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SINGAPORE

Learning in and for the 21st Century

CJ Koh Professorial Lecture Series No. 4
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A publication of the Office of Education Research, National Institute of Education, Singapore

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FOREWORD BY SERIES EDITOR

IT GIVES ME great pleasure to present the fourth issue of the *CJ Koh Professorial Lecture Series* – "Learning in and for the 21st Century". For this issue, I am pleased to have Dr Manu Kapur, Head of Learning Sciences Lab and Associate Professor in the Curriculum, Teaching and Learning Academic Group, as the Guest Editor along with his secretariat team.

This is a carefully crafted report of the symposium held in conjunction of the appointment of Professor John Seely Brown as the eighth CJ Koh Professor and of the public lecture he delivered during his appointment from 21 to 22 November 2012. Professor Brown is a visiting scholar and advisor to the Provost at the University of Southern California and the independent co-chairman for Deloitte Center for the Edge.

Since the inception and appointment of the first CJ Koh Professor in 2006, the CJ Koh Professorship has allowed for the appointment of distinguished professors of Education from the United States, United Kingdom and Europe. The appointments of the CJ Koh Professors have been made possible through a donation of S$1.5 million to the Nanyang Technological University Endowment Fund by the late Mr Tiong Tat Ong, executor of the late lawyer Mr Choon Joo Koh (CJ Koh) estate. The endowment serves the programme of the CJ Koh Professorship in Education. An additional sum of S$500,000 was

FOREWORD BY SERIES EDITOR

donated to the endowment fund for the awards of the Pradap Kow (Mrs CJ Koh) Scholarship in Higher Degrees in Education. The purpose of this report is to ensure that the fruitful discussions arising from the professorial appointments reach out to key stakeholders within the National Institute of Education (NIE), the Ministry of Education (MOE) and the wider local and global educational fraternity at large, who can benefit from the information shared.

With that, I would like to take this opportunity to thank all who contributed to this report in one way or another. To NIE Director Professor Sing Kong Lee and Dean of Education Research Professor Wing On Lee, thank you for your steadfast support of the *CJ Koh Professorial Lecture Series* from start to finish, which allows the report to become a reality. To our CJ Koh Professor John Seely Brown, your thoughtful perspective and sharing on learning in the 21st century has given this report its intellectual substance. To Dr Manu Kapur, thank you for graciously accepting this role as Guest Editor and for devoting your time and doing your utmost best for this issue. My sincere appreciation goes out to all of you who carved out precious time to contribute to the insightful discussions at the symposium and for attending the public lecture.

Finally, this consolidated report would not have been possible without the stellar secretariat team who were responsible for producing the first drafts through to the final product and also to our outstanding Publishing Team from the Office of Education Research, Ms Ai-Leen Lin and Mr Jarrod Tam. On that note, it's my joy and honour to present you the fourth issue of the *CJ Koh Professorial Lecture Series* – "Learning in and for the 21st Century".

On a sad note, our *CJ Koh Professorial Lecture Series* team would like to extend our deepest condolences to Mrs Ong Tiong Tat who lost her beloved husband and generous philanthropist Mr Ong Tiong Tat on 14 February 2013 while we were in the midst of producing this issue of the series.

Associate Professor Ee Ling Low
Associate Dean, Programme & Student Development, Office of Teacher Education, NIE
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September 2012
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PREFACE

PROFESSOR DAVID HUNG
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IF THE 20TH CENTURY was about providing basic and mass education to learners, then the 21st century is about empowering and enabling learner-centric learning environment and dispositions. John Seely Brown's (JSB) visit as CJ Koh Professor is concerned with how we can cultivate dispositions of tinkering and imagination in learners – dispositions that are critical to success in the 21st century. JSB's call is particularly potent in the 21st century context when change is exponential and requires one to constantly learn and invent new ways of thinking and being. Contextualising this concern to the Singaporean milieu, this prophetic call to reform seems to reflect that many students, and parents, are overly investing in the regime of credentialism, typically connoted by performance in formal settings around high-stakes examinations. Such a characteristic is not uncommon in East Asian societies, especially when the perception of moving up the social ladder relates to having a good certificate. Is it possible to excel in the examinations, yet remain true to interests and even hobbies that might cultivate 21st century dispositions? Even if a select and elite group might be able to maintain a balance of both, the general public would likely mourn over the struggles of these tensions. There seems to be the tension that over-preparing "for the test" or for teachers to predominantly teach to the test hinders other opportunities for learners to cultivate the dispositions which JSB deems to be fundamental to the 21st century.

However, these dispositions are not uncommon in informal learning situations, and in interest-driven

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communities. One direct implication is that if we encourage learners to pursue interest-driven activities, although not necessarily forsaking the need for some measures necessitated by schools in examinations, we just might still be able to cultivate the dispositions of tinkering and imagination; dispositions that are fundamental to an innovative society build upon intrinsic value creation of new ideas and products necessary for the knowledge economy.

Another, and not so direct, implication is to redesign formal learning environments in ways that foster the development of not only the kinds of skills and knowledge needed to excel in exams but also dispositions of tinkering and imagination. The two, though often dichotomised, need not be seen as such. In fact, emerging research, both locally and internationally, is suggesting powerful ways of designing learning environments that can develop both basic knowledge as well as 21st century skills. The Learning Sciences Lab (LSL) of NIE has generated several such experiments and design efforts (knowledge-building communities, productive failure, seamless learning, etc.) that have demonstrated the efficacy of designing for 21st century learning in real-classroom ecologies in Singapore.

We often lament over why Singapore has not produced the Steve Jobs or Bill Gates of the world. Compared to societies such as the US, we wonder why we are lacking in high-value, innovation-driven companies such as the Googles or the Apples. The typical response is that we have the disadvantage of a small population base, and, hence, the chances of a home-grown internationally successful entrepreneur is, probability-wise, highly unlikely.

Yet, if you look at Singapore historically, we are inherently a community of traders. Considering the first generations of immigrants from the region, they typically came to set up businesses and traded in different forms of communities. Today, this trading psyche is expanded to banking, property and other increasingly sophisticated arenas. In other words, the value-creating culture and disposition for innovative products and processes are inherently nascent.

While we have not yet matured in our high-end innovation companies, we are not without the tinkering and imaginative dispositions that JSB argues for. In this respect, tinkering and imagination have much in common with many improvisational performance arts, and examples of tinkering can be drawn from music such as jazz, stage drama and comedy (local Singaporean productions such as the *Mr Brown Show*, or local comedians such as Hossan Leong), culinary and cocktail-mixing art-forms, and other Asian-fusions. We suspect that such fusions occur due to a rich array of cultures in our society. We have strengths in a truly multi-cultural milieu here in Singapore.

Perhaps we now need to design for tinkering and imagination more squarely in the formal and informal curriculum. Schools in Singapore, although typically known for their performance in international benchmark examinations in Science and Mathematics, have interesting interest-driven activities, especially through the various Co-Curricular Activity (CCA) programmes. Our NIE researchers (e.g., Kenneth Lim) who delve into students' informal activities have observed students in the National Cadet Corps (Air), a uniformed youth organisation, in a typical school extending their interest in aeromodelling to tinkering critically in electronics and mechanics more generally. Created using funds pooled from their own savings, and using scrap materials and tools from the school's metalworking and woodworking workshop, the students engage in authentic informal learning in the pursuit of their interests originating from aeromodelling. Similar phenomena can also be observed in robotics.

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But undeniably, we can do more if we accept JSB's propositions. Many parents have remarked that children possess the traits of creativity and curiosity but somehow lose them along their trajectory towards adulthood. We appear to discourage "messing around" because parents regard it as "wasting time". Perhaps it is due to the current regime of credentialism, or an overly efficient pursuit of short-term performative goals, normally explicitly motivated. Perhaps it is time that we seriously re-think the design of formal learning environments as well.

We cannot simply rely on the informal; we need to create a powerful formal–informal dialectic that will drive the development of 21st century dispositions pervasively through the family and schooling experiences of our children. What we need is a re-design at the cultural level.

Hence, it appears that besides thinking about how to develop programmes in schools or courses in adult settings to cultivate tinkering and imagination, it is really a matter of transforming a culture. In other words, we need a culture-shift from one that privileges credentialism and forms of explicit rewards to one that is more balanced and motivated by intrinsic value, passions and innovations. Nudging towards such a culture-shift will enable greater equity and social mobility. We have a small population base, and every child matters in Singapore.

There is a need to provide infrastructure for play (another word for tinkering) and "messing around" that is publically assessable for all. LEGO®, for example, is well known for developing dispositions for play and constructing ideas for young children. These resources should not just be available for those who can afford it, but should be shared in public community spaces, libraries, and more. In the US, there is a recent phenomena of Techshops, Fab Labs and other maker-spaces where adults and youths can come and make things. These spaces allow for a Do-It-Yourself (DIY) culture in the US through the availability of tools and technologies such as the 3-D printers, and more. In Singapore, we can possibly engage our citizens in fabricative activities involving arts, crafts, electronics, woodworking and metalworking. In fact, these could be family activities or parent–child activities during weekends where they engage in making things and in cultivating ideas, dispositions and family bonding. In terms of early interventions, we suggest cultivating interest from young in kindergartens and schools. If children and youths develop and cultivate these interests, how do we sustain them through primary school all the way to adulthood? JSB illustrates with online communities where networks of practice are forged. Could the limitations of our population base be overcome by online networks of interests? How do we leverage vibrant online communities to cultivate intrinsic value creation culture?

Taking heed of JSB's call for tinkering and imagination, we believe that our children have the potential and innate abilities that can be cultivated. However, they, and we, need a Culture (Big "C") as constituted in the community, schools and in their homes, to encourage this cultivation. Parents and teachers, and other caregivers, must be able to see the interests of children and encourage these interests even if they do not initially appear to foster trajectories of practical pursuits. For example, children's doodling is now recognised to be far more significant in cultivating imagination and the connecting or remixing of ideas than previously thought. In doodling, individuals create and re-create through drawing. Perhaps the fundamental disposition for tinkering and imagination begins with basic interests such as these! In a world of exponential change, our credentials may just be nothing more than transient doodles.

ABOUT THE CJ KOH PROFESSOR JOHN SEELY BROWN

JOHN SEELY BROWN (JSB as he is often called) is a visiting scholar and advisor to the Provost at the University of Southern California (USC) and the independent co-chairman for Deloitte Center for the Edge. He was the Chief Scientist of Xerox Corporation until April 2002 as well as the director of Xerox Palo Alto Research Center (PARC) until June 2000, a position he held for 15 years. While head of PARC, JSB expanded the role of corporate research to include such topics as organisational learning, complex adaptive systems, micro-electrical mechanical system and NANO technology. His personal research interests include digital culture, ubiquitous computing, service-oriented architectures, global innovation networks and learning ecologies.

JSB is a member of the American Academy of Arts and Sciences (AAAS) and the National Academy of Education, a Fellow of the American Association for Artificial Intelligence, the AAAS, and a Trustee of the MacArthur Foundation. He serves on numerous boards of directors (Amazon, Corning, Varian Medical Systems) and advisory boards. He has published over 100 papers in scientific journals and was awarded the *Harvard Business Review*'s 1991 McKinsey Award for his article "Research that Reinvents the Corporation" and again in 2002 for his article (with John Hagel) "Your Next IT Strategy". In 1997, he published the book *Seeing Differently: Insights on Innovation*. He was an executive producer for the award winning film *Art • Lunch • Internet • Dinner*, which won a bronze medal at Worldfest 1994, the Charleston International Film Festival.

JSB received the 1998 Industrial Research Institute Medal for outstanding accomplishments in technological innovation and the 1999 Holland Award in recognition of the best paper published in *Research Technology Management* in 1998. He was presented with a 2002 Visionary Award by the

Software Development Forum and was inducted into the Industry Hall of Fame in November 2004. With Paul Duguid, he co-authored the acclaimed book *The Social Life of Information* (2000) that has been translated into 10 languages with a second addition in April 2002. With John Hagel, he co-authored the book *The Only Sustainable Edge* (2005) which is about new forms of collaborative innovation and *The Power of Pull: How Small Moves, Smartly Made Can Set Big 2 Things in Motion*, published April 2010. His current book, *A New Culture of Learning* co-authored with Professor Doug Thomas at USC, was released in January 2011.

ABOUT THE CJ KOH PROFESSOR JOHN SEELY BROWN

JSB serves on a number of international advisory boards of Singapore's institutions such as:

- International Review Panel for R&D Programme on Digital Media in Education, Ministry of Education, Singapore (2007–present);
- International Advisory Panel, Ministry of Education, Singapore and Media Development Authority (2007–present);
- Advisory Board, School of Information Systems, Singapore Management University (2006–present); and
- Scientific Advisory Board, National Research Foundation (2006–present).

JSB received a BA (Mathematics and Physics) from Brown University in 1962 and a PhD (Computer and Communication Sciences) from University of Michigan in 1970. His six honorary degrees include:

- Doctor of Science, Brown University (May 2000);
- Doctor of Science in Economics, London Business School (July 2001);
- Doctor of Humane Letters, Claremont Graduate University (May 2004);
- Doctor of Science, University of Michigan (May 2005);
- Doctor of Science, North Carolina State University (May 2009); and
- Doctor of Design, Illinois Institute of Technology (May 2011).

He is an avid reader, traveller and motorcyclist. Part scientist, part artist and part strategist, JSB's views are unique and distinguished by a broad view of the human contexts in which technologies operate and a healthy skepticism about whether or not change always represents genuine progress.

SYMPOSIUM AND PUBLIC LECTURE

PROFESSOR JOHN SEELY BROWN

21–22 NOVEMBER 2012

Introduction

WHAT DO S-curves**,** the Digital Revolution, white-water rafting, *World of Warcraft*, Jeff Bezos, *Jurassic Park*, Wikipedia and *Harry Porter* have to do with each other when we talk about education? Professor John Seely Brown (or JSB as he is fondly referred to) weaves ideas regarding these seemingly unconnected things into a cohesive argument about 21st century learning.

JSB is also advisor to the Provost at University of Southern California, and the eighth CJ Koh Professor at NIE. His 1989 seminal article with Allen Collins and Paul Duguid, "Situated cognition, and the culture of learning", has been cited more than 11,000 times. A recent publication with Douglas Thomas, *A New Culture of Learning: Cultivating the Imagination for a World of Constant Change* (2011), provides a compelling view of a new learning culture that is emerging with the digital revolution. Jokingly, JSB identifies himself as the Chief of Confusion.

In the following, we report on JSB's insights and arguments about 21st century learning, based on his symposium at NIE on 21 November, 2012, and public lecture at NTU@One-North on 22 November 2012.

Shifting Learning: From Scalable Efficiency to Scalable Learning

From S-curve to the Big Shift

From the 18th century to the 20th century, we lived in the era of the *S-curve* – an era of relative stability with regards to social and cultural development (Figure 1).

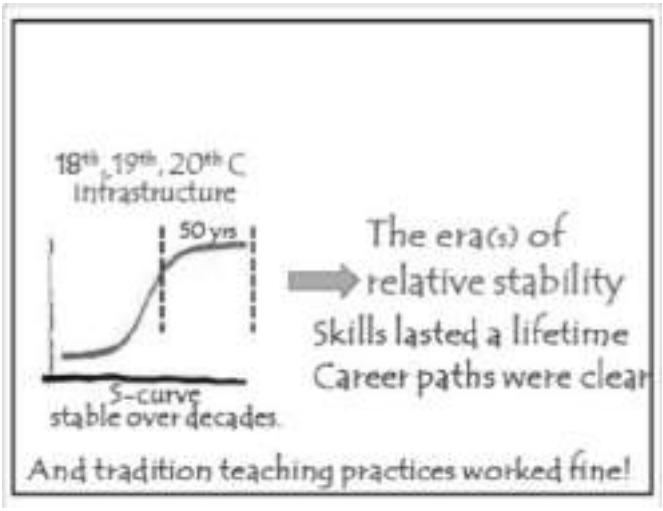

Figure 1. The era of the S-curve.

This era is characterised by episodes of technological systems being created and taking over a locale before being disseminated throughout the whole world. What would follow was a long period of stability, spanning 50 to 70 years. During this extended stable period, institutions were reinvented to help society understand how to operate in this period, teaching practices from teacher training worked, career paths were clear and skills lasted a lifetime.

The 21st century, however, cannot be seen as part of the S-curve. The 21st century marks the beginning of *the Big Shift* (Figure 2). Driven by digital innovations, the Big Shift is an era of exponential change and emergence, both socially and culturally. New skills and practices evolve with new technologies, which often last no longer than 18 months. The technical skills that one could depend upon for a lifetime in the S-curve society have now become irrelevant, just as skills and practices become redundant in just a few years in the Big Shift era.

JSB provided a personal account of learning in the Big Shift era. Having been trained as a computer scientist in the 1970s, he had to completely reinvent everything he knew about computers three times during the last 6 years. What happened was that cloud computing came and was quickly followed by graphic processing units (GPUs) after 18 months. From game machines, GPUs are now used to create super-computers. After yet another 18 months, *big data* came along, which required new ways of programming. Since ways of thinking about computing cannot be transferred across these technologies, old knowledge and skills need to be unlearned with each innovation in order for the learning of new skills.

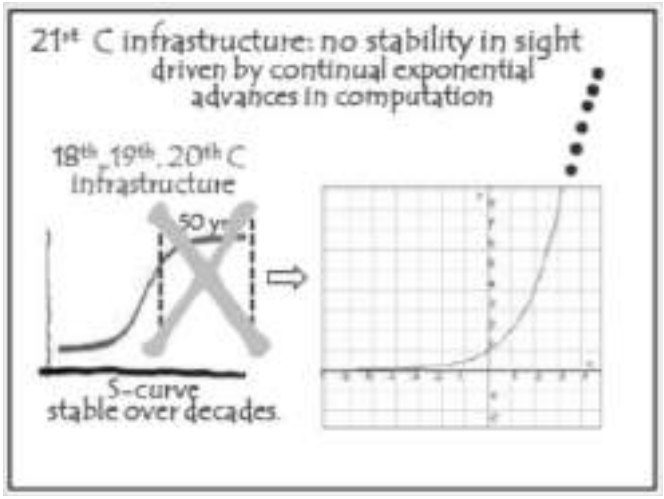

Figure 2. The Big Shift.

The Big Shift and scalable learning

Clearly, the mainstream education system is designed for the S-curve society. For the last 200 to 300 years, the primary concerns in education had been with skill efficiency and scalable efficiency, that is, how to optimise the transfer of expert-generated knowledge to students, even across a nation. However, the world is moving into a state, not of fixed essence, but of constant flow. In this world, much of the knowledge that is created is tacit because there is no time for it to be distilled, encoded and communicated before the next shift happens. This greatly challenges the relevance of standard pedagogies that have to do with explicit, rather than tacit, knowledge. Therefore, there needs

to be a shift in focus from skill efficiency and scalable efficiency to *scalable learning*.

What does scalable learning entail? JSB used white-water rafting as a metaphor for scalable learning. In white-water rafting, learning emerges through the interactions of each micro-second, as if a "conversation" with the water (context) through the paddle is taking place. White-water rafting represents scalable learning as a notion of total embodied cognition and deep participation in a constant flow of knowledge.

Scalable learning also takes into account how knowledge has moved onto networks. In his book, *Too Big to Know* (2012), David Weinberger observed that people used to know "how to know" by getting their knowledge as answers or facts from books and experts. However, since knowledge has moved onto networks, there is more knowledge than ever but topics have no boundaries and nobody agrees on anything. Perhaps now, good questions are more important than answers when it comes to learning in the Big Shift era.

Rethinking learning: Scalable learning

From a Cartesian view to a social view

The Cartesian view of learning constitutes the mainstream learning perspective adopted by schools. The idea of "I think, therefore I am" has informed schools to frame learning as knowledge transfer – from authorities and textbooks to the individual's head. However, the Cartesian view is inadequate in explaining how new situations raise new questions that demand their own answers, resulting in knowledge having a short shelf life. The Cartesian view is also misleading because any learning that is deep takes place through interaction and participation, as seen in the white-water rafting example. A *social view* of learning – "we participate, therefore we are" – is the more adequate perspective on learning in the age of digital innovations.

JSB offered two anecdotes that call into question the Cartesian view and that support the social view. According to JSB, when the President of Harvard embarked on a year-long study to investigate the best possible indicator of success at Harvard, it turned out that none of the standard ways students are judged today, such as grade point average and socioeconomic class, were relevant. Instead, the best predictor of academic success was the willingness of the student to form or join a study group. Similarly at Hewlett-Packard, the ability to lead study groups was the best predictor of an employee's ability to assume leadership roles at the company.

From explicit knowledge to tacit knowledge

Besides an epistemological shift from a Cartesian view to a social view, there needs to be a shift in focus from teaching explicit knowledge to learning tacit knowledge. JSB used an iceberg as a metaphor for the underlying differences between the two foci. While most schooling today is aimed at communicating the explicit in the spirit of scalable efficiency, most of the real (tacit) knowledge is lying beneath the surface.

JSB's own micro-epiphany reveals the differences between the teaching of explicit knowledge and the learning of tacit knowledge. As a student at the University of Michigan, JSB had been taught Mathematics without knowing how professional mathematicians actually worked. But one day in a particular class, what he saw changed his perspective. In order to solve a mathematical problem, his Mathematics professor turned his back to his students for half an hour and scribbled on the board, trying to figure out how to solve the problem. For the first time, JSB saw how a professional mathematician actually worked. He felt he had been lied up till then because students had been taught how to write up their results in a pristine form. The work that he saw that morning was chaotic yet imaginative.

From individual learning to social participation

In fact, learning to "be" is the tacit knowledge that lies at the heart of communities of practice. When people enter into a practice, they are cultivated into that practice and develop an identity in terms of belonging to a community. More specifically, practice and identity are ways of seeing and engaging in productive inquiry. In other words, differences in practice and identity constitute different epistemologies that define communities of practice as epistemic communities. This explains why communicating across different communities of practice becomes challenging; it is because ways of problem-solving differ. Hence, a solution that is elegant to one may be horrible to somebody else in a different epistemic community.

A close inspection of how architectural design studios work yields important lessons. The defining property of every studio is that all work in progress is always public. Therefore, if one is working on a project, his colleague who is just 6 feet away can completely understand his struggles and all that he is going through. What goes on is also a beautiful example of thinking with both head and hand. Conversations start to evolve as people work together on producing something durable. It is also an environment where there is permission to fail and retry, so one does not have to feel bad about failing in front of other people. The culture of learning that is being cultivated in people as they go through these environments is evident.

Some argue that the architectural design studio is something that is highly inefficient for learning, but its efficiency becomes clear when a master comes in and critiques a colleague. One will listen in their conversation, and since he has been a legitimate participant of his colleague's work, he is able to read tremendous amount of content into the conversation to get at their thinking.

The architectural design studios inspired researchers and educators to apply the model to more traditional academic settings, such as an MIT course that aims at building a deep understanding of quantum magnetic fields and electromagnetic theory. Of the 800 original students who were admitted to the course, 200 to 300 would eventually drop out. While this serves to sort out the "geniuses" from the "mere mortals", this seems to be a pretty inefficient use of time. In addition, social minorities tend to be the ones who dropped out. Therefore, MIT appropriated an idea from North Carolina State University called SCALE-UP. The idea was to rebuild the classroom as an architectural studio. There would be not more than 10 or 15 minutes of lecture. Instead, problems would be posed, designs tasks would be given, and then the professor would walk around and look at the problems that the students were having. If students at any particular table had an unusual problem, the professor would stop the class, project that problem up on the many screens around and talk it through with everybody.

However, after about 2 months, they had to stop the class because it could not work. Situated in an academic setting, the architectural design studio faced three problems. First, it required a new set of teaching practices that the professors had little understanding about, having erstwhile been "a sage of stage" rather than "guide on the side". The professors had to learn these new practices. This case shows how new technologies that people are so good at inventing also involve teaching new practices, which can be a significant challenge. Second, there was a problem that is common to Singapore as well: they were marked on a curve. This meant that while learning in the studio was meant to be social and collaborative, the number of students who could be awarded each grade was fixed. Therefore, the programme had to adopt a completely different type of assessment to make it work. Third, there was the problem of developing the disposition of

giving and receiving critique. Anyone who has actually run design studios will realise how students can be unstuck by the right comment and will move on, and how this makes them feel empowered. Instead of being good at criticising what is wrong, we need to know how to offer critique that advances motion.

In short, the focus needs to be on cultivating a culture of learning, not the training of skills.

Learning through online participation

From the perspective of the social view of learning, today's digital technologies enable the creation of contexts that foster social interaction and meaningful participation. For example, technologies and tools of social media, such as Google Hangout, allow one to form study groups and collaborate virtually. Such social media can amplify learning through peripheral participation by allowing one to listen in to another study group or expert groups that offer public access. Open-source systems such as Linux also allow through participation in online communities. To become a full member of an open-source community, participants have to write code that is readable. They also have to make useful criticisms. Open-source, thereby, revolutionalises learning by amplifying participants' ability to learn co-constructively. Now, approximately 1 million students are trained in sophisticated systems design because of open source.

However, the reality is that traditional, institutional views of learning can question or oppose the legitimacy of learning socially online. JSB gave the example of a student called Chris at Ryerson College, Canada. Chris had organised a study group on Facebook for learning Organic Chemistry, and over time, the group became 146 people strong. However, he was later taken to court and thrown out of the college for allegedly having compromised on academic integrity by making academic work too easy and self-directed. It was also deemed as cheating. Fortunately, he was subsequently reinstated when the Engineering Faculty Appeals Committee cleared him of these charges on the basis that the group had actually been engaging in collaborative problem-solving.

Learning with network technologies

In examining the commonality among many entrepreneurs, such as Jeff Bezos the founder of Amazon, JSB found that many of them had gone through progressive forms of education, such as the Montessori system. He maintained that progressive education systems, such as those proposed by Dewey and Montessori, can be reinterpreted through the lens of digital and network technologies to think about scalable learning.

First, scalable learning requires a new type of learning network that unifies the resources that youths utilise in and outside of school. These resources include those that they draw upon in physical and virtual spaces in school, museums and libraries. This new learning network potentially unifies communities on forms of social media such as blogs, forums and Facebook. Second, accreditation systems using network technologies present another possibility for scalable learning. For instance, badge systems can enable kids to be accredited based on their experience in open-source systems (Figures 3 and 4).

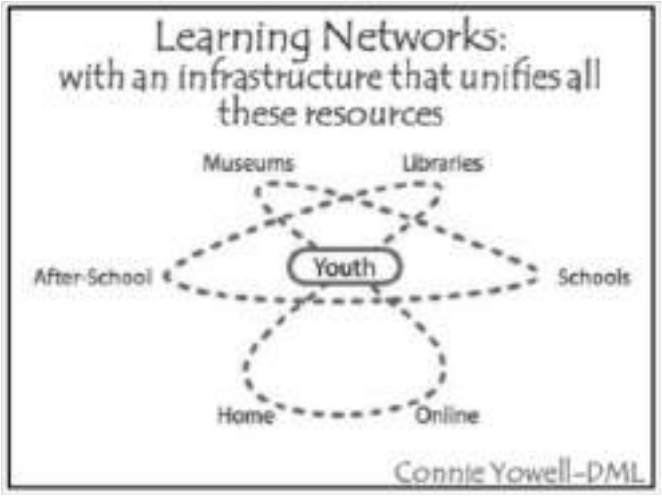

Figure 3. Learning networks.

Figure 4. Social networks and accreditation systems.

Third, power tools afford users to create informal learning networks and therefore can foster scalable learning. Today's kids are living in a world where they engage in a huge traffic of multi-modal digital content. These power tools even allow users to perform tasks like experts in informal learning networks.

The Entrepreneurial Learner

Having set the educational context in terms of the Big Shift and proposed how we might rethink learning in terms of scalable learning, JSB highlighted what scalable learning in the Big Shift demands in terms of dispositions of an *entrepreneurial learner*. The main point here is that dispositions cannot be taught, which is what mainstream school approaches try to do. Instead, dispositions have to be cultivated.

Online gaming communities offer a first sense of what the dispositions that constitute an entrepreneurial learner might be. A case in point is *World of Warcraft* (WoW). WoW is one of the most popular Massively Multiplayer Online Role-playing Games (MMORPG) today. Globally, around 12 million kids are seriously engaging in high-end raid teams by playing WoW. Approximately 15,000 new strategies are being created every night.

Research on WoW has revealed some critical dispositions of expert WoW players that suggest what it means to be an entrepreneurial learner. In particular, two essential dispositions are at play. First, there is "questing". In WoW, this means taking on big goals. Moreover, the processes of seeking, probing and uncovering are always being carried out because the problems and the resources needed for solving them are never given ahead of time. Second, there is "connecting". It refers to how WoW players learn from each other, made possible by social network technologies. The dispositions of questing and connecting are what are required for one to succeed in a world of constant change where people have to connect in terms of reciprocity and the building of social capital.

The Homo Sapien, Homo Faber and Homo Luden

Given the importance of cultivating such dispositions, how can we expand our logical conception of what it means? Human beings have been thought of as Homo Sapien, that is, Man the Knower; and Homo Faber, that is, Man the Maker. Therefore, we might first think of the entrepreneurial learner as both Homo Sapien and Homo Faber. Moreover, human beings are tinkerers at heart. The entrepreneurial learner is Homo Luden, that is, Man the Player as well (Figure 5).

In addition to conceptualising the entrepreneurial learner in terms of these three epistemic lenses, we can also begin to consider how they could be blended. The rise of the "hacker space" instantiates this blended epistemology in a community of practice. A hacker

space is a space where kids can come in and build things with others. It is established around a culture where the community members love to build and tinker. A physical sign outside one of these hacker spaces, Open Studio, depicts the spirit of the space: "'Hack' is a verb, to devise or modify something, usually skillfully". Innovation thrives at the crossroads where ideas, perspectives and information from different fields, places and people collide in the chaos of creativity. Clearly, kids engaged in these hacker spaces are coming together to build and to share things with each other.

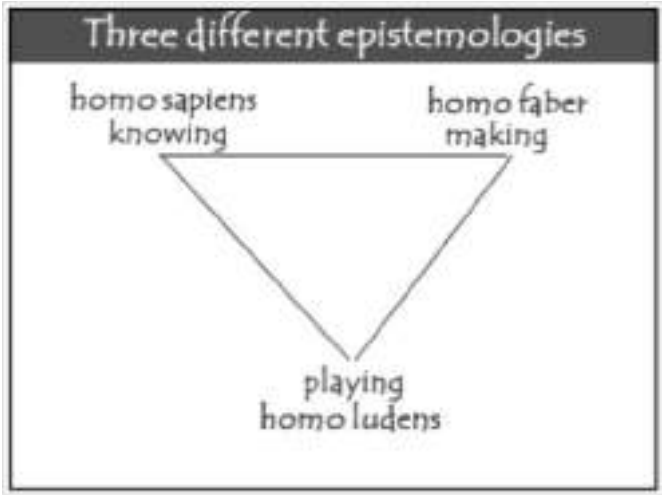

Figure 5. Three different epistemologies.

Making contexts

Human beings are predominantly thought of as makers, especially in terms of producing physical materials. However, there are now many tools in the digital world to help users make context as much as content. This was literally impossible before unless one were a billionaire and bought a TV station to create a context of how news can be curated, for instance. Now, even kids are starting to make their own contexts. Therefore, there is a need to reframe "making" in terms of "making context". In particular, we might consider how a context could be made using digital technologies and how in making context, people are able to frame how something is to be perceived and understood.

The practice of remixing is a fitting example of how new meanings are made by changing the context. Remixing is taking the content and changing what the content means to the viewer. For instance, when the music to a video is changed, the audience's emotional response to it will change as well. But more could happen, is that what is seen would also be changed. For example, JSB shared that people may remember seeing the scene of the T-Rex swallowing a man and chomping on him in the movie *Jurassic Park*, directed by Steven Spielberg. However, if a still frame analysis of the movie were to be carried out, it will be discovered that at the critical moment when the jaws close, the movie goes blank. What does happen is that the music continues, which is meant to make viewers imagine or "see" the T-Rex chomping on the man. Triggered by the music, viewers fill the scene with their own image in a way that is more powerful than if they had actually seen it.

Another practice that is context-building is blogging. A very successful blogger, Andrew Sullivan (2008) notes that "[A blogger] is – more than any writer of the past – a node among other nodes, connected but unfinished without the links and the comments and the track-backs that make the blogosphere, at its best, a conversation, rather than a production." What is being suggested here is that blogging is creating the context of an on-going conversation.

New contexts, new literacies

The emerging online practices, such as remixing and blogging, create contexts and new contexts that

require new literacies. The example of Wikipedia shows how the typical concern about content accuracy is legitimate, but perhaps misleading at the same time. The real concern should be about how Wikipedia is to be read. Unlike the *Britannica*, Wikipedia captures the previous arguments and versions that lead to the current pages being published. Knowledge should always be contested. Therefore, users of Wikipedia should be going to the edit page and examining the parts where definitions are contested.

These new literacies also mean that kids need to be taught critical reasoning, because they have to be able to read the contested knowledge to make up their own minds about what to believe. This is also part of civic intelligence. JSB illustrates this through the famous photograph taken in Baghdad during the Iraq War: the statue of Saddam being pulling down appeared on the front page of every English-speaking American newspaper. The photograph was real but cropped, therefore altering its meaning. What the photograph did not show was that the people pulling the statue down were American soldiers instead of Iraqis; the cropped photograph and the accompanying headlines made readers believe Iraqis had pulled the statue down. Fortunately, many kids today are so good at remixing that they have begun to understand exactly how such messages can be manipulated in very powerful ways.

The comfortable world of relatively stable context that people have been so used to has changed irrevocably. As the world moves from stable to fluid contexts, today's creators, leaders and teachers need to be able to constantly reshape their conceptual lenses. They need to radically rethink how they see things. The problem is that they may not even be aware that they are wearing them nor realise how these lenses influence how they see. Even if they are cognisant to the fact, they do not know how it is so second nature to them. In this digital world, kids are constructing frames by tinkering and playing in the ways that have been described above. Crucially, it turns out that one's conceptual frames come from playing.

The play of imagination

The sense of play emerges under at least two conditions: permission to fail and the exercise of play imagination. Extreme sports and hip hop are good illustrations. To reach extreme performance in extreme sports, kids must be given permission to fail again and again. In performing hip hop, kids are actually being poets in terms of attuning to the most nuanced shades of sound in a phrase.

Moreover, when kids are given a creative context for play imagination, epiphanies can arise which enhances learning retention. The learning that happens through epiphanies is never forgotten. One example is riddles. In solving a riddle, one needs to reframe and register words, as illustrated in the following: "A black dog is sleeping in the middle of a black road that has no streetlights and there's no moon. A car is coming down the road with its lights off, but steers around the dog. How did the driver know the dog was there?" If one thinks the reason is day time, one would be right! What needs to be done is to reframe the context that was initially established ("black", "no streetlights", "no moon" and "with its lights off"). This is play imagination at work.

Playful tinkering

Moreover, it is perhaps in playful tinkering and reframing that one is being Homo Sapien, Homo Faber and Homo Luden all at once (Figures 6 and 7).

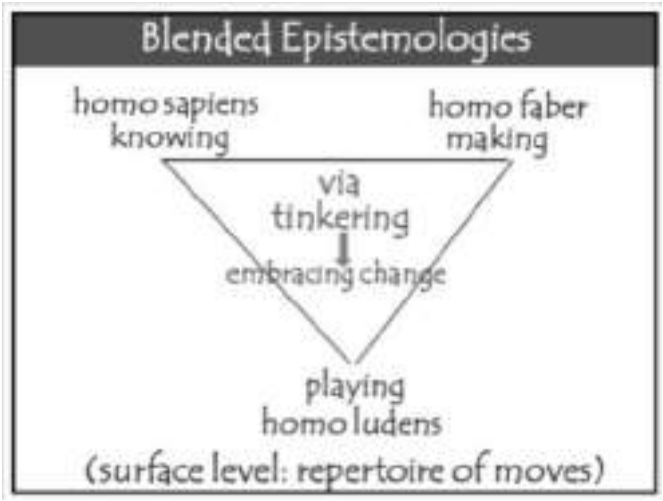

Figure 6. Blended epistemologies of tinkering.

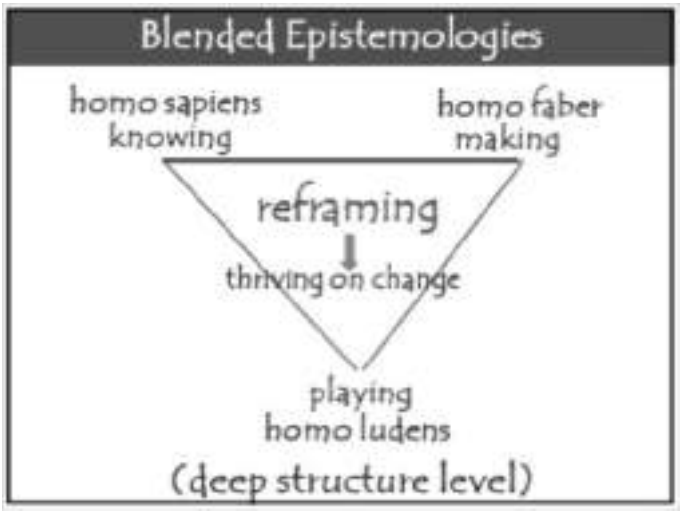

Figure 7. Blended epistemologies of reframing through tinkering.

As people tinker, they expand their repertoire for problem-solving, which also enables them to embrace change. The iPhone is a case in point. Kids will usually master almost everything important about it within an hour by tinkering with it. People of an older generation tend to require a manual. The point is that the way that one learns how to embrace change starts with him tinkering with something. In this way, he will acquire a repertoire of moves that helps him get unstuck. Once one can get unstuck and figure out how to solve a problem, it is with him for life.

Conclusion: Innovation, Play of Imagination and Learning

Until a few years ago, in areas of concern in Singapore and the US, almost everything was centred around knowing, little about making and almost none about playing. Perhaps, given the Big Shift, there is a need to focus on playing – by way of riddling and context-making or world-making – as much as we focus on knowing and making. This has critical implications on what it means to innovate, another area of concern among nations today.

Innovation entails making the strange familiar through world-making (Figure 8). In fact, many kids are already doing so on in a massively collective way. *Harry Porter* is a case in point. Although Harry's wand defies the laws of the real world, why does it still make sense? It is because Harry is situated in an imagined world, and in that world, even the strangest thing makes sense. However, this sense of being able to construct worlds actually happens by kids, not just J. K. Rowling. It is kids who are filling in the backstory of what is going in *Harry Porter*. There are approximately 1500 novels, of 400 pages or more, written by kids that are filling in the backstory of this imagined world. These kids are playing at constructing a world in a powerful way.

If the goal is to develop a nation of innovators, the first challenge is to rethink the role of writing, playing and constructing imagined worlds. Writing, playing and constructing imagined worlds could be placed much more at the core of radical innovation in current approaches to remaking education.

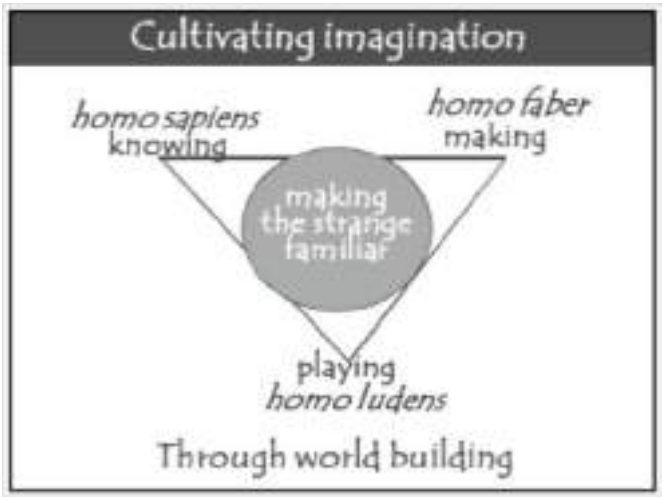

Figure 8. Cultivating imagination-making the strange familiar through world-building.

Figure 9. Imagination, intuition and inspiration.

The next challenge is to reshift the focus from creativity to the imagination, which is the basis for radical innovation. Singapore has worshipped creativity. This may be fundamentally misplaced. It was Henry Ford who said, "If I had asked my customers what they wanted, they would have said a faster horse." Creativity merely focuses on the objects at hand. Creativity is merely about new ways to solve old problems. Instead of creativity, we need to think about the imagination. Imagination focuses on world-building around the question, "What if?" Imagination is less about solving problems than about creating new problem spaces. Imagination reimagines the world around strange things to create new opportunities.

In conclusion, in this era of the Big Shift, what needs to be strived for in educating and cultivating learners is some sense regarding the question, "How do we bring inspiration, intuition and imagination together?" In addition, the issue that needs to be focused on is "How do we create contexts where kids have a sense of awe and curiosity?" (See Figure 9.)

Underlying all these is this fundamental idea: it is where and when imagination plays that learning happens.

Acknowledgement

All figures provided are used with permission from John Seely Brown.

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SYMPOSIUM AND PUBLIC LECTURE
QUESTION & ANSWER SESSIONS
PROFESSOR JOHN SEELY BROWN
21–22 NOVEMBER 2012

THIS ARTICLE REENACTS the exchanges between JSB and the audiences during the symposium at NIE on 21 November, 2012, and the public lecture at NTU@ One-North on 22 November 2012.

Symposium

Audience member 1: I was at your talk last year and I felt that the audience did not seem to be getting what you were trying to communicate. My intention here is to see how we can avoid that. Being pragmatic Singaporeans, some of the audience might have tacitly contrasted work and play. Some people have attempted to legitimise play by proposing the concept of "serious play". However, this again tacitly implies the contrast between "frivolous" and "serious". Moreover, the concept of "tinkering" is very alien to Singaporeans. As a result, many people in the audience bypassed tinkering and misunderstood what you meant by play, seeing it as frivolous.

Therefore, I am proposing a fourth "homo" – *Homo Somniāre* or the Dreaming Man. The Dreaming Man goes back to the Australian Aborigines and refers to two things. One, the ability to dream in terms of origin stories. Two, according to the Australian Aborigines, dreaming is a social construction. The concept of the Homo Somniāre might help to sidestep some of the issues of play being mere frivolous, since there is no such thing as a frivolous dream.

JSB: Thank you. Yes, I understand your intention. Let us consider the notion of "natural propensity", which is

more of a Chinese thought. What I am trying to get at is how we shift our focus from things to context, because if we actually spend more time shaping context, things naturally happen. For example, in some Chinese military theory, the best general is one who can get the enemy to see that everything in the context is working against him and naturally quits. Hence, in the last year, I have been thinking more about the power of context and how we play with it. How do we create contexts that allow for the cultivation of dispositions in a natural way?

In fact, the notions of "serious" and the "frivolous" miss what I am trying to get at. Recently, I said something that went viral on YouTube. I said that I would rather hire a Level 70 *World of Warcraft* player than a Harvard MBA, because of the former's ability to understand how to shape context, given that we are moving into a world where we need to think in terms of eco-systems. I was brought up as a kind of mathematician who played with axiom systems. If we can get this sense of play from kids, we are going to have a whole new generation of kids who know quite differently.

Audience member 1: Yes, we understand that. It is just that I hope we can avoid falling into a cultural gap.

JSB: In Singapore, one of the things I have been focusing on is the confusion of creativity for the imagination. The campuses in Singapore are pushing more for creativity than for the imagination with regards to design thinking. I had the same trouble in the US, and I am coming up with a new book called *Design Unbound* which gets at the heart of imagination, rather than design.

Audience member 1: Design is also associated with outward appearance. Therefore, from the layman's perspective, design is thought about it in terms of what it looks like from the outside.

JSB: That is why we need to think about imagination. And what is surprising to me – and I am not just commenting on Singapore but the Western world as well – is that we can argue rather seriously that schooling destroys imagination. Kids have a fantastic imagination but we seem to have found ways to suppress it. However, I observe that the kids who are playing certain games often turn out better at solving the complex problems of today.

Audience member 2: Thank you for sharing. I was very interested in what you said about the dispositions of an entrepreneurial learner and the networked community of learning. Let us say that there is this person who faces a complex problem. Solving it requires a bit of reading but he does not want to go through this process. Since he has many friends on Facebook, he poses them the question, and then draws upon the collective wisdom of his community. Hence, basically all he does is to pose the question. Maybe this problem is part of his homework, but he gets others to do it.

JSB: I understand what you are saying. In economics, we call them free riders. I have interviewed what you would call free riders. Some of these kids are actually free riding in order to get on with another subject that they are more passionate about. Moreover, if you look at a 5-, 6- or 7-year-old kid, you will realise that they often ask questions. We have encountered situations where the teacher was the one constantly being challenged because the kids kept asking questions he could not answer.

Audience member 2: I suppose what I was trying to address is the fact that there are different kinds of learners with different motivations in a community. Thus, the challenge is addressing people with different motivations for learning.

JSB: It is also about finding things that turn kids on. There are tools out there for capturing a kid's imagination. Therefore, the question is now, "How do you set the stage to help find what their interests are?" This is very contrary to what formal schooling is concerned with.

Audience member 3: Regarding your comment on formal schooling, a lot of content in school is not very appealing to students. How do we interest them in these subjects?

JSB: What I am about to suggest may seem very inefficient but I think that one way is to find something that captures a kid's imagination and build on it. I know of a class in South Chicago where the learning task was to create a movie about music in the 1930s. In order to make the movie, the kids had to read history books in-depth. This may appear inefficient until you realise what tools there are to capture a kid's imagination.

Audience member 4: Do you think that kids and adults of today are less playful that those in the past?

JSB: I come from Silicon Valley, and I think that most of the people there are rather playful. I think that the tools that we have today are so much more powerful than those before. The things that would require many people to do can now be done with small groups of people using these power tools. It is really amazing, and I think of that as "play".

Audience member 4: How would this concept of "play" change the role of teachers, and do teachers have to be more playful or at least appear to be more playful?

JSB: Well, I mean what I am about to say quite honestly, but it may not go down well. It is conceivable that the purpose of school is to suppress playfulness, and maybe even undermine imagination seriously. That is why Montessori created the schools that they did. There is a certain sense that if you go into a Montessori school – and I don't just mean pre-school, which is the case in Singapore, but I mean all the way to 4th or 5th grade – you will find that these kids are not doing what you would think of as "schooling". Instead, they are constantly playing with situations and getting into situations that they need to have a good understanding about.

I doubt that is not the right kind of foundation. Therefore, I was very serious when I said that in the United States, we may know how to "do imagination", but we do not know how to make it scale? How might we implement the Montessori technique all the way through 12 years using the power tools of today? Moreover, everybody is always concerned about learners getting at the right answers. I always find this concern rather peculiar because when I build something, whether a program, an amplifier or a motor, I know I am getting it right when it works. In some sense, reality is the final arbitrator of some kinds of truth. Therefore, I think there is a lot more we can do by thinking about the tools we have today at our disposal.

It is also the same with music. One of my motives in being over here is to relook at the world of arts in teaching. I am trying to argue that if I have to teach, I would start with the arts. It is a much better area to start with.

Audience member 4: This is what Steve Jobs started with.

JSB: Steve did start that way but he also had this ability to redefine reality. Steve was not just able to imagine a different kind of world, but it also had to have aesthetic qualities. As far as I know, he actually had the iPad done about 5 years before it came out. However,

he refused to let it come out because it was not elegant enough. Moreover, they had to wait until the batteries, screen and packaging were good enough so that when a potential customer holds the device, he or she would find it "cool". There is something special about being able to imagine what could be.

Basically, we have had a fixed notion of school for the last hundred years. Moreover, our notion of schooling pretty much came from Germany 140 years ago. Why is that the right path to take?

Audience member 5: I would like to understand your position on the effective implementation of the notion of "play" in the curriculum of our schools today. Are you suggesting a complete overhaul of the education system? Are you saying, let us make space so that the disposition that we want can be cultivated through play? Or are you saying that we may want to add a layer to the subject disciplines that we already have as a way of doing it better?

JSB: My answer is that you need to do both. Radical change usually happens incrementally and we are building a whole new set of schools in the United States right now on a completely different notion based on play. We will see how they work out. It is my conjecture that something really radically different and fundamental is happening.

It is conceivable that our education system has been highly tuned for the 20th century and 19th century. However, it may be becoming irrelevant quickly, given the speed at which things are happening in the 21st century. The best example of this is the military. In the United States, more learning theory gets deployed by the military than by schools. We thought we knew everything about how to train people on 21st century warfare and in command-and-control environments. All of a sudden, in going into guerrilla warfare, everything had to do with people lowest down on the street or in the woods being able to read context and make decisions. Everything about training people on 21st century warfare had to be discarded and reinvented.

Therefore, the present question is, "In this fast-paced entrepreneurial world, do we also need to reinvent education?" I imagine NIE is supposed to be looking at things like that.

Audience member 5: Alternatively, we could start interviewing kids and asking them how they would re-design NIE.

JSB: Moreover, we need to ask, "What is NIE for the 21st century?" Ten years ago, this would have been an inappropriate question. However, I think that today, it may have become a strategic question. A lot of us are looking at how to redesign our multinational corporations along a similar type of problem. Is the multinational corporation a dinosaur that is going to die out? How might it have the agility that is required to cope with the forces that I have been talking about? A lot of people believe that those forces are now inevitable. Since they are inevitable, then you have to think very hard about these issues.

Audience member 6: Given your knowledge of the Singapore education system, what are some things that you would like to see happening 10 years from now?

JSB: What would I like to see? I would say very quickly that the SOTA (School Of The Arts) model becomes the dominant model for Singapore. Is that a well-known model? It may turn out to be a much more interesting trend.

Audience member 6: Could you share a little a bit about what you saw happening in SOTA that is not happening in schools?

JSB: Well, (a) the passion of the students, (b) the role of the imagination, and (c) I believe that we completely under-emphasise the language of sketch. We all know language, whether it is English or some derivative of that. We also have to know Mathematics, Computer Science and sketch. If you know sketching, you will realise that it can be a very powerful way of communicating. For example, when you want to communicate something and you do a sketch, it becomes a boundary object that enables us to understand what you are saying. It is something that helps scaffold a conversation.

I think that how you scaffold a conversation and how you scaffold your own thinking have become important recently. One of the things that I find a little bit disturbing is that computers do not let you sketch. It is true that we have such things like the Zen Brush. However, I have used almost every computer there is, and I still jot things down and sketch the old way. Computers still do not have the ability to let you sketch.

Audience member 7: In your opinion, what is the role of canonical knowledge and how – if it is even possible – to learn canonical knowledge playfully?

JSB: It has to do with the notion of learning on demand. Think about any situation when you want to build something but get stuck, because you do not have the skills or knowledge to be able to build it. What you would do is to start getting information to solve the problem. It is a kind of pull-based notion of learning. Think about it for a moment. From the perspective of situated learning, what you really have here is a situation that is totally authentic. It is a situation that is created when you are actually trying to get something done. Now, you are getting knowledge from the Internet, and trying it out in context to see if it helps you advance toward the goal that you want.

This is the inherent mechanism that drives situated learning in a scalable way. The implication is that most of the things – 99% of it – that students are going to learn are things they are going to learn after they leave school. This is why I had to I go through what I did in the last 6 years, which entails tearing up the foundations of my own field. As you know, I do a lot of start-ups, and I have found that most kids coming out of the best schools in the United States are not well-equipped enough to be able to handle most of the problems we are trying to solve today. These kids have to come into the start-ups and learn on their own.

Audience member 7: It just occurred to me that many of your examples work because they are all characterised by learner ownership. However, when we are referring to organisations, educational or otherwise, the objectives and artefacts are very often defined externally.

JSB: There are two possible kinds of responses to this. One, organisations whose problems are externally defined will fail. Two, if the kid is passionately interested, you cannot stop him from learning. Thus, one of the questions is, "How do you actually (a) get them passionately interested and (b) give them the tools so they can learn with or without you?"

Audience member 7: And in ways that are also meaningful to other stakeholders.

JSB: That is right. However, people fail to realise what we call the "long-tail distribution". I conjecture that for any interest that any kid has, there is already a community of interest on the Internet. It is just a question of that kid finding that community. Therefore, learning is now considered "open". The reason why I started off with the Linux case is you have to learn how to find that community, join it and start to become a full-fledged member of it. If you can do this, no matter

how esoteric your passion and interest is, you are going to be able to learn with others. The amount of co-learnership going on unnoticed is never talked about, but it is huge. On the other hand, schooling defines a very narrow curriculum, a very narrow set of topics. And it is driven by a bell curve.

Thus, we need to have enough navigation skills to find these communities confidently, and we need to have enough understanding of how to build social capital. What we need to do is to take schooling as a preparatory stage to launch kids into this long-tail distribution. This means that no matter how often their interests change, they are going to be able to find new groups to associate with. I believe we always learn with other people.

Audience member 8: Can I say that there seems to be a tension between kids' interests or passions and adults' efforts at teaching the kids? You have been saying that mass education is actually very restrictive. Do you see such tensions?

JSB: Well, in some sense, there is huge tension – and it is likely worse in the United States – because there are tests to be passed. You also know that the closer you get to the test year, passion and curiosity start to diminish. We have limited resource, and these tend to be given to the best students.

Audience member 8: Let us go back to the first question that I wanted to ask. Let me rephrase it. It seems we become less playful as we grow older.

JSB: I hear you. If your institutions and workspaces never change, then all that we are talking about in terms of reimagining education does not matter. However, since we are conjecturing a new world of work, then the new question is, "How do you prepare kids to be not just successful, but happy?" What I find going on in the world, especially in the United States, is that people are terrified of change.

Audience member 8: If people in the United States are terrified of change, then in Singapore, we should be petrified! [Audience laughs]

JSB: Now, the interesting question to ask ourselves collectively is, "Why don't we change?" I do not want to play the same chess game over and over again. I do not want to play the same *World of Warcraft* game over and over again. In the game world, change is everything. Yet, why is the attitude of resisting change prevalent?

Audience member 8: Compared to kids, kids have a weaker notion of failure and doubts. Then, it is cultivated, leading to being petrified by changes.

JSB: That is right, and this is one of the reasons why I have introduced the counter-intuitive term called "tinkering". Now, what I find very interesting about the disposition of tinkering is that you do not think of it in terms of "failing". Instead, you think of what is new that you have at your disposal. Then, just as in playing a game, you try different options, and the game feedbacks whether it has gone well or not. In this way, you learn something from the experience. It is like an adventure. Therefore, it is not a question of failure. It is just that we have been thinking in terms of "failure", as opposed to constantly striving towards creating a new imagined state.

Public lecture

Audience member 1: My question is about tacit knowledge. I am fascinated with this concept of tacit knowledge and the transfer of that tacit knowledge in the organisation that I am with. You have mentioned that tacit knowledge is "under the iceberg", and you have talked about design studios and collaborative

learning. Not everybody is a Google or have the resources to do those things. Where do you see companies going with trying to harness that tacit knowledge and perhaps not having employees – valuable employees – walk away with that tacit knowledge?

JSB: Sure. By the way, the only way you are going to keep talent from walking away is if you can create a context that makes them stay. This is actually a very serious comment, but we do not think this way in terms of talent management. Instead, we think about increasing bonuses and things like that. We do not think about why kids stay in certain places, which is because they are learning more there than in any other places.

Regarding the beginning part of your question, I believe YouTube is an amazingly effective way to capture tacit knowledge. This regards a topic that I talked about a year ago here. This may seem rather strange but I studied champion big-wave surfers. And I can show you that today, a new move of a champion surfer will circulate around the entire globe in 48 hours. I would like you to know that a move in surfing is a 100% tacit.

What these kids are doing is that they collaborate on deconstructing these videos hours after they start circulating around, then try to work out the body moves – motions and rhythms – in these videos. I could not believe that this kind of tacit knowledge could be captured so easily and be circulated around the world so quickly. It got me thinking about ways to look at how we could capture the visualisations of practice, select the key moments out and then try to deconstruct them individually or collaboratively. This is a major start to being able to capture and share tacit knowledge.

We have also just done a contextual study, talking to 20-year-old students. We are finding out that they do not watch television anymore. What they do is that they watch YouTube. Now, they are already watching all sorts of YouTube videos and discussing them. With YouTube, you are pulling information on demand, and talking about things that you have become curious about.

Therefore, I think we are at the verge where our kids have already figured out something that we in the corporate world are just beginning to discover.

Audience member 2: I am just curious to find out how you arrive at the domains that make up the dispositions of entrepreneurial learners.

The second point is a comment. We educators are trained in the 20th century skills and you are suggesting that with regards to play and imagination, teachers need to be equipped, and they need to consider how they are going to be equipped to train these students. I think it could be the other way around – the students are teaching the teachers.

JSB: Let me respond to your comment first. My answer for you is the same as that for the corporate world. We are so used to thinking that we are the mentors for new staff that we do not think about reverse mentorship. However, I think that in a lot of situations, reverse mentorship and mentorship happen simultaneously. For example, the inquiry method can be problematic in the school system. Often, a situation arises when a kid asks a question and teacher has no idea how to answer that question. (By the way, we can answer most questions kids ask, assuming we have PhDs!) But, what is the chance of being able to sit down and say, “Look, we’ve got the tools here. Let’s work together to figure out the answer.”? Yet, when you do so, you might find that the kid is better at navigating to find out answers, while you are much better at critiquing if the answers are believable.

Maybe you can have mentorship and reverse mentorship happening simultaneously, and you are both co-learning different kinds of things. I think that this is a major step forward in unleashing a willingness to engage in a full inquiry method even more deeply than we do now. You cannot go back to school and spend years re-learning all kinds of new material, but you can say that I learn something through learning from other people every day. I think that this is the spirit of what we are talking about.

Regarding the question – I made up what the dispositions of an entrepreneurial learner are. This is how I work, and this is how my collaborators work. In Silicon Valley, what matters is ingenuity. Humility is important as well, so that I can work across multiple domains, from material science to the media. This is because the only way for people from multiple disciplines to work together is that they begin to realise that the thinking of each community of practice has its own sense of elegance. With this realisation comes our willingness and ability to listen to each other across epistemic boundaries. Thus, crossing disciplinary boundaries has a lot to do with a true sense of humility. Ten years ago, we had very few cross-disciplinary groups. Today, everything is happening that way. Most of our start-ups have to do with crossing disciplinary boundaries and we realise that humility is a very important element in our work.

Audience member 3: I would just like to ask some questions that I was thinking about and maybe just try to reframe some of the things you said. What I understand is that essentially, we are living in a world of many flows of information and ideas. The world is also full of resources, and the kids know how to understand most of these resources and imagine new contexts. From a gaming perspective – because I am one of those old-school Dungeon and Dragon gamers – there is never any fixed programming. During questing, gamers have to make up their own ways of having fun most of the time. There is nobody dictating how they should have fun.

Hence, my question is, do you think it is possible for schools to teach kids to "rock the boat" or to develop their own perspectives? In doing so, they create who they are.

JSB: Yesterday, I did a talk and I learned how the term *play* might get misinterpreted, especially in the Singaporean context, if not all contexts. The kind of play that I think about is in terms of the disposition to push the boundaries of a system. It is to understand what the edge is like, and to understand how I might transform a constraint into a resource. Therefore, it is not about "serious" play or "frivolous" play. It is actually about trying to understand the pushback of a system. Perhaps in a mysterious way, when I do design work in material science, I am actually trying to interpret the pushback of an atomic structure at a particular time or the system of the steering wheel.

Therefore, I think that there is a huge potential in the notion of play for rethinking education. I actually think that it is something that Singapore is thinking more about, as her politics starts to change a little bit too, with respect to understanding how to advance a position when you can no longer logically conclude where it will go. I have also been very influenced by the idea that it is not cognition, but a nuanced form of play that advances culture. I am arguing that culture evolves when people challenge the system by exploring its edges, seeing how the system responds and thereby understanding it better.

About the CJ Koh Professorial Lecture Series

The *CJ Koh Professorial Lecture Series* was launched by the Office of Education Research in 2011. It was conceptualised for the purpose of knowledge building and sharing with our internal, external and international stakeholders in education, who can benefit from the information shared during each CJ Koh Professorship visit.

Each year, outstanding professors in the field of education are hosted by the National Institute of Education under the CJ Koh Professorship in Education programme. The CJ Koh Professorship has been made possible through a generous donation by the late Mr Ong Tiong Tat, executor of the late lawyer Mr Koh Choon Joo's (CJ Koh) estate, to the Nanyang Technological University Endowment Fund.

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A publication of the Office of Education Research,
NIE/NTU, Singapore © 2013

ISSN 2251-3019