RESEARCH within REACH

issue 37 jul / aug 2012

issn 2010-1031

HotTOPIC

Creative Thinking as a Process

Creativity has been a hot topic since the Ministry of Education articulated its vision of Curriculum 2015, but many teachers are still not confident about teaching and evaluating creativity. John Yeo explains how we can better respond to the call for creative teaching.

Creativity is a complex and multi-dimensional construct. It isn't just about coming up with multiple solutions to a problem, says NIE lecturer John Yeo. Neither is it about the outcome alone and how innovative it is.

"We want our students to learn more creatively, and we think that means we need to teach more *creatively*," he notes. "Sometimes people even talk about a need to teach *creativity*."

John makes a distinction between these notions of creative teaching and teaching for creativity. "Teaching creatively and teaching for creativity are related but they're not the same thing."

They do, however, share a common focus—helping students learn by appreciating new points of view and values. And that's what John is interested in.

Teaching for Effective Learning

John believes we can help our students to learn better by teaching them to think creatively. For him, it begins with teachers' understanding of the creative process as that affects the way they teach—and thus the learning that results.

Many teachers equate creative teaching with engaged learning, but an engaging lesson does not necessarily lead to effective learning.

"Sometimes teachers think that creative teaching is only about engagement, but it doesn't always mean that being engaged results in effective learning."

In terms of creativity in education, John explains: "It is primarily about helping students to look at things differently. How do they understand the issues and identify challenges? And then, how do we generate better ideas?"

Teaching creatively and teaching for creativity are related but they're not the same thing.

- John Yeo,
Curriculum, Teaching and Learning Academic Group

In this issue

Web Extras! *Go to http://singteach.nie.edu.sg for more stories.*
Find us on Facebook at http://www.facebook.com/SingTeach

NIE National Institute of Education Singapore
An Institute of Nanyang Technological University
Supported by Marshall Cavendish Education

Useful Resources

Ministry of Education. (2010a). N*urturing our young for the future: Competencies for the 21st century*. Retrieved from MOE website: http://www.moe.gov.sg/committee-of-supply-debate/files/nurturing-our-young.pdf

Ministry of Education. (2010b, March 3). *MOE to enhance learning of 21st century competencies and strengthen art, music and physical education* (Press release). Retrieved from MOE website: http://www.moe.gov.sg/media/press/2010/03/moe-to-enhance-learning-of-21s.php

Puccio, G. J., Murdock, M. C., & Mance, M. (2005). Current developments in creative problem solving for organisations: A focus on thinking skills and styles. *Korean Journal of Thinking and Problem Solving, 15*, 43–76.

Yeo, J. (2011). Authentic assessment for creativity as a 21st century pedagogy. In K. H. Koh & J. Yeo (Eds.), *Mastering the art of authentic assessments: From challenges to champions* (pp. 37–54). Singapore: Pearson Education South Asia.

Though some think that teaching creatively is good to have but not a must-have for students to pass exams, John begs to differ. When students are thinking and learning creatively, they become effective learners. To do that, we need effective teaching.

"Effective teaching requires a child to understand the concept and to make meaning of that. That's a very creative process for the learners."

The Process of Creative Problem Solving

John is especially interested in the *process* of creativity (see box story). For him, it's really about creative thinking.

"I focus a lot on the process, or process learning, because you don't get creative ideas out of nowhere," he explains. "But if you go through the process, it helps us to then formulate better or more meaningful solutions."

John uses a model of creative problem solving (developed by Puccio, Murdock, & Mance, 2005) to help teachers understand the process of creativity.

Creative problem solving is an iterative process that involves both divergent and convergent thinking, where the situation is continually analysed and assessed. It is also an imaginative process as new solutions are constantly explored and elaborated upon.

John sees this creative problem-solving process as a powerful tool for developing skills in both critical thinking and affective skills. It is especially helpful for teachers who are perhaps more comfortable with evaluating the product of the creative process.

But because creative thinking is a process skill, John maintains that we can't just provide a rubric and expect teachers to assess students based on that.

"If you talk about 21st century teaching and learning, the teachers themselves must have the competencies. They need to understand it for themselves," argues John. Only then can teachers truly embody the attributes they teach.

The 4Ps of Creativity

A useful lens for understanding creativity is the four Ps of creativity introduced by Mel Rhodes in 1961: *person*, *process*, *product*, and *press* (or the environment).

In his study of creativity, Rhodes collected 56 definitions of creativity and imagination. From them, he identified four common strands:

- *Person* refers to the attributes and traits of a person in relation to creativity.
- *Process* refers to the mental activities, tools and techniques used to generate creative products and ideas.
- *Product* refers to the outcome of a creative process, an idea that has a tangible form.
- *Press* refers to the physical and psychological environment that may help or hinder creativity.

Creativity in the Curriculum

Some may insist that creativity cannot be taught. "I argue that it can be nurtured," John affirms. "It can be nurtured as a child speaks with others, as the child interacts with the content."

We want to develop creative learners—students who see themselves as creative individuals, and who dare to take risks and explore the new and unpredictable.

For John, the greater concern has to do with curriculum design. "The question then is, how do you design that as part of your curriculum? How do you create processes to bring about that learning?"

This requires a tolerance of mistakes, among other things, by both students and teachers. Teachers also need to be mindful not to over-instruct, as that could inhibit students' creativity.

Going back to the creative problem-solving process, John says: "If I use a process, at least the teacher can continue to go back and forth, and say, what am I doing well, and how is my process driving that learning process. The process will frame how the teacher guides the learning."

The process certainly takes more time, but as John points out, it's more sustainable and also more desirable for the child. "To me, that's more precious, and that's what teachers want."

John Yeo is the Guest Editor of this issue. He is a lecturer and the professional development leader in NIE's Curriculum, Teaching and Learning Academic Group. His research interests include creativity and creative thinking, teachers' professional learning, assessment of 21st century skills, lesson study and school-based curriculum innovations.

Interdisciplinary Thinking in Action

Real-world situations can be challenging and complex, often requiring solutions that cut across various domains of knowledge, thought and practice. NIE educators have a creative way of tackling this.

Education today needs to prepare our students for an increasingly complex and dynamic world. Junior College (JC) education, in particular, aims to develop future leaders who are equipped to deal intelligently and creatively with real-world issues.

Three NIE colleagues put their heads together to find a way to help new JC teachers. The result was "Knowledge Skills"—an interdisciplinary course designed to develop the knowledge, skills and values expected of JC teachers.

Dealing with Real-life Problems

As an interdisciplinary course, it is only fitting that the course co-ordinators are from three different academic groups in NIE.

"JC students are supposed to be on a leadership track," explains Benjamin Wong, one of the masterminds behind this course. "We want to prepare them to take leadership roles in a 21st century world."

This involves dealing with what he calls "wicked problems"—real-world problems that are not so easily defined, and solutions which could cause other problems.

Dennis Yeo, one of the trio, believes this is vital because JC is the "end of the assembly line" in terms of achieving the desired outcomes of education. JC teachers have one last shot at imparting as much knowledge and skills as possible to make sure their students are prepared for the real world.

"Students must be ready to go out into the market, one that is very volatile and changing. They need to deal with that kind of flexibility," says Dennis.

So how do you inject creativity into the JC system—one that is intensely exam-oriented and where lesson time is a limited commodity?

Beyond Disciplinary Boundaries

Their answer is to teach "process skills" which can be used across subjects. Skills like multidimensional thinking and critical literacy. To do so, they have chosen to adopt an interdisciplinary approach.

The reasons for this are simple. For one, classes like General Paper aren't subject-specific and are more focused on skills like critical literacy. "We're getting students from all sorts of subject areas, that's why we're emphasizing skills," says Dennis.

Also, in the real world, disciplines such as Physics, Economics and Literature do not exist in silos: they are interrelated. "Having knowledge is one thing, but how do you apply it? How do you contextualize knowledge and put it to meaningful use?" asks John Yeo, the third part in this dynamic combination.

The challenge, says John, is to integrate all these process skills together in practice. "The module doesn't just teach skills alone but the understanding is critical, and then the skill sets can come in real, applied ways for teaching."

"It isn't a lesson on creativity or critical literacy skills but part of the process of learning and the process of gathering knowledge," adds Dennis. "These skills are applicable in any real situation. It's not something that's outside of what teachers are teaching; it's something they can imbue within the lesson plan itself."

Making Connections

Trusting that teachers already have the required content knowledge, this course gets them to go deeper.

"We encourage students to start asking different questions, to ask deeper questions of the discipline," notes John. "If we keep asking the same questions from the textbook, we won't get new answers."

Article highlights

- Will an interdisciplinary approach help learning?
- How can we enhance the learning of process skills?
- What knowledge, skills and values are most critical for teaching?

(From left) *John Yeo, Dennis Yeo and Benjamin Wong*

About "Knowledge Skills"

"Knowledge Skills: Interdisciplinary Studies" was introduced in 2010. The course comprises three components:

- Multidimensional Thinking Skills emphasizes thinking and knowing across disciplines (led by Benjamin Wong)
- Critical Literacy Skills emphasizes creativity, visible thinking and dialogic teaching (led by Dennis Yeo)
- Project Work Skills emphasizes group dynamics, generation and evaluation of ideas, research methods and oral presentation skills (led by John Yeo)

The focus of the course is clearly on developing skills. It is designed to prepare the new JC teacher to think and teach critically and creatively—with the ability to select, analyse, synthesize and critique information across disciplines, and to present the content in a clear and cogent manner.

He continues: "The idea is to take that discipline knowledge and push it into more applied ways, and with greater novelty. Novelty can reside within the subject matter, but sometimes we need to think deeper, and to look across the subjects."

This course goes further by injecting a values component into the disciplines. "Once you understand the history of the disciplines, and the ones who came up with the theories, you humanize the discipline," Benjamin explains.

We start to realize that disciplinary boundaries are artificial, and there is much we can gain from drawing on both the arts and the sciences. "That enriches the understanding of the discipline and the ethical elements come in very strongly."

Daring to Be Different

Interdisciplinary thinking changes the way you think about the disciplines.

Having a broad base of knowledge of various disciplines will allow teachers to incorporate a range of skills within the curriculum. "It's a change in the paradigm of how they plan their lessons," says Dennis.

"The course helps them think about how to go about changing the format and structure of the classroom, how they go about questioning and the types of questions that they ask, and how they are going to make that kind of thinking visible and tangible for the students," he explains.

On the practical side, this takes a bit of courage, especially within the short two-year timeframe of the JC system. "Thinking out of the box is a very apt way to talk about creativity, but thinking out of the box requires rule breaking, and that requires courage," says Dennis.

But that leap of faith, once taken, opens the door to more creative teaching and critical learning. As Benjamin explains: "As they engage in this interdisciplinary process, they build confidence in relating to others and to overcome fears, especially the fear of new things and the fear of failure—if you're afraid to fail, you won't try new things. Once you overcome this fear, it opens the door to creativity."

Useful Resources

Holt, J. (1982). *How children fail* (2nd ed.). New York: Merloyd Lawrence, Delta/ Seymour Lawrence.

Holt, J. (1983). *How children learn* (2nd ed.). New York: Delacorte Press.

John Yeo is with NIE's Curriculum, Teaching and Learning Academic Group, **Benjamin Wong** with the Policy and Leadership Studies Academic Group, and **Dennis Yeo** the English Language and Literature Academic Group.

LangED

Inventive Thinking in Writing

They say necessity is the mother of all invention. Now more than ever, inventive thinking is needed in schools and in society. Why the growing emphasis? And what is the place of invention in the language classroom?

Article highlights

- What is inventive thinking?
- How can it be applied in a language classroom?
- What are the present and future benefits for students?

Creativity isn't just a final product—it's a process. Part of this process is inventive thinking. What is inventive thinking? And how can teachers inculcate inventive thinking in their students? PhD student Aliamat Omar Ali sets us thinking.

What is Inventive Thinking?

Inventive thinking is originally about inventing innovative products and hi-tech solution, where physical products are invented to solve material problems. This kind of thinking has been found to be useful in solving non-material problems.

"Inventive thinking is actually a mind-set of looking at challenges in a positive way," says Aliamat, who has chosen to do his PhD on this topic. "In my research, my focus is about changing students' perspectives, to be innovative and inventive in daily life."

> Inventive thinking is actually a mind-set of looking at challenges in a positive way.
>
> - Aliamat Omar Ali,
> *Universiti of Brunei Darussalam*

He believes this is necessary in a constantly changing society, especially one that seeks to advance socially and expand economically. At the crux of this way of thinking is a shift in focus from the final product to the thought process.

"What is happening now is that inventive thinking is viewed as a product. The process is not explained nor taught in classrooms," notes Aliamat.

He wants to make the process of solving a problem visible. "By teaching this process, we are changing this perspective of students, to make them see challenges and hurdles in a positive way."

Stimulating Creative Thinking

Aliamat's research is based in Brunei Darussalam, where he is from. Creative and critical thinking is not new to schools in Brunei, many of which use a thinking programme based on Edward de Bono's Cognitive Research Trust (CoRT). But not all teachers are seeing the desired outcomes.

"My concern is that the CoRT programme is in English. Research conducted in Brunei found that some students can't cope because the majority of them are not comfortable with learning CoRT in English," he explains.

Although English is the main language of instruction in Brunei schools, Malay is commonly used outside the classroom. The teachers believe most students find it easier to think and learn in Malay as that's the language they are most comfortable with.

In addition, without knowing the process of thinking inventively, many students become complacent and use the standard solutions, which are usually neither original nor novel.

Concerned that this is stifling creative thinking, Aliamat is keen to find a way to help students think out of the box. "I am trying to propose an alternative to CoRT by teaching inventive problem-solving methods to students in the Malay Language classroom."

Problem Solving in Writing

"Inventive thinking is one of the main types of skills that is needed in the 21st century," Aliamat points out. "The objective is to develop students to generate good solutions to a problem—original and novels solutions, not common ones."

Putting the theory of inventive problem solving into practice, Aliamat hopes this skill can be inculcated through composition writing in the Malay Language classroom.

He is looking at how the process of inventive thinking can encourage students to write more creatively, by helping them to come up with original ideas and not rely on standard answers.

For example, in a traditional writing assignment, students are given a topic and would contribute points that are predictable and typical. Instead, students can be given a *problem* and asked to suggest original solutions.

"By giving students some sense of problem solving in writing, students can come up with solutions themselves—not just the right kind of problem to be solved, but the 'how to solve', that is, the process of defining and solving a problem. This minimizes rote learning and makes the classroom more student-centred."

Benefits of Inventive Thinking

The process of inventive thinking helps students think critically, systematically and inventively, rather than just concentrating on getting the right outcome. They will also become more confident in their answers.

The process helps to hone the quality of ideas that are generated and also teaches them to be responsible for the ideas they generate.

These benefits will stand them in good stead outside the classroom, too. Aliamat believes that if we can develop our students to be inventive thinkers now, they will be more innovative and adaptable when they go out into the marketplace in future.

"I believe it will not only help the students to write more interesting compositions in the language classrooms, but also help them to see real-world challenges from a positive perspective," says Aliamat. "It also makes them better and more proactive contributors to society."

"Every problem has its solution," Aliamat reminds us. He is sure this mind-set will take them a long way in life.

The objective is to develop students to generate good solutions to a problem.

- Aliamat *on the goal of inventive thinking*

Useful Resources

North Central Regional Educational Laboratory. (2003). *enGauge 21st century skills*. Naperville, IL: Author.

Sokol, A. (2008). *Development of inventive thinking in language education* (PhD thesis). Retrieved from http://www.jlproj.org/this_bibl_e/books/TA_thesis_ch2.pdf

Trilling, B., & Fadel, C. (2009). *21st century skills: Learning for life in our times*. San Francisco: Jossey-Bass.

Aliamat Omar Ali is a Language Education lecturer at the Sultan Hassanal Bolkiah Institute of Education, Universiti Brunei Darussalam. He is currently doing his PhD with NIE's Asian Languages and Cultures Academic Group.

Solving Problems One Step at a Time

Article highlights

- How does creative thinking help with problem solving?
- How can creative thinking be injected in Science?
- How does the thinking process develop other skills?

Mrs Joyce Teo and Mr Simon Foo from Temasek Junior College

The Science teachers at Temasek Junior College have put great effort and thought into designing their pedagogy and curriculum. They believe this has helped their students to be better thinkers and learners.

When the first batch of students from Temasek Junior College's (TJC) Integrated Programme (IP) took their first Science common test, together with their first-year JC counterparts in the mainstream, they didn't do so well.

It wasn't that they didn't have the requisite knowledge. It was simply because they had not taken a pen-and-paper exam in a while. In fact, they had not used a Science textbook for some time either.

But it wasn't long before they were outperforming their peers. Their teachers believe it was because these students were taught to THINK differently.

THINK in Progress

The THINK© cycle was introduced as a key pedagogy for Science when the IP began in 2005.

"The THINK cycle is a *rojak* (or blend) of problem-based learning, inquiry-based learning, project-based learning and more," explains Mr Simon Foo, Head of TJC's Science Department.

The THINK cycle begins with a trigger, usually a case study involving a problem or an inquiry. Students drive the process by exploring and discovering the gaps in their knowledge. They gather and interpret the data on their own, and then come together to build on each other's findings and hypotheses.

Teachers take a step back and provide guidance when needed. "We are there as facilitators and not dispensers of knowledge," explains Simon. "Most of the time we answer their questions with questions pointing them in a certain direction or to read a certain article."

At the end of the cycle, students present their work to their other classmates, in the form of a video, model or Flash animation. The challenge is to present their findings and explain the Science concepts used to solve the problem to others.

The THINK Cycle

The THINK© cycle consists of five steps—Trigger, Harness, Investigate, Network, and Know—guiding students through either a problem or an inquiry. Working in small groups, students conduct research, brainstorm, and then come up with a solution.

- *Trigger* – The trigger is in the form of a problem or question that will spark students' interest to find out more.
- *Harness* – Students try to fill in their knowledge gaps by asking questions and doing research.
- *Investigate* – Students check whether their speculations are correct and gather data to support their hypothesis.
- *Network* – Knowledge is constructed as it is shared and interpreted together.
- *Know* – Students should arrive at a solution for the given problem.

TJC is now working with Gongshang Primary School to see how the model can be applied at the primary school level.

Getting Used to THINKing

As with all things new, the THINK cycle needed some getting used to. Mrs Joyce Teo, Head of IP Science, notes that students often feel insecure when they first join the IP. They are more accustomed to structured tasks and pen-and-paper assessments.

Teachers, too, especially the newer ones, sometimes struggle because their own learning experiences were mostly teacher-centred. But everyone usually gets accustomed to it after a term or two, especially the students.

Through years of using and refining this process, the teachers have found that the critical approach to learning does encourage creative thinking in their students.

Joyce notes that they pick up the skills of working through the thinking process rather than expecting answers to be given. They start thinking about what can be done, how it is done, and why it is done a certain way.

"They feel it's okay to be uncertain and to explore and to not know," adds Simon. It helps that they also start to do better in their project assignments, and that encourages them to keep at it.

Effectively Creative Science

At the heart of the THINK cycle is a desire to make Science learning relevant. "It's actually very much about how Science should be learned in an authentic form, and not in terms of memorizing facts, putting them down on a piece of paper and scoring well."

This model of teaching was thus designed to help contextualize learning. "Science is not learned in silos—all of it has connections to our daily lives," says Simon.

It also effectively develops 21st century skills such as being a more confident and self-directed learner as well as an active contributor. "The Ministry of Education encourages two elements—collaborative learning and student-directed learning," notes Simon. "That's very much in our THINK cycle!"

"We realize that this mode of teaching and learning does take up a bit of time, and with that it also means that the content we cover may not be as much," notes Joyce. But the teachers at TJC have pressed on, firmly believing that the THINK cycle works, and they believe their efforts have paid off.

Simon is pleased to note that the students are clearly learning in a deeper manner. When given a problem, they are able to gather knowledge from various sources and apply it to solve the problem. "I do see a lot of transference of knowledge and thinking of other dimensions," he says.

As Joyce notes, "In the real world, they will not always get answers. They have to find it, and then decide how to share the ideas." For these students, they can say they know how.

In the real world, they will not always get answers. They have to find it, and then decide how to share the ideas.

- Mrs Joyce Teo,
Head of IP Science,
Temasek Junior College

MathED

Problem Finding and Mathematical Thinking

Many people believe creativity begins with finding many solutions to a problem. What if that's actually at the end of the process? Dr Manu Kapur is turning the creative thinking process on its head and exploring the mechanics of problem finding—and we believe he's on to something!

Article highlights

- How is problem finding different from problem solving?
- Why is problem finding an important skill to develop?
- How can problem finding develop mathematical thinking?

Philosophers and scientists alike have claimed that problem finding is important but in truth, we don't really understand what the process looks like.

That's a gap Associate Professor Manu Kapur, Head of NIE's Learning Sciences Lab, hopes to plug—both in terms of our understanding of the problem-finding process as well as the practice of Math in schools.

So What's the Problem?

In traditional problem-solving situations in schools, the Math problem is either fully specified or known to a great degree. The assumption is that students have sufficient knowledge to solve these problems because they have been taught and the goal is specified.

With problem finding, however, the problem itself is not known. We may not even have enough knowledge to solve the problem, which is the case in many of the challenges we encounter in life.

"We have a very good sense of the processes of problem solving, but we don't quite have a theory or an understanding of what the process of finding a good problem looks like," says Manu.

So instead of giving students a set of data and asking them to calculate something definite, we give them the data and say: What problems can we generate based on this data? He gives the example of soccer league tables. Instead of asking them to invent various measures to determine who the best team is, students can ask and answer mathematical questions of their own.

"That's a very different enterprise, where students have to use whatever knowledge they have, both formal and informal knowledge, to really start thinking." This, says Manu, provides a huge opportunity for developing mathematical thinking and invention.

"The mere act of defining the problem, even though you're asking students to invent multiple solutions, constrains mathematical thinking," he explains. "You would be surprised by how many important problems you could define just given the data, which you would miss if you just gave students a problem and asked them to solve it."

We have a very good sense of the processes of problem solving, but we don't quite have a theory or an understanding of what the process of finding a good problem looks like.

- Manu Kapur,
Learning Sciences Lab

The Process of Problem Finding

So what does this process of problem finding look like? And what implications does it have for schooling and education? That's the area of research that Manu wants to start looking into.

We know a lot about the processes of problem solving in the cognitive and the learning sciences, but not about problem finding, says Manu. Yet every time we talk about innovation, inventiveness, or breakthroughs, people say it's thinking about a problem to solve that's more important than actually solving the problem.

"If you look at the history of scientific revolution, or the history of innovation, invariably it's about finding a good problem to solve, and yet we don't have an understanding of that process," explains Manu.

Interestingly, the process of solving a problem is much easier than finding a useful problem to solve. Problem finding is a very long, divergent and iterative process—you don't know until you try many things, until you finally stumble upon a good problem to solve.

"Once you've defined a good problem to solve, it's easy to solve the problem!" Not that solving a problem is not difficult, Manu qualifies. But it's not *as* difficult as finding an inventive, original and meaningful problem to solve.

Developing Inventive Thinkers

"There's a lot of rhetoric around creating students who are inventive, entrepreneurial, innovative, creative," notes Manu. "I think the more we understand this process, the more we will learn about how to use this process more effectively for education."

He differentiates between inventing your own problems and inventing multiple solutions to given problems. The latter is good and necessary to train people to solve problems—we need workers like that in the workforce.

"But if you want the leaders and the innovators, then you want these people to think of important problems to solve, so that as a society we move higher up in the value chain."

While it is still early days, Manu is hopeful that addressing *this* problem will not only help students learn Math better, but also help develop the dispositions of creativity and inventive thinking. For the moment, he is working on designing problem-finding activities that can help develop this skill.

"This is really about inventing your own problems and then developing the skill to see which problems are better than others. If we can develop this skill in our students, then they will be much better prepared for the 21st century."

Manu Kapur is Associate Professor with the Curriculum, Teaching and Learning Academic Group and newly appointed Head of the Learning Sciences Lab at NIE. He is well known for his concept of Productive Failure and its application to Math teaching and learning.