapore's urban environment makes it difficult for students to relate to what's in the textbook, says Kenneth. "This is where the virtual environment comes in."

Working with the Ministry of Education, an archipelago of islands was acquired in *Second Life* as an exploration site for Geography students.

Using their avatars, students can learn by exploring through virtual field trips. They can walk through a river basin, for example, and take measurements and field notes, just as they would in a regular field trip.

Through the avatar, students also learn by doing. "Whatever happens to the avatar, the learner is taking it as if he himself is doing it," explains Kenneth, drawing on James Gee's concept of *projective identity*.

On the practical side, of course, there are fewer field trip logistics to worry about.

Developing Intuitions As with any other subject, the goal of learning is to develop an intuitive understanding of the subject domain.

One of the most powerful applications that lends itself to this is "terraforming". Students may be given a flat piece of terrain and asked to form a river basin. To do this, they need to apply their understanding of geographical concepts.

The virtual landscape becomes a "canvas" for representing students' "geographical intuitions" even as they develop. This also means that misconceptions in learning can be immediately surfaced—clearly evident in the resulting landforms that they create.

Real Gains in Learning While the environment may be virtual, the gains in learning are real. One of the most significant gains of the virtual environment is in collaborative learning.

"Because of the authenticity of the task, and because they're having fun, students are curious as to how their work compares to others. But more importantly, they don't mind having their work put on display for others to critique."

This significantly enhances learning because they are no longer afraid of making mistakes. "You can see other people also making mistakes and you can learn from each other."

Second Life has given a new lease of life to the teaching and learning of Geography. It seems the possibilities are virtually endless. ■

Ed Putting Language Learning in Their Hands

PROJECT TEAM

Principal Investigator Wong Lung Hsiang, *National Institute of Education, Singapore*
Collaborators Chai Ching Sing, Jan Ming-Fong, Rebekah Lim, Chin Chee Kuen, Chen Wenli, *National Institute of Education, Singapore*; May Liu, Hsieh Yu Fen, *Singapore Centre for Language Learning, Singapore*; Ivica Boticki, *University of Zagreb, Croatia*

CURIOSITY MAY have killed the proverbial cat, but it's a desirable trait when it comes to language learning. That's what a research team from NIE's Learning Science Lab believes, and they have plenty of evidence to prove it.

Bridging Learning Dr Wong Lung Hsiang believes that every context presents unique learning opportunities. His team leverages on the use of personal, portable networked technologies, which he believes will become more ubiquitous in the lives of learners.

"Ubiqitous" is the keyword here. His latest project to enhance Chinese language learning is called *MyCLOUD*—My Chinese Language ubiquitOUs learning Days. He wants pupils to be able to learn anytime, anywhere.

Says Lung Hsiang, "We want to promote language inquiry learning, where pupils who come across new vocabulary will be curious to find out what it means and to search for answers, either on the Internet or through discussions with friends and teachers."

Seamless Learning *MyCLOUD* actually builds on two earlier projects. Thus far, they have experimented with Class Wiki spaces and mobile phones at Nan Chiau Primary School.

However, Lung Hsiang maintains that it isn't about the technology per se—which is constantly evolving—but its potential for making learning seamless across different contexts.

"The basic idea is to bridge formal in-class learning and out-of-class informal learning as well as an infusion of social and personal learning," says Lung Hsiang. "We are trying to facilitate pupils' learning across different contexts."

Mobile technology enables them to do just that. It helps to bridge the formal and informal learning spaces, so that learning can take place in and out of class.

Authentic Learning To master a language, learning cannot be confined to the classroom. With the customized software, language learning takes place in the most natural way—through constant usage in daily life.

For example, in an earlier research project, Lung Hsiang found that with the aid of mobile technology, pupils quickly progressed from learning individual idioms, to making meaningful associations, then to forming complete sentences.

The research has shown that this use of technology is effective in enabling pupils to make meaning of their own learning and share it with their peers. Of course, it helps that language learning is now a lot more fun.

They have successfully developed a school-based language curriculum using this seamless language learning approach, and are working to integrate this approach to vocabulary learning into the formal Chinese curriculum for Primary 3 to 5.

"We are interested in a pedagogy for the future. We need a change in the curriculum structure so as to integrate technology-enhanced learning." ■

Lung Hsiang wants to put learning in the hands of pupils.

PROJECT TITLE MyCLOUD – A Seamless Chinese Language Learning Environment Leveraging on Ubiquitous Technology and the Construction of Mental Lexicon

PROJECT NUMBER OER 17/10 WLH
START DATE Jun 2011 PROGRAMME 2

Bridging Formal and Informal Learning

PROJECT TEAM

Principal Investigator David Hung, *National Institute of Education, Singapore*
Co-Principal Investigators Kenneth Lim, Kim Misong, *National Institute of Education, Singapore*

EVERY WEEK, Professor David Hung accompanies teenaged students to the bowling alley. After each game, they put their heads together to analyse it.

They reflect on what worked, what didn't, and what can be done better in the next game. In the process, the students learn strategies for success that will, hopefully, carry over into their academic learning.

This same belief undergirds a research project on bridging informal learning in co-curricular activities (CCAs) and formal learning in classrooms.

"We're using the unstructured bottom–up learning of children in the 'messiness' of their CCAs, and from these activities help them frame their learning opportunities," says David.

Informal Learning Because the informal setting naturally lends itself to learning through trial-and-error and experimentation, it is potentially rich in experiences of good learning.

The problem is that many students don't see these experiences in the informal context, like in sports, as learning.

"In their CCAs, students are responsible towards other people, they experiment on what they do, they reflect on what they do. But they don't realize that this is learning," says David. "To them, learning is what happens in the classroom."

"So we make them reflect upon their learning. We make it explicit and make them realize that this is actually learning."

David with Research Fellows Imran and Shu Shing believe in learning from life experiences.

Rich Learning The research team contends that if students can anchor their learning in these experiences outside the classroom, they can then "transfer" these *anchored learning* experiences to the classroom context.

"These learning opportunities are very rich in their contextual fullness," notes David. "They are so full in their authenticity—in emotions, in success and failure, in community and individual dialectics."

"In formal academic situations where they may be weak in, or are clueless as to how to improve on their performance, they can compare what they had in previous experiences and what they now experience, and use the rich anchors that were established earlier as frames of reference."

Learning among Peers Working with a primary school over the past year, the research team has been teaching the kids how they can think about what they do and to construct their own strategies—winning strategies to overcome the weaknesses that they themselves identify.

This approach to learning is entirely bottom–up. Students rely on peers to critique each other, not on the teacher. "We teach them strategies to draw from their previous experiences and re-contextualize these strategies in the new contexts," adds David.

"Once they know the methodology, we transfer that methodology over to the formal context. Then, instead of telling them the strategies, they construct their own strategies to overcome their weaknesses."

Learning for Life David and his team suggest that we can think of a student's learning trajectory in terms of the number of such anchored experiences: "When a student has a repertoire of anchored experiences, these become usable and transferable."

"Because they had these in the other contexts, they similarly might know how to re-formulate these strategies in the new context, to stage themselves and restage themselves towards improving goals," he adds.

In the end, he surmises, "That's how we learn in life!" ■

Ed Research Highlights

CONGRATULATIONS TO our NIE colleagues whose research projects were approved for funding in the 5th Request for Proposals by the Office of Education Research.

Project No.	Project Title	Principal Investigator	Programme
OER 12/10 KHL	Understanding and Profiling Teachers' Technological Pedagogical Content Knowledge (TPACK) Development Patterns	Joyce Koh	1
OER 13/10 LYT	The Development of a Framework for the Effective Translation of Educational Research into Sustained Practice in Singapore	Kenneth Lim	5
OER 14/10 JYL	Students' Academic and Non-academic Outcomes: An International Perspective from PISA 2009 Study	Jihyun Lee	5
OER 15/10 HLC	Singapore Teachers' Perspectives of Diversity and Multicultural Education	Ho Li-Ching	1
OER 16/10 LCK	Design for Scalability: From a Class Intervention to a Level Intervention	Looi Chee Kit	2
OER 17/10 WLH	MyCLOUD – A Seamless Chinese Language Learning Environment Leveraging on Ubiquitous Technology and the Construction of Mental Lexicon	Wong Lung Hsiang	2
OER 18/10 KB	STEP* for the Future: Investigating Pedagogical Change in New Approaches to Learning and Teaching in Math and Science	Katerine Bielaczyc	2
OER 19/10 LWO	Citizenship Attributes for the 21st Century: A Study of Singapore Teachers' Perceptions in Comparative Perspectives	Lee Wing On	4
OER 20/10 TAL	Partnership for Change Towards Science as Inquiry in Elementary Science Classrooms: Collective Responsibility of Teachers and Students	Tan Aik Ling	4
OER 21/10 GLB	Building a Singapore Learner Corpus of English Writing for Pedagogy	Guo Libo	4
OER 22/10 MC	Hydration and Fluid Replacement Knowledge, Attitudes and Behaviours in Heat-Acclimatized Singaporean Youths	Michael Chia	4
OER 23/10 DH	Study of Developing a Framework for Understanding Relationships Between Formal (Schools) and Informal (Communities) Learning Environments	David Hung	5
OER 24/10 ZDB	Morphology in Biliteracy Acquisition: An Intervention Study	Zhang Dongbo	5
OER 25/10 LYJ	The Work that Teachers Do	Lee Yew Jin	1

The full list of approved projects is available on the NIE website (www.nie.edu.sg) under *Research@NIE.*

Legend

Programme 1: Teacher Learning
Programme 2: Technology in Formal and Informal Learning Environments
Programme 3: Leadership and Organizational Change
Programme 4: Pedagogy and Classroom Practice
Programme 5: Student Motivation, Cognition and Learning Outcomes

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