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# Game-based Learning

Big Idea

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## Games for 21st Century Learning

*Games are being used in classrooms not just because they are fun. If designed well, they can foster deeper and broader learning in our students.*

“Life is more fun if you play games,” wrote Roald Dahl, a British novelist and author of children’s books. Learning has become a lot more fun too for students as more educators are using games in their classrooms.

Why are they doing so? Fun is only part of the reason. Dr Mingfong Jan, a Research Scientist at NIE, tells us that well-designed games not only enliven the classrooms, but also engage students in deeper learning.

### Designing Contexts for Learning

“If we go back to 19th century, the question would have been, why are we using textbooks as a learning tool? I would reply, because our goal is to help students acquire content and basic literacy skills,” says Mingfong, an expert in game-based learning.

The basic literacy skills and content mastery are still important, but insufficient today. We also want students to develop 21st century competencies and skills that will prepare them for the future.

Such skills, such as problem solving and collaboration, are hard to foster through direct instruction. Instead, the goal now is to have “designed contexts” in which students can learn those skills.

“From learning content to learning higher order thinking skills in context, that’s a big transition,” says Mingfong.

“We have to see learning as a process where a lot of learning experiences cannot be explicitly taught using conventional ways. It must be cultivated through guided participation in the context of problem solving, inquiry and collaboration.”



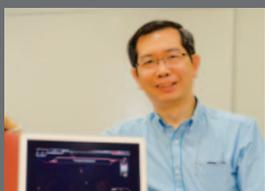
- Mingfong Jan, posing with Green City Blues, a board game that he designed



An Institute of



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He strongly feels that games can be designed to provide contexts for students to engage in such learning, and even values and moral education.

“In school, we learn content but we don’t learn it as tools for problem solving. Games happen to be a really good medium for you to use information for problem solving and inquiry.”

He gave an example of a board game that he designed: *Green City Blues*. For this game, players form teams to investigate the mysterious death of a man called Ivan who lived in Green City. Could it be a murder, suicide or even a brewing public health crisis?

In a team, each player plays a different role, such as an environmental scientist, government official or medical doctor. Each player has exclusive access to certain types of information, such as medical records and secret government documents. The team has to piece together all the information and find out the cause of death.

“It’s role playing, collaboration, and problem solving all at the same time. And because they have to inform the public what happened to Ivan, it’s also about the values of being a citizen.”

## Computer Games in the Classroom

For teachers who want to use computer games as a learning tool in their classrooms, what advice would Mingfong give?

It is an extremely complex process for teachers to either design their own games or work with vendors. Instead, they can start with a game that has been successfully used in another setting (perhaps another country)

and localize it so that the contents become relevant to students.

“But when you adopt the package, try not to change it too much,” Mingfong advises, so that the original learning design and aims stay intact.

He also thinks that teachers should make it a team effort instead of doing it alone.

“It’s better to work on it as a team because you may be out of your comfort zone. In a team, you have better psychological support. Don’t work on things that are too challenging technologically, because technical issues may make you feel overwhelmed.”

### Transformative Games

All games are not created equal for learning, however. Games such as *Candy Crush* and *Bubble Breakers* are used to train specific skills such as pattern recognition.

Mingfong finds that such games are more popular in Singapore classrooms, possibly because they are easy to use.

A Math teacher, for example, can easily Google for a game on multiplication and then use it in class. Such games are fun for students, and they’ll be motivated to play them again and again and thus become better at multiplying numbers.

Compare that with a complex role-playing game like *Civilization*, which puts players in a situation where they must work with other players and come up with strategies to build and sustain an empire.

Such a game can be described as *transformative*, because it has the potential to transform the teaching and learning experience.

For example, in such a game-based learning environment, students are players who make their own decisions in the game. Teachers become game masters who guide their participation instead of teaching content. But some teachers would still feel the urge to teach, by stepping in to conclude or explain things to students.

“If you don’t do this, you feel you’re not being responsible to your students!” says Mingfong. “It’s a very different kind of role playing in the classroom. It may be out of the teachers’ comfort zone, but we need to help teachers to feel comfortable about changing their teaching approach.”

As such, game-based learning is not just about the games themselves, but also very much about the classroom “game”, or classroom culture. It has the potential to change rules, roles and tasks in the conventional classroom.

### Changing the Classroom

Very often, technology such as digital games comes to mind when we talk about game-based learning. But it need not be the case.

**Mingfong Jan** is the Guest Editor of this issue. He is a Research Scientist with the Learning Sciences Lab at NIE and he is interested in how new media (e.g., Flickr, mobile phones and digital cameras) restructure thinking, values, actions, community and culture. Between 2004 and 2013, he was involved in the designing of more than 10 transformative games, including *Mad City Mystery*, *Dow Day*, *Sick at South Shore Beach*, *Saving Lake Wingra*, and most recently, *Green City Blues*.

“When you can change the classroom using high technology and with sufficient technical support, that is an ideal situation. I would call it a ‘perfect storm’, where everything meets your requirements.”

But as all teachers know, the conditions are seldom just right in a classroom! In such a case, a “thunderstorm” can still be generated without expensive or complex games.

“Another way is to use low-cost technology, even paper or cards. Students tend to be motivated by any kind of games you use in the classroom,” Mingfong says.

“Think about the different ways to change the classroom, such as ‘gamifying’ the classroom. It can be any game where students and teachers play different roles, and you use game mechanics to create a scenario for problem solving.”

The ultimate aim, really, is to change the classroom culture and the way students and teachers interact with each other, so that both learning and teaching can become richer and, yes, even fun!

Learning must be cultivated through guided participation in the context of problem solving, inquiry and collaboration.

- Mingfong on the learning process

## Research

# Transforming Learning and Teaching with Games

*In the world of games, knowledge isn’t useful unless students translate it into action. What does this mean for learning and teaching in the game-based learning classroom?*

To teach how acids corrode metals, you can let students conduct experiments with some zinc lumps and sulfuric acid.

Or, you can let them fight off metallic monsters using guns loaded with an acidic mixture.

Some teachers did just that in Chemistry lessons, by using the computer game *Legends of Alkhimia*, developed by Dr Chee Yam San and his team in NIE.

In this game, students take on the role of chemists who have to figure out what combination of chemicals gives them the best ammunition to kill off those monsters that are hot on their trail.

It certainly sounds exciting—and in more ways than one.

### First-person Learning

To Yam San, games such as *Alkhimia* have the potential to change the way learners relate to what they learn.

“If I teach you about nickel, for example, the learning is in the third person,” he says. The focus is not on the student, but on the content.

“But in these game spaces, students are someone and they take on a role,” he further explains. “They’re the hero, the protagonist, the person who matters.”

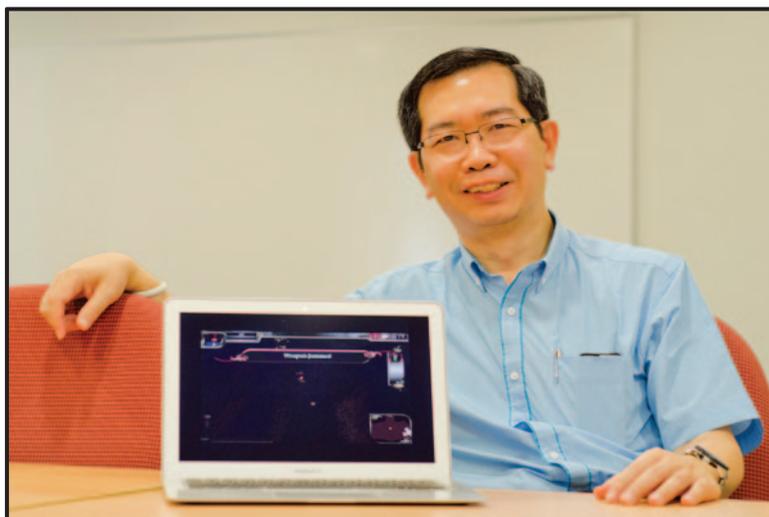
Because of that, students are much more likely to stay engaged throughout the learning process.

“Games offer this epistemological shift in the relation between the learner and what is being learned: from the third person to the first person. And that makes learning real and alive.”

### Knowledge in Action

A game like *Alkhimia* creates a space for inquiry and puts students firmly in the action seat. Knowledge is no longer something that they simply memorize and recite back to the teacher. Instead, they have to turn their knowledge into action, or risk being mauled by monsters (virtually, that is).

“It changes your relationship with what you know, because you’re acting on it and not just knowing it,” says Yam San.



Learning becomes a continual becoming—becoming an expert.

- Chee Yam San,  
*Learning Sciences and  
Technologies Academic Group*

## Online Extras!

Read about Yam San's pedagogical model for game-based learning in our online box story.

## Reference

Chee, Y. S. (2011). Learning as becoming through performance, play, and dialog: A model of game-based learning with the game *Legends of Alkhimia*. *Digital Culture & Education*, 3(2), 98–122.

**Chee Yam San** is an Associate Professor with the Learning Sciences & Technologies Academic Group at NIE. His current research focuses on new media and new literacies in education, with a special emphasis on game-based learning in formal and informal learning environments, as well as identity construction through living online. He was involved in the development of numerous digital games, including *Statecraft X*, *Legends of Alkhimia*, *Escape from Centauri 7*, and *Space Station Leonis*.

This opportunity for students to act on what they know is often missing in traditional schooling. And it's a gap that games fill very well. Immersed in a virtual environment, students are free to try out different approaches to solving a problem.

Here, the notion of *play* is pivotal. Students can play with the knowledge by doing and re-doing in the game space.

Even if they get it wrong the first time, they can always restart the game. Doing and getting things wrong can be invaluable to students' learning, says Yam San.

"It is because you can do the wrong thing that you'll understand and have a basis for justifying why the right thing is indeed right!"

That, to him, is what true understanding is all about.

## Learning to Be an Expert

When students are doing and re-doing something, they've changed from learning about content to learning to be. "Learning becomes a continual becoming—becoming an expert," says Yam San.

He calls this approach to learning *performance*. Just as professional swimmers or musicians constantly practice to improve their performance, students are doing the same.

But practising alone is not enough. Students have to be reflexive about it.

"You can interrogate your own performance and ask: How well did I do?", Yam San suggests. Students may even compare their performance to their ideal standard.

"If you're a classical pianist, you have an ideal of how you want your performance to turn out. During the actual performance, there may be some wrong notes played. During your reflection, think about what's different between the actual and the ideal. That tells you what you need to pay attention to. That's key to performance."

## Opening Up the Classroom Conversation

Another crucial part of game-based learning is *dialogue*. On this, Yam San talks about the Social Studies game *Statecraft X* that he and his team came up with.

Governance is traditionally a tricky topic to teach as it involves many abstract concepts, such as democracy.

"It naturally invites a game-based treatment, where it's not just understanding about governance, but understanding governance by *doing* governance," Yam San notes.

In *Statecraft X*, students are governors of their virtual states and have to ensure that their citizens are happy and well taken care of. This includes fulfilling the citizens' basic, higher order and cultural needs, and also maintaining economic stability and multicultural harmony.

It's a great way to introduce civic and societal issues to students in an engaging manner. But to relate what they're doing in the game to the real world, students need a little extra help.

This is where teachers come in, to help them talk through what it means to govern a state and to be a citizen of the state.

"The game opens up the classroom conversation and that's where the dialogue takes off. As a teacher, you can help students understand themselves and their own values in relation to these issues," Yam San explains.

Facilitating such classroom conversations may mean that teachers have to adjust the way they teach (see box story online "Transforming Practice: Lesson Preparation, not Planning"). But the effort they put in will mean a lot to their students. As Yam San puts it, "That's how you make learning alive for them—make it matter and relevant."

## Classroom

### Designing History

*Making history come alive in the classroom is on every History teacher's wish list. Instead of bringing students back to the past (which is impossible anyway), a teacher from Raffles Girls' School (Secondary) lets them make up their own games about History.*

Even after teaching the subject for 19 years, Mr Tan Kok Wah constantly asks himself: “How do I make History interesting for students?”

“If you give them documents after documents to read, students will get bored,” he says. “They will say, ‘Tell me, what is in there for me?’”

While students can go on field trips to experience Geography concepts in real life, Kok Wah says that it is not the same for History. “I can’t bring my students back to BC (Before Christ)!”

What these students need in the History classroom is another kind of motivation. So, when a student suggested to Kok Wah that they play board games, he thought, why not?

Instead of buying games off the shelves for his students at Raffles Girls’ School (Secondary), Kok Wah decided to make it more challenging for them. He told his students to design their own games.

### Self-designed Games

His reason for doing that is simple: teachers and students have very different perspectives.

Get a teacher to design a game for students and the learning outcomes may not mean much to them. After all, teachers may not always know what students want and like to learn about.

Kok Wah explains that teachers often prefer games with closed systems such that “this and this must equal to that”. Students, on the other hand, prefer an open system with less structure. This gives them more room to explore on their own.

“You have to understand their mental model,” Kok Wah says. “You don’t want the game to be structured in such a way that when they play, there are too many fixed rules and steps.”

Get students to design games for each other, and the learning they gain from the experience may just exceed any learning outcomes achieved from playing commercial games.



The end goal is not the game but to tell me, as you are designing, what were the processes, the thinking and the reflection that you went through?

- Tan Kok Wah,  
Raffles Girls’ School  
(Secondary)

## The Game Design Process

Designing games involves plenty of patience and high-level skills such as the ability to collaborate, question assumptions and think out of the box. Kok Wah shares what happens behind the classroom doors when the students embark on a journey of game design.

**Topic:** Due to time constraints, students pick a small segment of the historical unit they are studying—usually the topic that interests them the most.

**Concept:** Students propose a game concept, such as *Ladder and Snake*, *Tic-Tac-Toe* or *Cluedo*.

**Research:** To justify their choice, students research on the rationale behind the game concept, and why people like to play it. They also write a literature review of the game concept.

**Design:** After gathering substantial research, students start designing the game, tweaking its contents to fit their chosen historical topic.

**Pilot test:** Students run pilot tests with their classmates to see if the game works the way they plan. If it doesn’t, they will review their game and do the necessary modifications.

**Questions:** Kok Wah has to ensure that the girls are on the right track. Every so often, he checks on their progress and asks them challenging questions that will push them to brainstorm further. Some of the questions include:

- Are you too ambitious?
- Are your game instructions clear and coherent?
- Which historical perspectives have you included? Which have you left out?
- What assumptions about the players do you base your game on?

### Game Design in the Classroom

The students are given just 2 weeks to come up with a game design.

During the first lesson, Kok Wah introduces a History topic and related concepts to the class. Students are then given the liberty to choose an interesting part of what was taught for further examination.

There are different types of playing. I would say this is serious playing. It is fun, but it is *hard* fun.

- Kok Wah on his approach to game-based learning

**Tan Kok Wah** has been teaching for 19 years and is currently teaching History at Raffles Girls' School (Secondary).

Working in groups, students think of a game that can help their peers understand that particular historical concept better. For example, one group of students picked the topic of Japanese Occupation and came up with a board game based on the *Ladder and Snake* concept.

Their game design has to be based on sound principles, and so students do extensive research and come up with a literature review of game concepts.

And it doesn't just stop there. Upon design completion, students have to run pilot tests of their game prototypes by asking their own friends and even families to play them and provide feedback.

### Developing Critical Thinkers

"If you ask me whether the process is tedious, I would say yes. It is very painful for the students," Kok Wah says. "It is actually harder than pen-and-paper tests."

But such a challenge gives the RGS students a chance to exercise their critical thinking skills.

In designing the games, they had to think like a designer and player. In the case of the Japanese Occupation game, the players could be Japanese, British or locals. Each would have a very different historical perspective.

Because of this, the students learned that there will always be different interpretations of the same historical event. Although some of them felt unsettled by such ambiguity, Kok Wah thinks that this is precisely what students need to learn to thrive in today's world.

This part of the design process becomes very important to learning.

As Kok Wah told his students, "The end goal is not the game but to tell me, as you are designing, what were the processes, the thinking and the reflection that you went through?"

"What have you understood from the design? The concepts of game design and the concepts of history—how did you infuse them together?"

Rather than model answers, the girls are given only guidance and coaching from their teacher. The collaborative element in designing games also helps these students foster a sense of belonging within the group they work in.

"There are different types of playing," Kok Wah explains. "I would say this is serious playing. It is fun, but it is *hard* fun."

And these are the kinds of hard fun that the girls welcome in their History classroom. As Kok Wah puts it, play is inherent in humans—to play is to learn.

## People

### 21st Century Competencies: Learning to Learn

***The fact that it's crucial for our students to acquire 21st century competencies is something many teachers believe in. But what can they do to help students acquire those competencies? What teaching strategies should they use?***

Volatility, uncertainty, complexity and ambiguity: These four words were used by the Minister of Education Heng Swee Keat to describe the 21st century environment at the 2013 MOE Workplan Seminar.

The question of how schools and teachers can help students acquire the competencies to navigate this brave new world is being debated about not just in Singapore, but all over the world.

Representatives from 10 major cities in Asia and North America recently convened in Singapore to discuss this and other key issues in education. The meeting was organized by the Global Cities in Education Network (GCEN) of the Asia Society (based in USA), and the Ministry of Education and the National Institute of Education in Singapore.

As part of their activities in Singapore, GCEN invited renowned panelists to speak at the public symposium "Teaching and Assessing 21st CC: An International Perspective" on 9 October 2013.

The panelists are:

- Professor Linda Darling-Hammond, the Charles E. Ducommun Professor of Stanford University, USA;
- Ms Gen Ling Chang, Associate Director of the Toronto District School Board, Canada;
- Mr Wong Siew Hoong, Deputy Director-General of Education (Curriculum) of the Ministry of Education, Singapore; and
- Professor Lee Sing Kong, Director of the National Institute of Education, Singapore.



The audience of 370 educators and policymakers were treated to insightful discussions on how 21st century competencies should be taught and assessed. We bring you excerpts from the discussion on teaching strategies.

*The panelists at the Asia Society's Global Cities Educators Network Public Symposium*

### **Professor Linda Darling-Hammond**

I think there is some consensus that more of certain strategies can be helpful. Engaging students in productive and well-designed collaborative work, using technologies for finding, analyzing and synthesizing information aimed at solving problems—that is, empowering the use of technology.

But I do think that there are competing ideas in practice. There's a lot of furore over technology, about how some people are really using it like an electronic workbook, where the students are controlled by the technology. You see a lot of this, and it's called 21st century learning because there's a computer involved. But it's actually not really about critical thinking and innovative skills. It's the student being managed by the computer to fill out multiple choice questions, to master bits of information.

So we shouldn't be confused by the presence of technology and whether it automatically means we're pursuing 21st century skills, which should be the fluid ability to use tools, text resources, ideas to solve problems in a new space.

We're learning to learn. I often quote two of my colleagues at Berkeley who have been studying the growth of knowledge. They found out that between 1999 and 2003, there was more new knowledge created around the world than in the entire history of the world. Human knowledge was doubling every 2 years at that time. It's now doubling every year.

What that means is you can't just take a curriculum and make sure the kids master a certain number of facts from there every year. Then, at the end of 12 years, we'd be done. They would be working with knowledge that hasn't been invented yet, to solve problems that we can hardly envision, using technologies that don't yet exist. These need 21st century skills.

Computers are a way to access information. If you can Google it, the real question becomes, do you need to memorize it then? That's a good debate and we should engage in it. I'm not saying, throw away the facts. There is knowledge that you need to master and understand, but yet, master it in a way aimed at using it to solve new problems, rather than to just forget at the end of the exam. So I think that's one of the areas where learning has to be continually focused on: the use of that knowledge.

### **Ms Gen Ling Chang**

Technology is a fascinating thing. We look at the use of technology as a learning device. You can use it as a substitution tool or you can use it to augment learning capacity. It's two very different concepts. When we begin to look at that, we see a "participation gap". A student could use social media forum to engineer and influence debate and discourse, while another student uses Twitter to talk about what Lady Gaga wears. Two very different use of a learning device: that's a participation gap.

So what is the role of our schools? We begin to develop what we call the general learning skills for kids, where we teach them how to harvest information relative to their purpose, how to curate, archive and use them without plagiarizing. That is a whole new set of skills.

There are kids who sit at the computer for 2 hours and they don't do their assignment because they're navigating YouTube which is so fascinating to them. They listen to one speaker after another and when the next assignment comes up, they do the same thing because they've not learned the skills or capacities.

**There is knowledge that you need to master and understand, but yet, master it in a way aimed at using it to solve new problems, rather than to just forget at the end of the exam.**

*- Linda Darling-Hammond,  
Charles E. Ducommun  
Professor, Stanford University*

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*- Gen Ling Chang,  
Associate Director,  
Toronto District School Board*

What I'm very sure of is that we need to move away from very traditional pedagogies.

- Wong Siew Hoong,  
Deputy Director-General  
of Education (Curriculum),  
Ministry of Education

I think the key is, teachers must capitalize on the learning profile of our children.

- Lee Sing Kong,  
Director, National Institute  
of Education

I'm just giving you an idea of how far more complex the work of a teacher is as we move forward in developing the 21st century competencies.

#### Mr Wong Siew Hoong

I echo Ms Chang's view, which is that teaching has become a lot more complex.

What I'm very sure about pedagogy for 21st century competencies is that it can't be didactic. The days of teachers standing in front and delivering a set of ideas and knowledge to students, that is no longer relevant. This is because of technology and also how knowledge is now freely available. So what I'm very sure of is that we need to move away from very traditional pedagogies.

And that's where the whole array of different pedagogies might then be applied. That's where the complexities of teaching have begun to complicate our lives as teachers. Because as teachers we have to think, "Which pedagogy is the most relevant to my subject area?" And it's not just about teaching a set of ideas, but a set of skills related to those ideas that can bring students forward in the 21st century.

My proposition is therefore that our teachers, all of us in teaching, must be ready to apply within the classroom a wider repertoire of pedagogies.

#### Professor Lee Sing Kong

Teaching in the 21st century is not easy, it's a very challenging task! For professors teaching in universities, the moment they begin to speak about a certain topic, the students are way ahead of them because they've already Googled the topic. In fact, they'll be asking the professor questions which may stump him or her. I believe many children in our schools are also like that. I describe the students in our schools today as EPIC learners (who learn in ways that are experiential, participatory, image-driven and connected to the world).

I think the key is, teachers must capitalize on the learning profile of our children. Teachers must understand who our students are, and how they prefer to learn. That's why I totally support the idea that NIE continues to inculcate in our teachers the belief that we must teach our students to learn how to learn. Knowledge is freely available. What you think you have given them, they can find it in many other places. We must facilitate their learning so that they know what knowledge to look for. That's why one of the outcomes we want to achieve is self-directed learning.

The other part is, students love to work as a group, either physically or virtually. So, in schools, we must learn to tolerate noise. In the past, when we talk about didactic teaching, the quieter the classroom is, the better it is. Today, I think it is the opposite. We must tolerate noise simply because we want to encourage our students to talk, to collaborate and, in the process, to learn.

Teachers today are facing a very strong challenge when it comes to how to teach. But the greatest importance of a teacher today is to understand your students well. Different groups learn differently. Once you understand your students well, you can adopt an appropriate approach. It is really no more a one-model-fixes-all situation.

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## Online Exclusives



A Literature Review of  
Game-based Learning



Collaborating in the Chinese  
Classroom



Playing with the Environment