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LEARNING TOGETHER

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BREAKING THE LANGUAGE BARRIER IN SCIENCE

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LEARNING TOGETHER

Studies have shown that when teachers learn and inquire together, they become more effective and their students also perform better.

Article highlights

What are professional learning communities?
How can you create such a community in your school?

As early as the 1980s, researchers have been asking questions of how workplace settings affect employees' performance.

Rosenholtz (1989, cited in Hord, 1997), in an early research study on the co-relation between the work environment and teachers' performance, found that teachers who felt supported in their learning and classroom practice were more effective than those who did not.

Since then, several other researchers have found that performance can be improved through the practice of what has come to be known as *professional learning communities* (PLCs).

The concept of PLCs was highlighted by the Education Minister at the recent MOE Work Plan Seminar. Dr Ng Eng Hen spoke of the "need to build capacity for teachers themselves to take the lead in professional upgrading" (Ng, 2009).

What are PLCs and how can they be implemented in our schools?

What are PLCs?

The term "professional learning communities" is used to describe schools where the school administrators and teachers are committed to working as a team to enhance their effectiveness as professionals for their students' benefit. Together, they continually seek and share knowledge.

Creating a PLC in your school

It goes without saying that such a community cannot be cultivated overnight. Building a PLC in school requires a huge amount of dedication and commitment.

In fact, some teachers and school leaders might find the process difficult, even radical, because it requires them to rethink their roles and duties. It will necessitate a change in mindset and in practice.

Five characteristics of learning schools

When researchers studied five schools in the United States that had implemented PLCs, they found that these schools shared similar characteristics (Louis & Kruse, 1995, as cited in Hord, 1997).

1. **Shared vision**
   One of the main characteristics of such schools is an "undeviating focus" on student learning. This focus must be shared by all school leaders and staff. This vision guides every decision that is made about teaching and learning in the school.
2. **Shared leadership**
   These school leaders are democratic leaders, and decision making is shared. Teachers are encouraged to participate in decision making so that they have ownership of what's happening in their school.

   This new relationship between teachers and school leaders helps them to see themselves as being part of the same team, working towards the same goal (Hoerr, 1996, as cited in Hord, 1997).
3. **Inclusive community**
   It is important to include *all* teachers and school administrators in building the PLC. Leaders must find ways for every member of the community to come

together to discuss and decide on issues that concern all of them. While it may require more effort initially, this is critical to the future success of the PLC.

4. **Constant learning**
   One-day workshops are insufficient for developing teachers' abilities (Birman et al., 2000, as cited by Fang, 2009). For the teachers to be more effective, their attitudes and abilities must be shaped and reinforced constantly in the contexts in which they work and learn (O'Day, Goertz, & Floden, 1995, as cited in Hord, 1987).
5. **Action research**
   Action research requires teachers to examine what's happening in their schools and classrooms, to find out if they can make it more conducive for student learning (Calhoun, 1994, as cited in Hord, 1997). When teachers are engaged in action research, they are already taking a step towards developing learning communities.

The Singapore experience

In 2006, Assistant Professor Fang Yanping and her colleagues at the National Institute of Education introduced a similar concept in a Singapore primary school - through what is known as "lesson study".

Lesson study is a professional development process where teachers systemically examine the way they teach with the help and support of their peers. Their overall goal is to become more effective teachers. (Lesson Study Research Group, n.d.)

Teachers involved in the project met with their peers for 2 hours each week for 5-7 weeks. During their weekly meetings, they would come together to plan their lessons. They also observed video-taped lessons and discussed ways to improve their teaching.

After 2 years of working in close consultation with their peers, the teachers saw an improvement in their practice. They were more attuned to what works and what does not work in the classrooms. (Fang, Lee, & Haron, 2009)

Although done on a small scale, the results of this project have been encouraging. If nothing else, it hints at the rich possibilities of what could be achieved if the entire school gets involved in a process of continued and communal learning.

Building successful and sustainable communities

The journey towards implementing a PLC may be fraught with difficulties but research has shown that schools which have successfully built a PLC have much to celebrate.

[The teachers] engaged students in high intellectual learning tasks, and students achieved greater academic gains in math, science, history and reading than students in traditionally organized schools. In addition, the achievement gaps between students from different backgrounds were smaller in these schools, students learned more, and, in the smaller high schools, learning was distributed more equitably. (Lee, Smith, & Croninger, 1995, as cited in Hord, 1997)

This process is just beginning to take root in Singapore, as we begin to understand the importance and benefits of building PLCs.

For starters, the Ministry of Education is setting up a Teacher Development Centre to create a space for teachers to come together and "share and exchange ideas on learning and teaching, engage in research or simply meet up with colleagues who share common interests" (Ng, 2009).

But while the Ministry is looking at providing adequate resources to schools so teachers can spend more time on their professional development, its success really depends on the commitment of its stakeholders - the teachers and leaders in the respective schools.

Building a successful and sustainable PLC will require all teachers to personally take charge of building knowledge and working together to improve their practices.

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Article highlights

Why is metacognition important?
How can metacognition be taught?
What are the benefits to students?

Why is metacognition important?

When asked why he chose to focus on how to teach metacognition to students weak in math for his doctoral research, Assistant Professor Lee Ngan Hoe shared how his encounters shaped his decision.

"The role of metacognition is explicitly stated in the Singapore Math Curriculum, and it dates as far back as 1990 when the curriculum framework was conceptualized," says Ngan Hoe.

"But as late as 1998, after 6 years of implementation, I attended a conference where there were a few hundreds of math teachers, but when asked 'what's metacognition', no one appeared to be confident enough to explain nor cite examples."

So, what is metacognition?

Metacognition is basically "thinking about thinking" (Ministry of Education, 2006, p. 7). We can view metacognition as "being aware of and regulating of one's thinking". "It is just a big word, but it is actually a very common practice when we solve problems," says Ngan Hoe.

"During the problem-solving process, we will normally try several approaches before we arrive at the solution. When we know we are not getting anywhere with an approach even before we reach a dead end, we will stop and try another approach."

From his 6 years of classroom teaching experience, Ngan Hoe noted that students weak in math tend to lack this skill of monitoring their own thinking process. "When they are faced with non-routine problems, a lot of them believe that there is only one way of doing it," he says.

They use what he calls the "bulldoze way"; such students simply "bulldoze their way until they hit a brickwall" and then they will give up. These students lose confidence after repeated failed attempts at solving problems and begin to believe that they are not good in math.

Using a classroom-based approach

Ngan Hoe wanted teachers to view research on metacognition not just as theories but as something that can be effectively used in the classroom.

For his intervention programme, he offered his services to a neighbourhood school where he taught the "coaching classes" - an after-school programme that the school developed to provide extra help to their students.

Four groups of Secondary 1 Normal (Academic) students - one experimental group and three comparison groups - were used in the study. These students attended coaching classed each week over a period of 10 weeks.

For the first few sessions, Ngan Hoe went through each of the components of the Problem Wheel (see Figure 1). At this point, the students did not need to solve the problems.

For example, for the first lesson, students were provided with a list of problems and asked to focus on the "given" component. They were instructed to write down all the information that was given in each problem. The subsequent lessons focused on the other components.

Ngan Hoe later got the students to practise solving problems on their own, with the Problem Wheel to guide them.

The Problem Wheel

In an earlier study with gifted students, Ngan Hoe successfully applied Richard Paul's reasoning wheel (see Lee, 2008, p. 65). For this intervention, Paul's reasoning wheel was simplified to become the Problem Wheel (Figure 1).

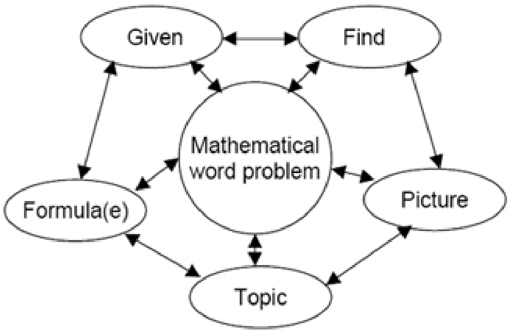

Figure 1. Problem Wheel

The Problem Wheel comprises 5 components:

Given: What is the problem about? What information is given in the problem?
Find: What you are supposed to find?
Picture: Using the information you have found, draw pictures to represent the problem. This helps students to visualize the relationships among the information given.
Topic: Think of the topics you have studied, e.g., Algebra, Geometry, Fractions. Which topics are relevant to this problem?
Formula(e): Focus on the formulae you have learned in these topics. Choose the most appropriate formula(e) to solve this problem.

The four metacognitive strategies

Using the Problem Wheel as a basis for questioning, Ngan Hoe also used four strategies to help the students to be more aware of their thinking process: *mathematical log writing*, *effective questioning techniques*, *identification of structural properties of problem* and *pair and group problem solving.*

Mathematical log writing: Students write about their mathematical learning, which helps to make their thinking visible to themselves.
Effective questioning techniques: Teachers and students ask questions about the problem, which helps them develop productive habits of problem solving.
Identification of structural properties of problem: Encourage students to compare different problems, which makes them aware of how they can apply prior knowledge to solving similar kinds of problems.
Pair and group problem solving: Get students to question each other, which makes their thinking process visible to all in the group, including themselves.

In class, students were allowed to talk out loud while solving the problems, whether individually or in pairs/groups.

He would give them fairly similar problems and prompt them to compare the problems and see if there were similarities and differences. This helped the students appreciate that they could tap on past experience to solve new problems.

At the end of each session, the students wrote a reflection of what they had learnt in their mathematical log.

Becoming more confident students

When Ngan Hoe compared the math exam results immediately after the intervention and a year later, he found that the difference between the coaching class and the other three comparison classes had closed up. From being the worst class, tthe students in the intervention group were now on par with the top class in terms of math achievement and problem solving.

Before the intervention, they would "stare and say I don't know how to do" to the problems given to them. By the end of the intervention, he could see them trying to make sense of problems given by asking themselves questions and drawing pictures.

The Problem Wheel helped the students to kick-start the problem-solving process. Going through the components of the Problem Wheel enabled them to see that "they actually know something about the problem before starting to solve the problem". This helped to build up their confidence, and in turn, their attitude towards math also improved.

Ngan Hoe's experience demonstrates how important it is to equip our students with metacognitive skills. By teaching them how to systematically think through the problem, to think about what they were doing and thinking, even the weaker students were able to independently solve math problems.

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Further reading

Visit http://math.nie.edu.sg/kywong for more information about metacognition.

Lee Ngan Hoe is an Assistant Professor with the Mathematics and Mathematics Education Academic Group at the National Institute of Education.

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MAKING MALAY MEANINGFUL FOR STUDENTS

Step into Mr Aidil Subhan's classroom and you may see pupils trying to figure out how to make a hot drink of Ovaltine, or how to cook a packet of instant noodles. These food wrappers and drink packets are his "textbooks" - the materials he uses to introduce the Malay language to his students.

Article highlights

How can everyday experiences make language learning meaningful?
What is the importance of spontaneity in learning a language?
How can the use of differentiated learning help in classroom instruction?

As a former teacher, Mr Aidil Subhan understands the difficulties that Malay language teachers face. He also realizes that mere instruction from the textbook is insufficient for engaging his young and restless charges.

So Aidil tried to introduce other "instructional materials" into his lessons. As part of his instruction, the pupils were asked to read the cooking instructions on the back of Malaysian food products like "Maggie mee" or "Ovaltine".

Rather than explicitly telling the pupils how to prepare the food, Aidil let them figure it out for themselves. "I would ask students to bring the wrappers of these products to class. Then, I would ask them how they would make Ovaltine," he says.

"I use the instructions as a comprehension text," he explains. "Because some of the words are relevant, and are used in the textbook." This exercise also serves to build important life skills, through the learning of the Malay language.

Making it relevant

Aidil believes that language learning should begin with the familiar. Thus, "nasi lemak" and "mee rebus" hold the key to making the Malay language more meaningful to students, not the textbook alone.

By first introducing students to words that relate to aspects of everyday life, pupils begin to see the relevance and utility of the language. This is particularly important in today’s Malay language classroom, where close to 60% of students speak both English and Malay at home, and an increasing minority come from homes where only English is spoken (Ministry of Education, 2005).

And because food is both interesting and relevant to most students, Aidil believes it is a good place to start teaching the Malay language.

Focus on high-frequency words

But there is another reason for doing this. Words like "mee" and "nasi" are examples of high-frequency words - words that we see often but are often not explicitly taught. Other examples include honorific terms, like "Mr" (*Encik*) and "Miss" (*Cik*).

High-frequency words are commonly used in everyday interactions. Exposing students to these often-used words provides a good introduction to the language.

In a study Aidil conducted with non-Malay speakers, he found that when high-frequency words were taught to these non-native speakers, there was an improvement in their reading ability. If these results are anything to go by, then introducing native Malay students to high-frequency words should prove fruitful.

Increasing student spontaneity

Aidil noted that what is particularly lacking in the Malay language classroom is spontaneity. In a study of Primary 1 students, he found that while students have a high knowledge of the Malay language, their ability to speak it spontaneously in the classroom is diminishing.

In line with the new Malay language syllabus, there is a growing need to encourage spontaneous oral skills. However, *sebutan baku*, or the standard pronunciation of the Malay language, is so thoroughly taught in the classroom that it actually adversely affects the spontaneity of the students.

Thus Aidil is propagating a balance - a communicative approach where spontaneity is encouraged, and an emphasis more on form rather than structure during the initial years.

Aidil believes that more needs to be done to help students communicate more freely in the Malay language, especially at the lower primary level. His suggestions are easy to implement:

1. Encourage students to speak up and express their ideas
2. Focus on the ideas they articulate rather than on the grammar
3. Use task-based activities that require the students to do hands-on work, rather than just worksheets

Using differentiated learning

Aidil also recommends the use of differentiated learning - providing students with different ways to learn about a subject. There are three aspects to differentiated learning:

1. **Content**
   Choose what you teach based on what your students are interested in. Ask your students what they want to know about a particular topic. For example, if they choose the topic "the neighbourhood", ask them what they want to learn about their neighbourhood.
2. **Process**
   This has to do with how the lesson is conducted. Lessons can be taught online, or they can involve task-based or problem-based learning.
3. **Product**
   When it comes to assessment, it need not be a written test or worksheet. Try a skit or a video. Or get your students to createe a brochure or website about, say, their neighbourhood and the things that are happening there.

A matter of planning

Seems like a lot of extra work in a limited time frame? As an ex-school teacher, Aidil sympathizes, but believes it can be done.

"It seems like a lot of work. But with proper planning, it is possible," he says. "Schools usually start their planning around July and August. So it would be good to plan around May or June."

Aidil shares his strategy to work around the problem. Teachers should be proactive, plan well, and try to fit their plans into the school agenda.

"By showing that whatever you do is related to classroom teaching and will benefit the students at the end of the year, you can make it work."

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Aidil Subhan is a lecturer with the Asian Languages and Culture Academic Group at the National Institute of Education. His research interests are in language planning and policy, curriculum and pedagogy, and stylistics.

BACK TO TOP

BREAKING THE LANGUAGE BARRIER IN SCIENCE

Many students often feel threatened by "scientific language". It hinders their learning of science concepts. But once they master this language, they become better learners of science. How can we teach students this skill?

Article highlights

What is the language of science?
Why do we need to learn the language of science?
How can students be taught the language of science?

Despite our best efforts, some students still do not do well in science. A crucial problem that is often unaddressed lies in the language used to communicate science concepts.

Many students are put off by so-called scientific "jargon" and the seemingly complex sentence constructions. Students learning science in other languages, like Chinese, French and German, encounter the same kind of complexity that confuses students learning science in English. (Tan & Soong, 2006)

In fact, students may not be confused by the complexity of science concepts, but by the way they are communicated. How do we surmount the language barrier so that students become better learners of science?

Learning the language of science

The key is to view the learning of science from a "language-learning perspective" rather than viewing science as "an experimental, empirical discipline". What looks like scientific "jargon" is actually a specialized language with a unique set of rules of phrasing, grammar and vocabulary.

This specialized language makes science appear "impersonal and even inhuman to many students". It seems much more difficult than it is, and students feel alienated from it. (Lemke, 1990, p. xi)

However, scientific texts can be made accessible. And as Assistant Professor Tan Aik Ling puts it, science is all about reading, writing, and talking about it.

"Language is the medium through which scientific knowledge is constructed," she explains. "Students need to learn how to code and decode the language of science. They need to read like a writer and write like a reader of science to be true science practitioners."

In other words, knowing the rules of science communication is crucial to understanding science concepts. This is because scientific goals and thought processes are closely interlinked with the language used to communicate science. (Tan & Soong, 2006)

The challenge, then, is to teach our students to be "scientifically literate".

The language of science

Science involves a lot of defining, categorizing, explaining, and justifying of hypotheses. These characteristics can be seen in the way science is communicated.

In science, we tend to condense several words into one. As a result, a single word may hold a lot of meaning.

For example, to describe an accident, a scientist might say: "The car accelerated and there was a collision."

However, if a layman were to describe the same car accident, he would simply say: "The car travelled faster, hit another car, and caused an accident."

Scientists use the term "acceleration" not because they want to make language complex, but because acceleration means many other things - change in the velocity, in direction and speed - which the words "travelling faster" do not communicate.

Scientists call this *nominalization* - the alteration of the grammatical structure of a sentence by converting verbs to nouns. (Fang, 2004)

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STRAW - Scientific Reading And Writing

Aik Ling investigated the benefits of teaching scientific literacy skills to students in a project called STRAW, short for "Scientific Reading And Writing". In her study, 40 Secondary 3 students of one school were taught scientific literacy skills in an enrichment course.

Over five weeks, the students were given three science articles to analyse. The course focused on:

1. Introducing patterns of scientific language
2. Common difficulties and how to overcome them
3. Extracting information from scientific articles
4. Reading and writing summaries in science

Students were asked to pen down their thoughts about each class in a journal. Their journal entries indicated that they found scientific articles daunting but were progressively able to make sense of these articles.

The students were assessed before and after the course for comprehension of two different scientific articles. Results showed significant improvements in students' understanding of scientific articles after they were taught the language of science. (Tan & Soong, 2006)

Teaching the language of science

Aik Ling recommends that science teachers make a conscious effort to teach the language of science, and not just the content of science. This may be infused into a regular science lesson, or taught separately as she did with her STRAW programme.

Here are some ways to to infuse the teaching of scientific literacy skills:

- Point out elements of style and phrasing every time you read scientific texts with the class.
- Discuss the process by which the writer arrives at a particular idea and how he communicates his idea.
- Explicitly teach students about the language and grammar rules in science. For example, teach them about nominalization, and how scientific articles are written from a third-person perspective.
- Encourage students to use the language of science in scientific activities, rather than everyday language.

When your students are able understand both the language of science and its content, they become more independent and effective science learners. They can then read, write and talk in a scientific manner - just like a real scientist.

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Tan Aik Ling is an Assistant Professor with the Natural Sciences and Science Education Academic Group at the National Institute of Education. Her research interests include scientific literacy skills of students, especially in scientific reading and writing in Biology.

BACK TO TOP

REDEFINING THE TEACHING PROFESSION

There has been much talk about teacher professionalism of late. This is often spoken of in the same breath as "21st century skills". What has professionalism got to do with acquiring 21st century skills? And what does it mean for teachers?

If you are teaching today, you cannot escape the reality of the "21st century". This information-rich, technology-based world requires different skills and competencies.

But to develop future-ready students for tomorrow requires future-ready teachers today. Thus the need for teachers to remain on top of the game, to be equipped with these skills in order to impart them.

For teachers in Singapore, these "21st century skills" are clearly outlined in *Curriculum 2015* (Ng, 2008). C2015 presents a vision of "an education system geared to the needs of the 21st century" (MOE, 2009).

Governments around the world are concerned with building an education system that is relevant to 21st century realities. In a report on teacher education for 21st century schools, it was noted that:

> The challenges of the current context require a rethink of the notions of teacher professionalism.... We suggest that this **requires of teachers, individually and of the profession as a whole, a strengthened or *redefined professionalism*, possessing specific 21st century characteristics** that are crucial enablers for teachers to continue to do intelligent and demanding work in the classrooms. (International Alliance of Leading Education Institutes, 2008, p. 22, emphasis added)

Redefined professionalism basically means that we recognize teachers as bona fide professionals and their work as complex and demanding. It suggests that we accord due honour to members of the profession, as we would do to any other profession.

However, with the recognition also comes the expectation that every teacher will conduct himself or herself as a professional. This includes a commitment to continuous learning in order to enhance student outcomes and strengthen their professional identity.

This brings the discussion back to teacher professional development, a key focus of the recent MOE Work Plan Seminar.

"We need to build capacity for teachers themselves to take the lead in professional upgrading," said Education Minister Dr Ng Eng Hen. It is a "quest for professional excellence" that is expected of every teacher. (Ng, 2009)

What does this mean in practical terms? In light of this discussion, we can ask ourselves the following questions:

1. What does it mean for me, as a teacher, to be seen as a professional?
2. What do I need to grow as a professional?
3. What am I willing to do to develop myself as a teaching professional?

Or perhaps it is time to redefine our *raison d'être* - our "reason for being" in the teaching profession in the first place.

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