EDITION /001

EDUSCAPES

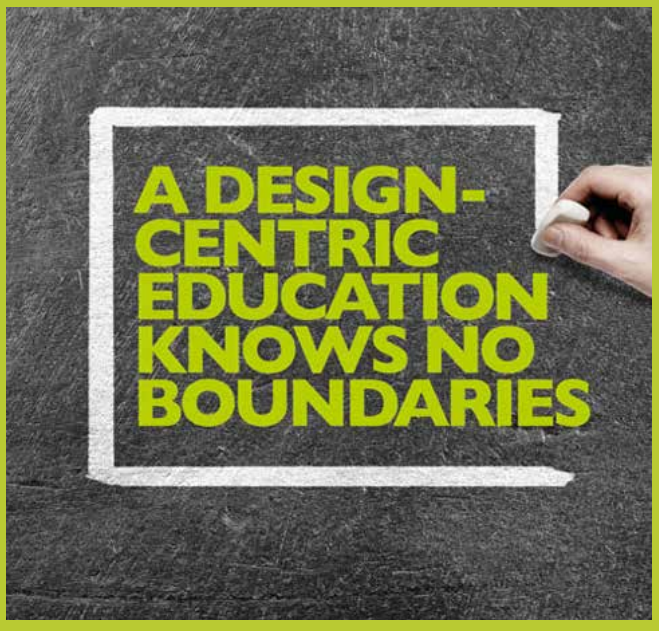
AN SUTD PEDAGOGY NEWSLETTER

SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

LEARNING SCIENCES LAB
OFFICE OF EDUCATION


HANDS-ON
LEARNING
BRINGS
THEORIES
TO LIFE


SMALLER
CLASSES
HAVE MORE
ROOM FOR
LEARNING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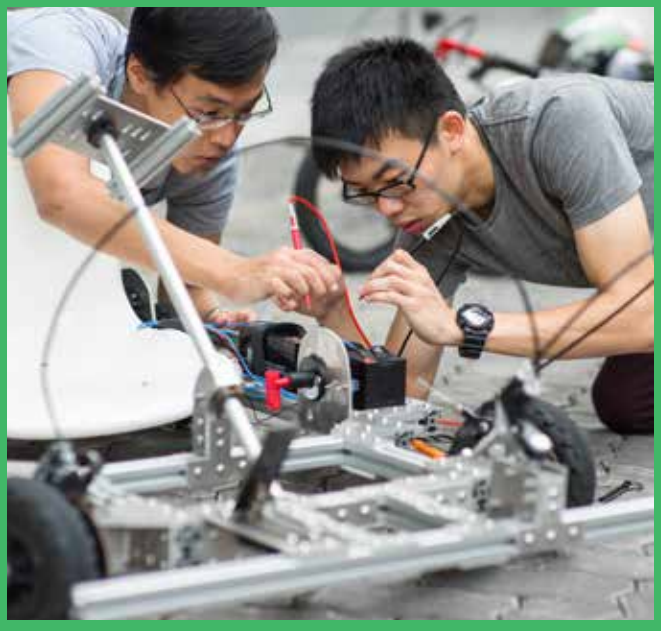

AIMS

This newsletter aims to promote and celebrate teaching excellence and experience at SUTD, by taking a reflective, evidence-based empirical approach into teaching and learning practices at SUTD and beyond, to identify innovative and effective pedagogies for SUTD. We also hope that the newsletter will serve as a platform for sharing pedagogical resources on technology and library tools.

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MANAGING OFFICE

As a central and university lab on teaching and learning, Learning Sciences Lab (LSL) from the Office of Education (OED) plays a vital role in shaping and coordinating this newsletter, by leading and working with various stakeholders from SUTD.

LSL was established at SUTD in July 2016 and aims to support instructors and learners in engaged teaching and learning. LSL offers various programs and services on teaching and learning to faculty members, graduate teaching assistants and learners. LSL aims to build communities of practices in teaching and learning at SUTD - within and in collaboration with other universities. LSL is led by Nachamma Sockalingam.

From Left to right: Oliver, Nacha, Xingyin, Dawn, Norman, Bina and Nazry

The editorial board of this newsletter comprises faculty from each of the pillars and clusters, together with the LSL lead. They are deeply involved in various aspects of teaching and learning at SUTD. They have played critical roles in shaping the newsletter, peer reviewing articles, working with authors, authoring and copy-editing. The team hopes to cultivate a rigorous yet nurturing environment to encourage inquiry into teaching and learning practices, and sharing of such experiences so as to promote significant and quality teaching and learning at SUTD. Aside from LSL, Office of Communications and Marketing has also been instrumental in getting this newsletter to print.

EDITOR'S NOTE

It is our great pleasure to bring you the inaugural issue of **EduSCAPES: the pedagogy newsletter from SUTD**, which presents the **diverse educational landscapes at SUTD in one place**, providing you with a **refreshing escapade** from the humdrums of work and daily routines of academic life.

The figurehead in the cover characterises the authors as well as the readers. The various icons making up the figurehead represents various aspects of education at SUTD such as design, technology, science, maths, humanities, social sciences, and the 21st Century skills. The spikes in the figurehead signify expanding knowledge, creativity, out-of-the-box thinking. Overall, the artwork symbolizes reflection and synthesis of teaching and learning experiences arising from the diverse educational landscape at SUTD, providing a reclusive escape which inspires innovations in teaching and learning.

The idea of the newsletter has been seeded by many over the past years and this issue is the product of many colleagues' involvement and contributions. Many thanks to all, especially our advisor, editorial board members, support team and authors who have contributed articles.

You will find a good spread of articles in this issue. We have a total of 14 articles, including this editorial, two interviews, three research contributions, six reflections, and two articles on resources. Our contributors include not only faculty members, but also staff members, and graduate teaching assistants (GTAs). They represent the various pillars, clusters and offices, giving a good overview of pedagogy at SUTD. We thank all our colleagues at SUTD for their contributions.

In the Different Perspectives section, we have two of our prominent pioneers of SUTD, Professor Tom Magnanti, President, and Professor Pey Kin Leong, Associate Provost for Education. We ask them some tough questions on SUTD's pedagogy and technology that you will want to know about. So turn to the pages to get the historical insights and informative details.

The three research articles in this issue take an empirical approach and examine the implementation of flipped learning in biology classes, gamification to teach programming in Digital World classes, and a technology tool, Splashtop, in physics classes. It is interesting to note that some of these teaching innovations need not be too drastic or resource intensive, and yet they could contribute to significant improvements in the learning experiences. This is encouraging because we could take small steps at a time and yet the impact could be remarkable.

The six reflections are multi-faceted; one from a faculty member on the need for a little downtime (white space) during learning to rejuvenate and energize for better learning, while another on tactile learning of Mathematics for making learning fun and engaging. Often active learning is assumed to be involving activities (as in the case of tactile learning). On the other hand, the article on white space is contrasting and highlighting that active learning is not all about activities, and should cater to some time for thinking and reflection. A valid and practical point for consideration.

The third reflection is from our ASD faculty member on using yet another teaching method - case studies and diagramming skills to prepare architects of the future. The fourth reflection is on a conference organized by the Humanities, Arts and Social Sciences Cluster at SUTD on world literature and global core texts, bringing the global community to SUTD to discuss world literature - not just for the sake of theory construction but for practical applications in classrooms to provide our graduating engineers and architects with a holistic education at SUTD.

The fifth reflection is from an interdisciplinary 2D project module, showcasing SUTD's design projects and design-based learning. The sixth reflection brings experiences from three graduate teaching assistants (GTAs) on the teaching preparation course they had attended at SUTD, mapping their journey through the course and the impact on their conceptions of teaching at SUTD.

The two write-ups on resources bring us information about facilities such as Academic Studio and Library services available at SUTD to support our faculty members and learners. OED is constantly aiming to bring you the best support services and this section brings you the latest.

We hope that you find the newsletter informative, enjoyable and inspiring. This would be an annual newsletter and we would like to invite all interested in SUTD's pedagogy (including students) to contribute to subsequent issues. Please see the guidelines for submission. We look forward to your contributions. Share with us and others your insights, reflections, findings on teaching and learning by emailing us at lsl@sutd.edu.sg.

Warmest regards

NACHAMMA SOCKALINGAM
Assistant Director, Learning Sciences Lab
October 2017

GUIDELINES FOR SUBMISSION

WE ACCEPT A VARIETYOF ARTICLES IN THE FORM OF:

Current Issues
This could be a write-up of the latest happenings in the education industry on topics such as learning analytics and project-based learning

Reflections
This would be opinion and reflective pieces that involves sharing of perspectives and experiences

Research Articles
Research articles are empirical, evidence-based write-ups of action research/inquiry into teaching and learning

Different Perspectives
This would be interviews with various stakeholders

Book Reviews
Review of books on pedagogical topics

Teaching Resources
Write-ups from various offices in SUTD/external stakeholders on teaching resources

YOUR ARTICLE SHOULD

- ✓ Meet the aims and scope of the newsletter
- ✓ Be well-written and easy to follow, without unnecessary technical jargons
- ✓ Be original – not reprinted anywhere else
- ✓ Go beyond being descriptive – should attempt to take a more empirical, reflective approach
- ✓ Highlight the impact and significance of the findings

RECOMMENDED FORMAT

- Less than five A4 pages, Times New Roman font, size 12, single-spaced, justified.
- Authors are encouraged to use relevant visuals. Picture quality has to be at least 300 dpi for print.
- Articles to be sent to **lsl@sutd.edu.sg.**

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PERSPECTIVES ON SUTD PEDAGOGY: PAST, PRESENT AND FUTURE

Professor Tom Magnanti (President)

Thanks Tom for providing us with the opportunity to interview you. This is for the first issue of SUTD pedagogy newsletter. We thought that it would be appropriate to hear your thoughts about your term at SUTD so as to give our readers some historical context, insights and lessons. Let us begin.

One of SUTD's defining features is our unique pedagogy, which involves teaching in teams, interdisciplinary curriculum and active learning. You are one of the key persons to have proposed and shaped this pedagogy. Could you tell us more about what inspired and motivated you to do so?

Technically, I have been with MIT for 46 years. I think I have learned a lot during these years - some which good and some of which not so. One such good thing I have learnt is the importance of active learning, engaged learning, and cohort-based instruction in higher education. I would have loved to have implemented that at MIT. I must add that it is implemented in certain parts of MIT but not throughout the university as a whole. So, when we started SUTD, I wanted to see if we could implement that as a different approach to teaching, a different approach to education as well as a different structure to the university. This university (SUTD) is structured like no other university in the world and I think it is the right structure for today's and tomorrow's world. Others might argue that - especially, the traditional universities, but I would not.

To follow up, what do you think makes SUTD unique among other Singapore universities?

SUTD is unique in many ways. Its organization is unique. Its degree programs are unique. Its structure is unique. Its approach to teaching and education is unique. Its culture is unique. It is unique in terms of many dimensions. I could probably go on building up this list -- probably add ten more features.

When we started SUTD, we wanted to create an American-style university. NUS and NTU, which are great universities in their own way, were more based on the British system. So we wanted a culture here that very much provided autonomy to the faculty and staff. SUTD is very entrepreneurial, which had sort of an interesting mix of bottom-up and top-down initiatives in a variety of ways. There is a sense of passion everywhere; passion for learning among the students, passion for teaching and research among the faculty, passion in work among the staff. This spirit of excitement, this passion creates magic. I often say that what we as university administrators are meant to create magic. So providing the right environment where magic can happen is what SUTD is about. There are magical moments in many aspects at SUTD.

Any specific examples of magical moments?

I think there is magic happening almost every day in the classroom where faculty members are teaching in interesting ways. Our 4D concept is pretty magical and in essence brings design into the classroom, across classrooms, across semesters and then the fifth row, for social good. So I think there are many other things that are magical.

Now that SUTD is past its five year mark, how do you think the SUTD pedagogy has performed so far? What is your evaluation of the success of our pedagogy?

I am actually quite pleased with the pedagogy. I think the faculty members have done a really good job of implementing it. I think the students really love it and they really love the cohort-based classrooms. In fact, they prefer that for the whole undergraduate curriculum.

I think there is magic happening almost every day in the classroom where faculty members are teaching in interesting ways

Most days I get up and I am very happy. The minor areas where things could be better are that we are not quite as modular as I would like us to be. I go out to visit the classrooms all the time to see what is going on and lots of time I see a fair amount of lecturing in the classrooms. I prefer to see less of that, more of small modules, and flipped learning and these types of things but I think this is a minor correction to something that is already quite marvelous. I think we can always improve. We can learn from the social sciences, psychology, cognitive psychology and we should implement those things in the classrooms.

How do you see SUTD pedagogy evolving over the next five years?

Better! You know, I am actually quite impressed with some of the faculty initiatives such as the 2D projects in which they have created synergies between two classes or subjects. I think they have been very good. So I think we will probably see more of these over time. I think we will see more modularization of the curriculum. We have just started our new continuing education unit and it is going to be creating a fair amount of digital materials. I think we will see more digital materials being used for our activities. Some of the faculty members have done marvelous things.

Some of them have implemented Khan Academy-type of videos for their classrooms, which are really innovative. I think that is great. Great for the students. Great for the faculty.

How can the SUTD community continue to own and shape the pedagogy that we already have?

Well, I think we need our faculty's will and support to do this as well as institutional support. In my 46 years of experience, most faculty members are quite creative in their classrooms and they take classes seriously. They prepare for it but they sort of anchor onto a particular type of instruction. I think we need to give our faculty the flexibility to do interesting things in the classroom and we need to provide some institutional guidance for them in the classroom.

We need the faculty team, the student team and the leadership team to embrace the notion of educational innovation as an important part of what we do to be in one of the best places in the world in research as well as service.

MIT has a training program for teachers to learn about pedagogical skills – currently, we are starting that here at SUTD, through Learning Sciences Lab. So that is one possibility. Another way is to bring science into teaching and learning, as well as understand how we can help faculty. This would provide opportunities for them to learn and be engaged like when I was at MIT. You can have sharing sessions where faculty could actually meet with each other to talk about pedagogy. So I think there are actually a wide variety of things. Learning Sciences Lab in Office of Education could play a central role in this.

It was insightful to hear your thoughts about the past, present and future of SUTD's pedagogy. Many thanks for taking time to share your thoughts with us, Tom. It has been a pleasure interviewing you.

Interviewed by Nazry Bahrawi (HASS) and Nachamma Sockalingam (LSL) on 11 August 2017.

PERSPECTIVES ON SMART LEARNING AND SMART CAMPUS @ SUTD

Professor Pey Kin Leong (Associate Provost - Education)

Thank you Kin Leong, for doing this interview with us. We would like to focus on the idea of Smart Nation, Smart Campus, and Smart Learning for this interview.

Building a Smart Nation was one of the three key issues that Prime Minister Lee Hsien Loong focused on in the recent National Day rally in August 2017. The question is, what is meant by "Smart" and how does that translate to SUTD? The Office of Education at SUTD has tried to envision this as Smart Learning and Smart Campus. As our Associate Provost for Education, we wanted to get your perspectives of Smart Learning and Smart Campus. Could you tell us more about what this means to SUTD?

The whole idea of the Smart Learning concept was to support our national initiative on Smart City and our SUTD pedagogy. It is a marriage of the two. We are thinking of taking advantage of the latest technology to enhance the teaching and learning experiences. Take the example of Mixed Reality -- students and faculty could use this technology and interact in the virtual space, so-called virtual reality.

On the other hand, I am mindful that this concept of Smart Learning may seem to go against our SUTD pedagogy to some extent. We know that technology can allow people to learn almost anytime anyplace, anywhere – this may seem to lead to independent work rather than collaborative work. I like to see this differently. It depends on how we use the technology.

You can imagine that one could be in Singapore and another in San Francisco, say on a business trip. But with today's technology, they could still interact in the virtual world. I think this is the way to go. So within the cohort-based environment at SUTD,

students could use technology to interact face-to-face in campus through project discussions and couple this with Virtual Reality in cases where some students may not be able to make it physically to the campus. The group could still discuss and keep to their learning schedule.

Another aspect is our move to support Lifelong Learning and SkillsFuture initiative. I think that in the current age of technology and smart phones, people want to learn anyplace, anywhere. Now, we want to give them not just a MOOC space for learning online but also real-life experiences by implementing technology that allows interaction, simulation and virtual experiential learning.

In a nutshell, the Smart Learning that we have in mind at SUTD is one in which we use technology to learn almost anytime, anywhere, anyplace- but without compromising the active, peer-to-peer learning that is characteristic of our SUTD pedagogy.

How does this concept extend beyond Smart Learning to become Smart Campus?

We extend this to aspects other than teaching and curriculum. It is about having a Smart facility or environment as a "Smart Campus". We are right now trying to deploy robot in lab spaces to mentor and support learners. Our Fab Lab and Cleanroom are already using this. We could extend this further. We could use robots with artificial intelligence to interact with students to check the identity of the students or mark attendance or answer a simple query. There is a multitude of possibilities. On the one hand, a robot can be put to use to support teaching and learning, or it could be used for facility security and so on.

But the backbone is always the IT infrastructure because you need a high bandwidth for data transmission – for Internet of Things (IoT) devices to sense things.

Deployment of Robot in FabLab

What are some measures that the Office of Education is taking towards this?

At SUTD, we take a lot of bottom-up approach with a little bit a top-down approach. In terms of budget and resource support, our idea is to get people excited about technology innovation. So we have set up the SUTD Pedagogy Innovation Grant, which I think we have been doing amazingly well. I would say that over the past four to five years we have about 35 to 36 projects, ranging from small to large-scale. This is very much a bottom-up approach. The top-down approach is more of setting up the framework and systems that allow faculty to engage in this, with the faculty's buy-in.

We know very well that from the learning or teaching perspective that we cannot take a "one-size-fits-all" approach. Whether this is pedagogy or technology, we just want to provide a set of tool box. I think it is a holistic, progressive approach. At the end of the day, I am hoping that the majority will buy-in and embrace the ideas about Smart Learning. When people start a project, they will tend to continue with it. So what we need to provide is the right environment for innovation and creativity.

We have also recently set up the Learning Sciences Lab at SUTD. The role of the lab is critical. On the one hand, the lab will work with faculty members to innovate and help us design new pedagogy, and build programs to train our faculty in certain skill sets or competencies in teaching. But beyond that I think the lab could also support and guide faculty members in technology-enabled learning. As I have mentioned, there is no one pedagogical method that fits all context. Students learn quite differently today and rely on technology to a great extent. We have to adapt and continue to transform and embrace the latest technology in education. So it is important to also continually innovate our teaching using technology. We have to take a comprehensive approach towards this.

What do you foresee as the next steps for SUTD?

I think we have an exciting time ahead of us and we are ready to take on new opportunities and challenges that are to come. Our fundamental undergraduate program is more or less stabilized right now, and so we are looking to refine this and improve it further. I think that the next five to ten years will be very exciting for SUTD. Our collaborative environment, open culture, and innovative curriculum and pedagogy make for a rich academic environment. We should harness these opportunities to achieve greater things.

> In a nutshell, the Smart Learning that we have in mind at SUTD is one in which we use technology to learn almost anytime, anywhere, anyplace-but without compromising the active, peer-to-peer learning that is characteristic of our SUTD pedagogy

That really sounds very promising and exciting for SUTD, Kin Leong. It is great to know more about these new initiatives on Smart Campus and Smart Learning at SUTD, and we look forward to more developments in the future. Thanks for your time and the interview.

Interviewed by Nachamma Sockalingam (LSL) on 31 August 2017.

Acknowledgements: Vincent Tang (FabLab) for overview on how they deploy robots.

PEDAGOGY INNOVATION GRANT RECIPIENTS

2016

- Storytelling as a Pedagogy Tool in Teaching Linear Algebra
  Sergey Kushnarev (ESD) and James Wan (ESD)
- Crowdfunding Campaign as a Pedagogical Approach for Experiential Learning of Engineering Entrepreneurship
  Jianxi Luo (EPD)
- Gamification to Provide Prior Knowledge to Digital World Class
  Oka Kurniawan (ISTD), Ngai-Man Cheung (ISTD), Andrew Yoong (ISTD), Ng Geok See (ISTD)
- Analyzing the Impact of the Design Brief in the Design Outcome
  Arlindo Silva (EPD) and Christine Yogiaman (EPD)
- Real-time Assessment in Just-in-Time Teaching
  Teo Tee Hui (EPD) and Lee Chee Huei (EPD)
- Adaptation of Traditional Chinese Short Fiction into Visual Artifacts
  Zhenxing Zhao (HASS)
- Smart Classroom with BYOD for Active and Interactive Learning
  Lee Chee Huei (EPD)

2017

- Training Methods and Strategies - Technology Based Assignment and Assessment
  Teo Tee Hui (EPD) and Lee Chee Huei (EPD)
- Design Science Learning Modules
  Lucienne T.M. Blessing (IDC), Kristin Wood (EPD/IDC), Arlindo Silva (EPD) and Panos Papalambros (University of Michigan)
- Developing and Implementing Virtual Laboratories in a Freshmore Biology Course
  Bina Rai (SCI) and Yajuan (Julia) Zhu (SCI)
- Enacted Case Studies As Online Appetizers
  Lakshminarasimhan Krishnaswamy (EPD)
- Assessment Gamification
  Omar Oritz (SCI/ESD) and Sergey Kushnarev (ESD)
- Impact of Robotics on Visualizing Algorithmic Thinking and Students' Motivation
  Oka Kurniawan (ISTD), Subhajit Datta (ISTD), Norman Lee(SCI/ISTD), Robin Soo Jian Wei(ISTD) and Nachamma Sockalingam(LSL)
- A Unified Paradigm to Teach IoT, Robotics, Control, Decentralized Systems (and more) using LEGOs
  Roland Bouffanais (EPD) and David Mateo (EPD)

PROVIDING PRIOR KNOWLEDGE FOR "DIGITAL WORLD" CLASS USING GAMES

Oka Kurniawan (ISTD)

Bransford has shown in his study that learning is affected by students' prior knowledge (Bransford, 2000). Students may find it difficult to understand new concepts if they lack prior knowledge. In other words, people do not learn new concepts from scratch. They try to connect and associate new knowledge with what they have learnt before. When they do not have enough prior knowledge, they will not be able to grasp or understand the lessons well. The role of an educator then is to provide scaffolding so that students can overcome the gaps in prior knowledge and learn better.

Every student in SUTD is required to take the "Digital World" course in Term 3 during the Freshmore year. This course provides an introduction to Python programming and computational thinking, and it serves as a prerequisite course for others. The main difficulty in teaching this course is the diversity in students' background. Another issue is motivating students to learn programming in a short time. Since "Digital World" is a compulsory course, all Freshmore students have to take it regardless of their preferences. With these different levels of background, the question is how to motivate these students to learn programming?

To help students prepare and learn, the course teaching team has been running pre-course workshops (Kurniawan, et al. 2016). Over the years, one of the findings has been that games help to motivate students. However the team had not examined the impact of games on academic learning. This article describes an intervention that was done in 2016 just prior to the start of the "Digital World" course and examines the impact of using games to teach programming and computational thinking on motivation and learning.

The teaching team conducted a five-day workshop of three hour lessons on each day to teach basic computational thinking to those students who had no programming background. The purpose of the workshop was to help these students and provide them some prior knowledge for the Digital World course. The workshop gave the participants an introduction to computational thinking, Python syntax and three basic structures of computer programs.

The workshop participants were first-year students in Term 3. Two classes participated in the study. One of the two classes used a board game called RobotTurtle and an online game called CodeCombat. The other class was taught using traditional teaching methods without games.

Figure 1 shows students' self-perception of their programming skills (zero, novices, or expert) and their pillar of choice after completing their Freshmore year. Most students indicated that they have not written any programming code before.

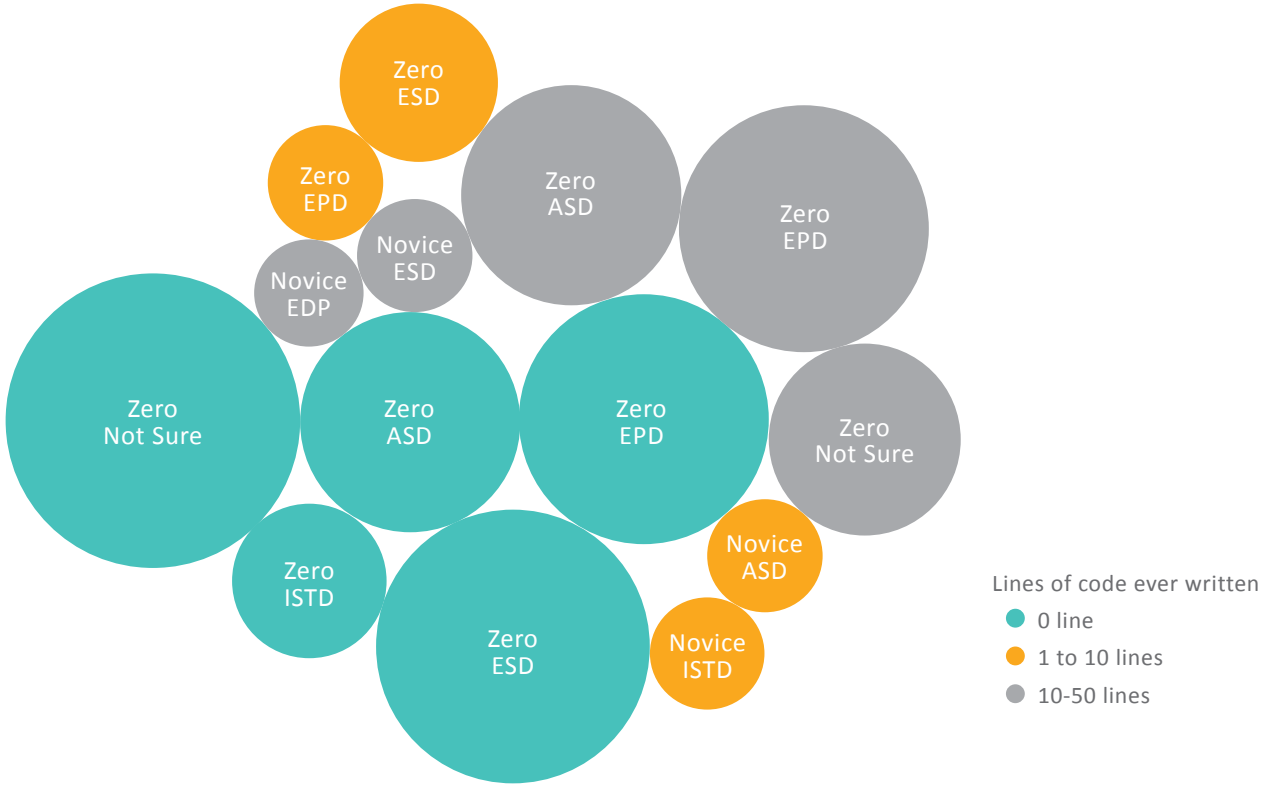

Figure 1: Programming background of workshop participants

At the end of the workshop, participant were asked to provide feedback on their learning experience. Figure 2 captures their responses.

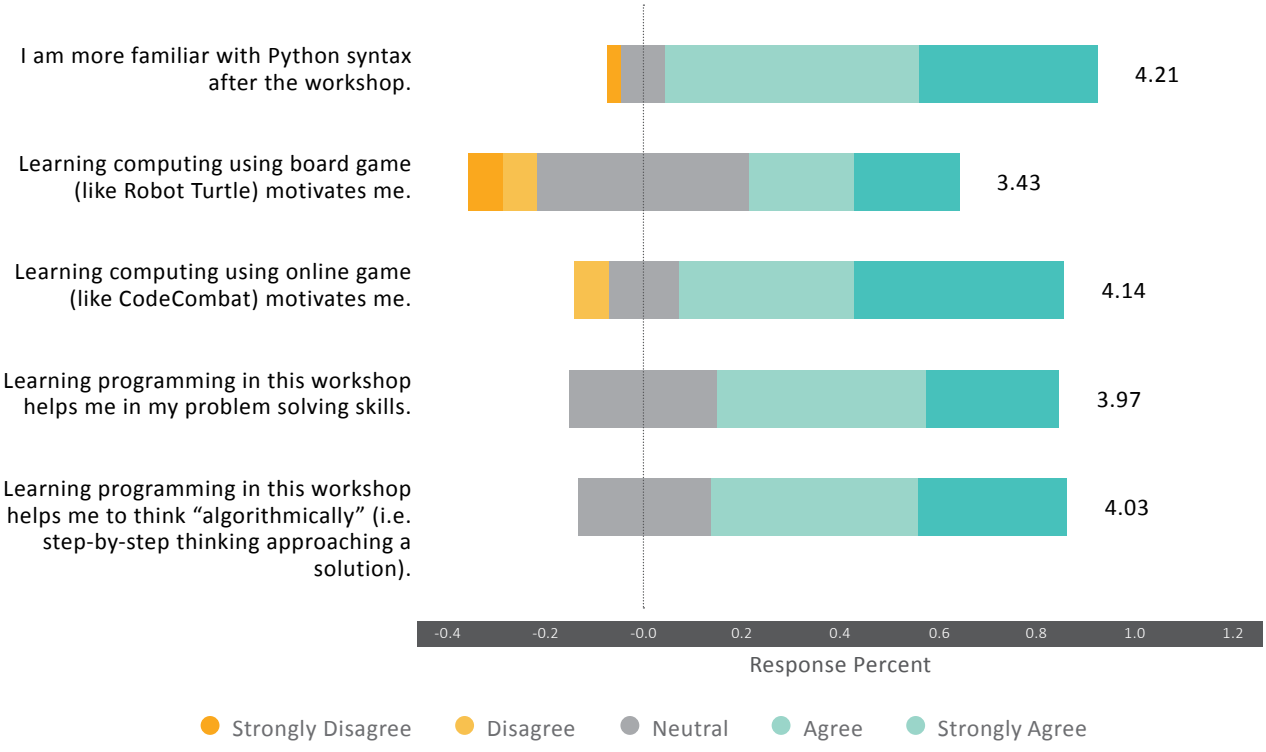

Figure 2: Participant response on the games

It is evident from students' responses (Figure 2) that the workshop had a positive impact on students. Students felt that they were more familiar with Python syntax as a result of the workshop and that it helps them in their problem solving and algorithmic thinking. It is also evident that the online game CodeCombat motivates students significantly better than the board game RobotTurtle. This is expected since these students are living in a digital age.

These results indicate that the workshop using games seems to help the participants in learning some aspects of computational thinking, such as how a computer executes a program and how to solve problems using the basic structures. Students get familiar with algorithmic thinking and have an overview of our problem-solving framework. However, this does not translate to the actual writing and testing of the code - students find these tasks to be difficult.

This is possibly because the workshop is short-lived, lasting only one week. Writing code and implementing algorithmic thinking is likely to require familiarity with the programming language syntax as well as the thinking processes required. Achieving this probably needs more time and constant practice.

Another reason why students could still find it difficult to write the code is that the games themselves present problems in a very different way from traditional computing problems. Problems from the games are in a form of tasks with set rules. On the other hand, traditional computing problems are in words with a set of test cases. The problem that was given at the end of the workshop was more of a traditional computing problem rather than one that suited the gaming context. This could mean that some gaps are present between learning using games and solving traditional-like computing problem.

While the students felt that the games helped in their learning and thinking, it seems that the games did not have an effect on their performance. Following the workshop, we calculated the average of the mid-term test scores that students achieved for the "Digital World" course. We found no significant difference between the two workshop classes. Hence, it seems that using games only improves motivation. However, this requires further investigation as many other factors can influence the students' performance in tests.

In summary, our study shows that students found the workshop to be helpful in introducing them to computational thinking. Amongst participants who used games, their preference was for the online digital strategy game CodeCombat over a board game like RobotTurtle. Overall, games seem to motivate students than traditional teaching methods without games. On the other hand, games only seem to lead to enhanced motivation and not actual academic performance. Both traditional lecture and a class that uses games seem to be as effective. More investigation is still needed on the impact of games on student learning.

In the future, we will study the effect of adding more practice sessions in between playing the games to test if this allows students to translate what they have learnt from the games and apply it directly to something similar to traditional computing problems. We hope to see this approach bring better results in giving more confidence to students in terms of writing computer code and testing them.

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2. Kurniawan, O. Cheung, N.M., Yoong, A., Ng, G.S. (2016) Providing Prior Knowledge for Digital World Class using Games, ISTD Technical Report.
3. CodeCombat, http://codecombat.com.
4. RobotTurtle, http://robotturtles.com.

ABOUT THE AUTHOR

Dr. Oka is a Senior Lecturer at ISTD and teaches the course "Digital World". He has been conducting several research projects on how to teach programming over the last three years at SUTD.

TEACHING TIPS FOR FLIPPED CLASSROOM

Bina Rai (SCI) and Yajuan Julia Zhu (SCI)

Many of us who studied biology before the 2010s would have attended lectures that were designed to transfer information to us, making us passive learners in the process. Memorizing facts was sufficient to excel in the exams, but it did not encourage critical thinking. As lecturers at SUTD, we were presented with a unique opportunity to change the way biology is taught in the classroom. We designed a fascinating blended learning approach that incorporates flipped classroom into the "Introduction to Biology" curriculum. This teaching approach could potentially help to increase conceptual understanding, develop higher level critical-thinking skills, and enhance students' interest in biology. This would have the greatest impact on Freshmore students at SUTD, who are not likely to have had a background in biology during their pre-university education.

The flipped classroom was implemented in the half-module biology course during the last six weeks of Term 3 in 2016. We prepared five sets of lessons that contained both flipped classroom and hands-on, in-class activities for the learning of advanced topics in biology namely cell signaling, cell cycle, fly genetics, human genetics and cancer. Figure 1 shows the structure of the lessons.

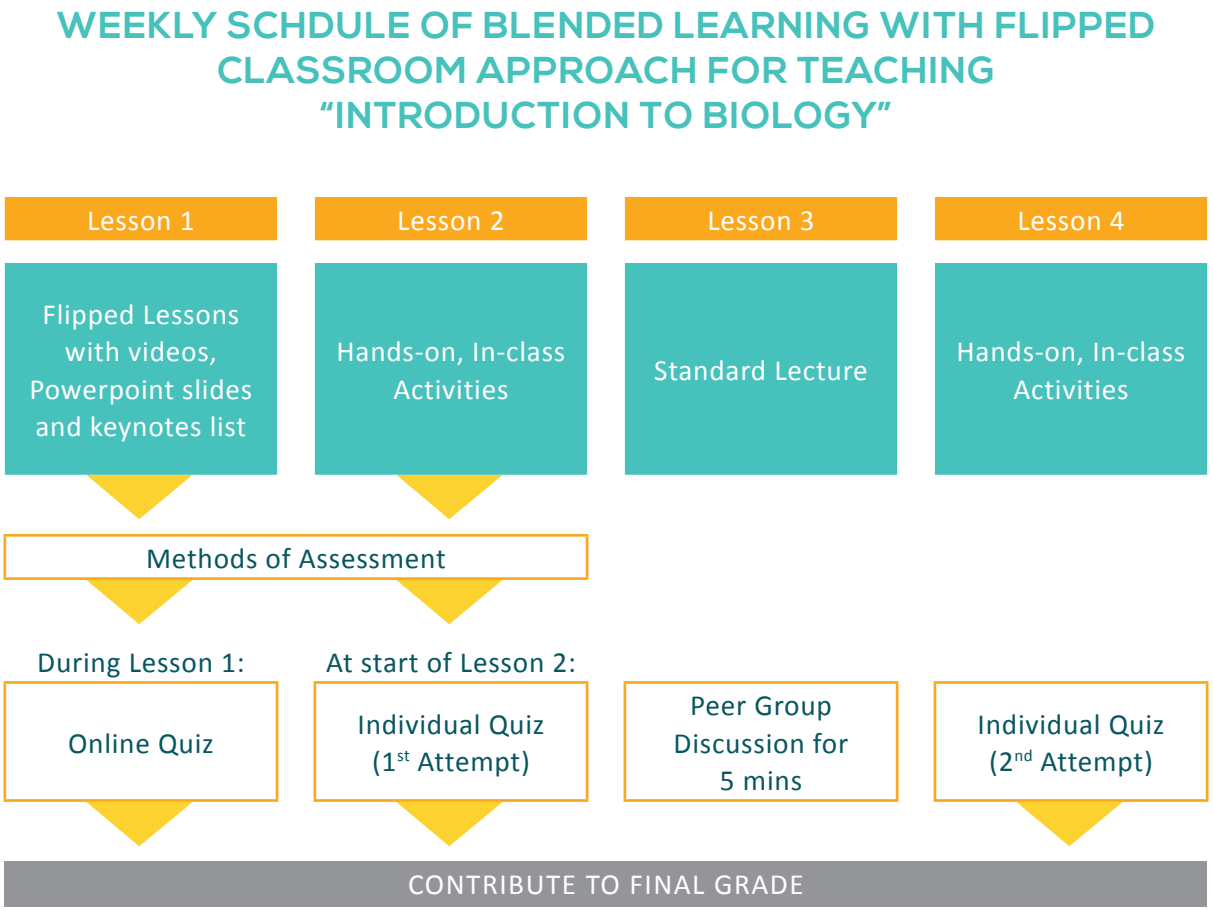

Figure 1: A schematic diagram illustrating the flipped learning approach

The first lecture of each week was flipped, while keeping the second lecture as a standard, in-class lecture. Another two lessons were held in smaller classrooms, i.e. cohort classes, where hands-on activities were carried out each week. Each flipped lesson consisted of a video recording, PowerPoint slides and a keywords' list. This was designed to facilitate the auditory, visual and reading/writing learners. Students were required to attempt an online quiz immediately after completing the pre-class exercise. The students were also assessed using a 5 to 10-minute quiz at the beginning of the first cohort class each week to further gauge their understanding of the topic.

Having a short quiz at the beginning also helped boost attendance and punctuality for class. Scores for both quizzes contributed to the overall students' grade, which was a source of motivation for them. Once in class, students used the content they had learnt in the flipped classroom to complete various in-class activities that target SUTD's kinesthetic learners. These activities included real and virtual experimental laboratory exercises as well as case studies relevant to the advanced topics in Biology. Figure 2 shows the virtual lab.

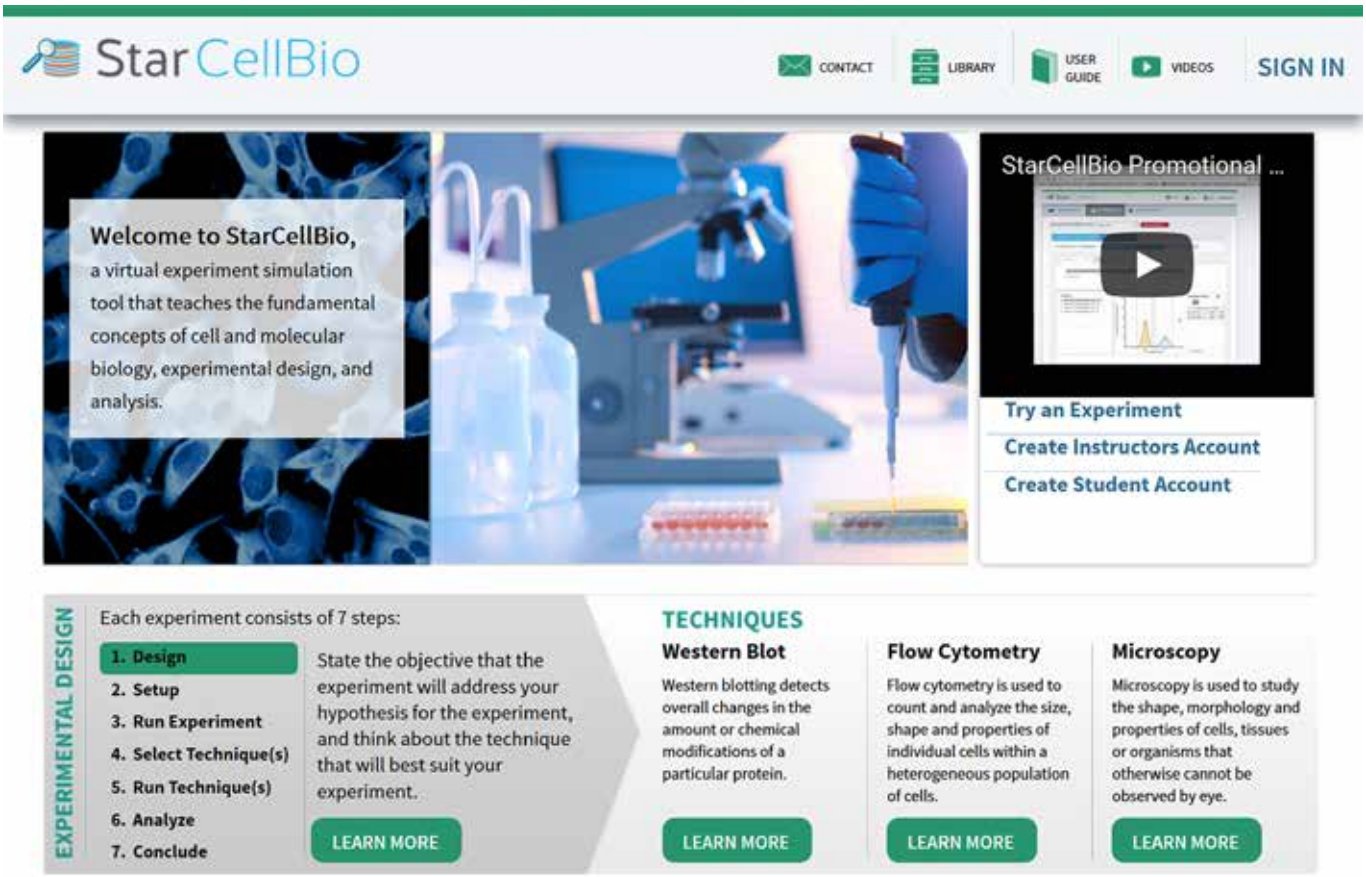

Figure 2: An example of an in-class activity using StarCellBio, a virtual simulation experiment tool, developed by MIT for teaching cell signaling and cell cycle

To find out students' thoughts on the flipped classroom, we collected student evaluations of the flipped classroom at the end of the course using a questionnaire of nine multiple choice and two open-ended questions. The data revealed that the flipped classroom approach was well-received by the 260 students who responded to the survey.

Despite the expected initial resistance to this student-directed learning initiative, most students felt confident with this learning approach towards the end of the term. The majority of students agreed that having the lectures flipped allowed them sufficient time to schedule and learn the fundamentals more effectively at their own pace, and helped prepare them for the cohort activity of the week. The weekly quiz held students accountable for timely review and completion of the flipped classroom lesson material. However, some students felt that a quiz at the start of the first cohort class was not fair for those without a biology background as they were not given a chance to clarify any doubts about the pre-class lesson. Some students also felt that having the flipped lesson over the weekend was stressful.

To address these concerns, we tried a novel strategy for the next batch of students in 2017. A five-minute peer group discussion of the quiz questions was introduced after the individual quiz. After the discussion, the students were then allowed a second attempt at the quiz individually. This significantly helped to encourage discussion of key concepts and shared learning amongst the students. It was heartening to see the students so completely engrossed in discussion with each other. The instructors felt "invisible" for once. The final quiz grade for that week was calculated by averaging the two quizzes taken.

A possible consideration for a future implementation would be to modify the structure of the flipped classroom. This would mean a format of one standard lecture, followed by a cohort class and then a flipped lesson and subsequently, a second cohort class in a week. This may take away any unnecessary pressure over the weekend and also equip the students with basic knowledge to better prepare them for the flipped classroom lesson.

In conclusion, our attempt at adopting a blended learning approach with flipped classroom for teaching an introductory biology course at SUTD (Figure 3) was rewarding. By taking an inquiry-based approach into our teaching and diligently taking notes on how we can improve, we discovered a good "formula" that encouraged student-directed learning and improved their attitude towards learning biology. We strongly believe that blended learning with flipped classroom, when implemented the correct way, can be very beneficial to the learning process.

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ACKNOWLEDGEMENTS

We thank the Office of Education for the funding support from the SUTD Pedagogy Innovation Grant, 2015-3019. We would also like to acknowledge research contributions from Drs. Khoo Xiaojuan, Dawn C-I Koh, Lakshminarasimhan Krishnaswamy, Rajesh Chandramohanadas and Ong Eng Shi.

ABOUT THE AUTHORS

Dr. Bina (Left) is a Lecturer and Dr. Julia (Right) is a Senior Lecturer from the Science and Math Cluster at SUTD. They teach Freshmore science subjects and their expertise and research interests include active learning, flipped classroom, and virtual laboratories.

INTERACTIVE TEACHING AND LEARNING USING TECHNOLOGY

Lee Chee Huei (EPD) and Teo Tee Hui (EPD)

Our cohort classrooms at SUTD are designed with whiteboards on all four walls, and many instructors make full use of them when teaching. However, we have noticed some drawbacks. Only the black and blue markers would provide sufficient contrast for reading, especially for students sitting at the back of the class. Often, instructors need to reproduce graphs, diagrams or equations on the whiteboard, eating into precious classroom time. Furthermore, due to the relatively large space of the cohort classroom, teaching effectiveness can be dampened by small handwriting, poor classroom lighting and other such logistical issues.

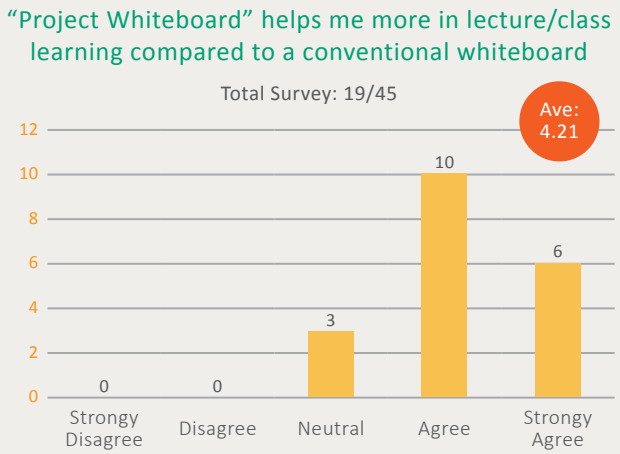
To overcome this problem, we decided to use Microsoft Surface Pro 4 (SP4) as a "Projective Whiteboard" to conduct lessons in cohort classrooms and lecture theatres and evaluate the learning experience. One distinct beneficial feature of Surface Pro is that we can write on its screen with a stylus, thus enabling annotations on PowerPoint slides and handwritten notes on note-taking software such as Microsoft OneNote. Once the screen is projected onto the multiple projectors in the cohort classroom, many disadvantages of teaching with the whiteboard are eliminated. Being able to annotate directly on PowerPoint slides means we can highlight keywords and explain graphs without having to copy them on the whiteboard. The space for writing with OneNote is unlimited, thus eliminating the need to erase the whiteboard for more space. In addition, portions of the screen can be magnified when needed, thus enabling students sitting at the back of the classroom to see clearly.

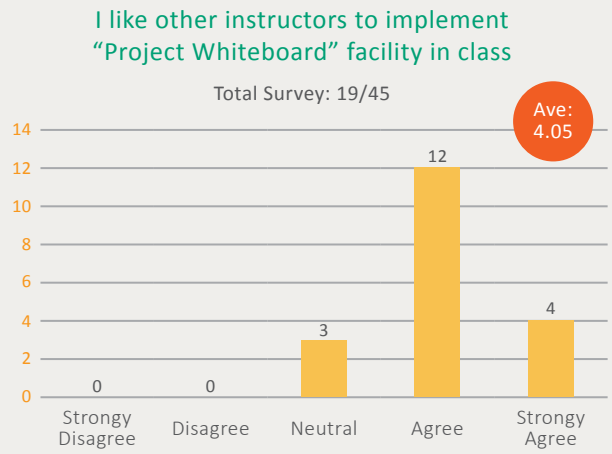
Having found that the "Projective Whiteboard" was better than using a normal whiteboard to teach, we wondered if we could engage students' attention further and help them learn better using other technologies. We also wondered if our annotated slides can be shared with students more efficiently. We felt that screen-sharing technology can help to achieve these goals. We used a system called "Splashtop Classroom". This tool allows the instructor's laptop screen to be shared with students' own laptop or mobile devices. This is particularly useful in teaching venues such as the cohort classrooms, lecture theatres or in a laboratory setting at SUTD.

The technology in Splashtop Classroom is easy to implement. Firstly, software installed on the instructor's computer displays a four-digit code or a QR code. Students key in this code using a plug-in on the Google Chrome browser or on the Splashtop Classroom mobile app. Upon doing so, they will be able to see the instructor's screen within 30 seconds. At the same time, the instructor is able to monitor the number of students that are logged in, enabling him to decide when to start the lesson.

We tested out both the tools for one Physics 2 cohort class in Term 2 of 2015 and surveyed the students at the end of the term. Out of 45 students, 19 responded. Overall, students perceived the "Projective Whiteboard" to be more helpful to their learning than a conventional whiteboard. This is supported by their comments (Figure 1).

> The Splashtop Classroom technology merely makes it convenient for the students by bringing the screen closer to them, but true learning and understanding happens through practicing and meta-learning

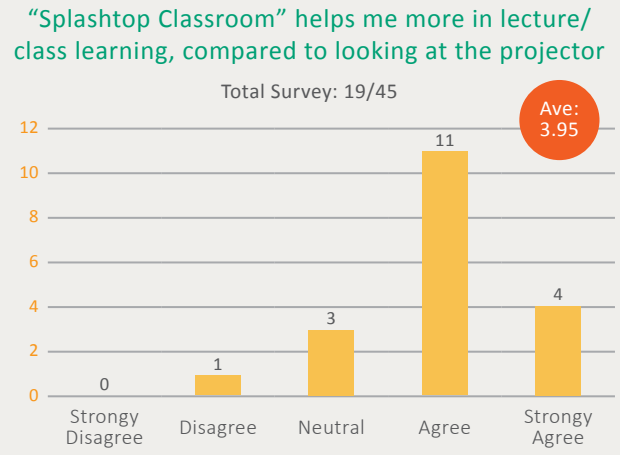


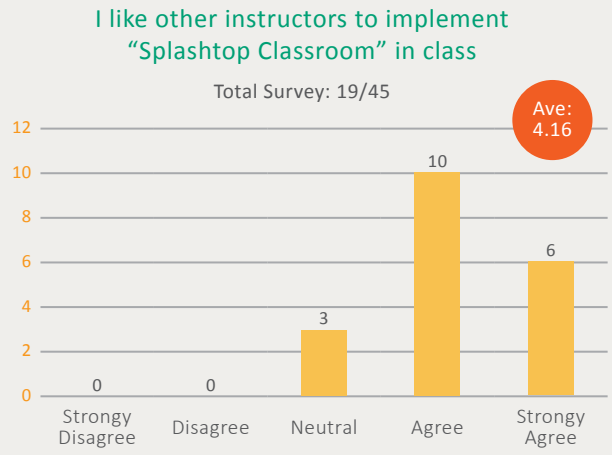


- It is easier to understand the topic being taught when the professors write additional notes alongside the slides
- This is a nice teaching complement and helps to make better sense of the slides. It helps much with the learning process.
- It helps to understand the concepts, the content and derivation better (all details are shown).
- Reduces time wasted while waiting for professor to erase the whiteboard (physical) and color variations help me learn better (highlights key points)
- I like handwritten notes and equations than typed ones.

Figure 1: Students' evaluation of "Projective Whiteboard"

Similar response was noted for "Splashtop Classroom" (Figure 2). Students indicated that they would like other instructors to use this technology. We feel that this is feasible as the technology enabling writing on the laptop screen has been available for several years and has reached a mature level. Since then, the use of projective whiteboard and screen-sharing technology has become common practice in our classes.





- Not easily distracted by switching between the whiteboard and screen, back and forth.
- Easier to read from the (my own) screen.
- Able to take screenshots easily, convenient, really easy to follow.
- A useful tool. It can be implemented in the lecture halls where those sitting at the back may find it difficult to see.
- Splashtop helps a lot when it is working well, but when it suddenly disconnects, it is somewhat distracting.

Figure 2: Students' evaluation of "Splashtop Classroom"

LESSONS LEARNT

Although it is possible to just use the projector screens in the cohort classroom to teach, we find that annotating on PowerPoint slides and broadcasting it to students' screens is a powerful combination. We recommend that instructors consider using a projective whiteboard and Splashtop Classroom in large teaching venues, or venues where students' view of the projector is blocked. For example, students seated at the back of lecture theatres 1 and 2 will find it hard to read what is written on the whiteboard at the front.

We had to design our PowerPoint slides in order to leave sufficient space for annotations. We were also careful not to write too much on each slide as it can look messy. It is possible to use Splashtop Classroom even as the instructor mingles among the students while teaching e.g. when supervising group work or a classroom activity. The instructor just needs to use Splashtop Classroom to share his laptop screen with the desktop computer found in most of the teaching venues. The desktop computer is then projected in the front of the classroom. In this way, Splashtop Classroom enables the instructor's laptop to be projected wirelessly.

Broadcasting slides to students' devices will not serve its purpose if instructors teach by merely flashing slides without providing any annotation. Usually, students can already download the slides from eDimension before coming to class. We also notice that students often refer to these slides on their laptop while the lesson is going on. Hence, it would not be necessary to use the screen-sharing system if no annotation on the slides is done.

Instructors should still remind students of the benefits of taking notes manually and practicing questions on their own. With Splashtop Classroom, there is nothing to prevent them from taking screenshots instead of writing the annotations down. This could be sub-optimal for students' learning as merely taking screenshots would not aid understanding. The Splashtop Classroom technology merely makes it convenient for the students by bringing the screen closer to them, but true learning and understanding happens through practicing and meta-learning.

CONCLUSION

We have explored the use of projective whiteboard and screen sharing technology to conduct our lessons in teaching venues such as the cohort classrooms. We find that both technologies complement each other. Our survey of one cohort class shows that students adopted this combinatorial method with a positive attitude. Students perceived it to be useful for their learning during lesson time and it is helpful for them to have the instructor's slides on their own laptop. As with any technology, users need to be aware of some best practices that can enhance teaching and learning.

ACKNOWLEDGEMENTS

We would like to thank the Office of Education for the Pedagogy Innovation Grant. We also acknowledge the Learning Sciences Laboratory for consultations on evaluation of technology tools. Colleagues who would like to try Splashtop Classroom can contact Chee Huei: cheehuei_lee@sutd.edu.sg.

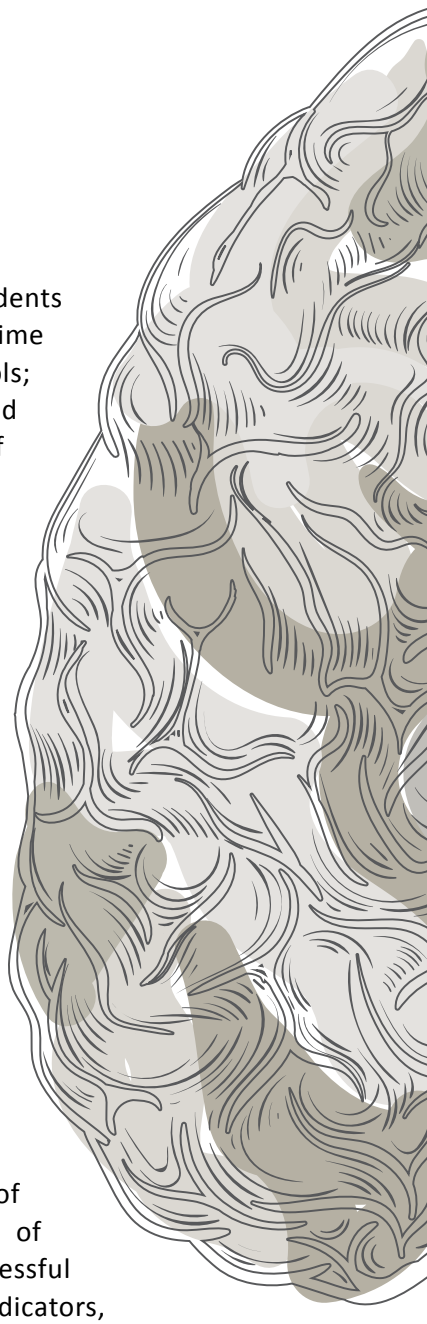
ABOUT THE AUTHORS

Dr. Chee Huei has been a Lecturer at EPD for more than 4 years. He is passionate about using technology to enhance teaching and learning. He has been working on physics education development to increase students' interest in physics.

Dr. Tee Hui is a Fellow of IES (Institution of Engineers Singapore) serving SUTD as a Lecturer at EPD. His pedagogy research interest is design science education in product development. He has initialed and invented his modified-JiTT (Just-in-Time Teaching) teaching and learning flow.

WHITE SPACE

Tara Marie Dankel (HASS)



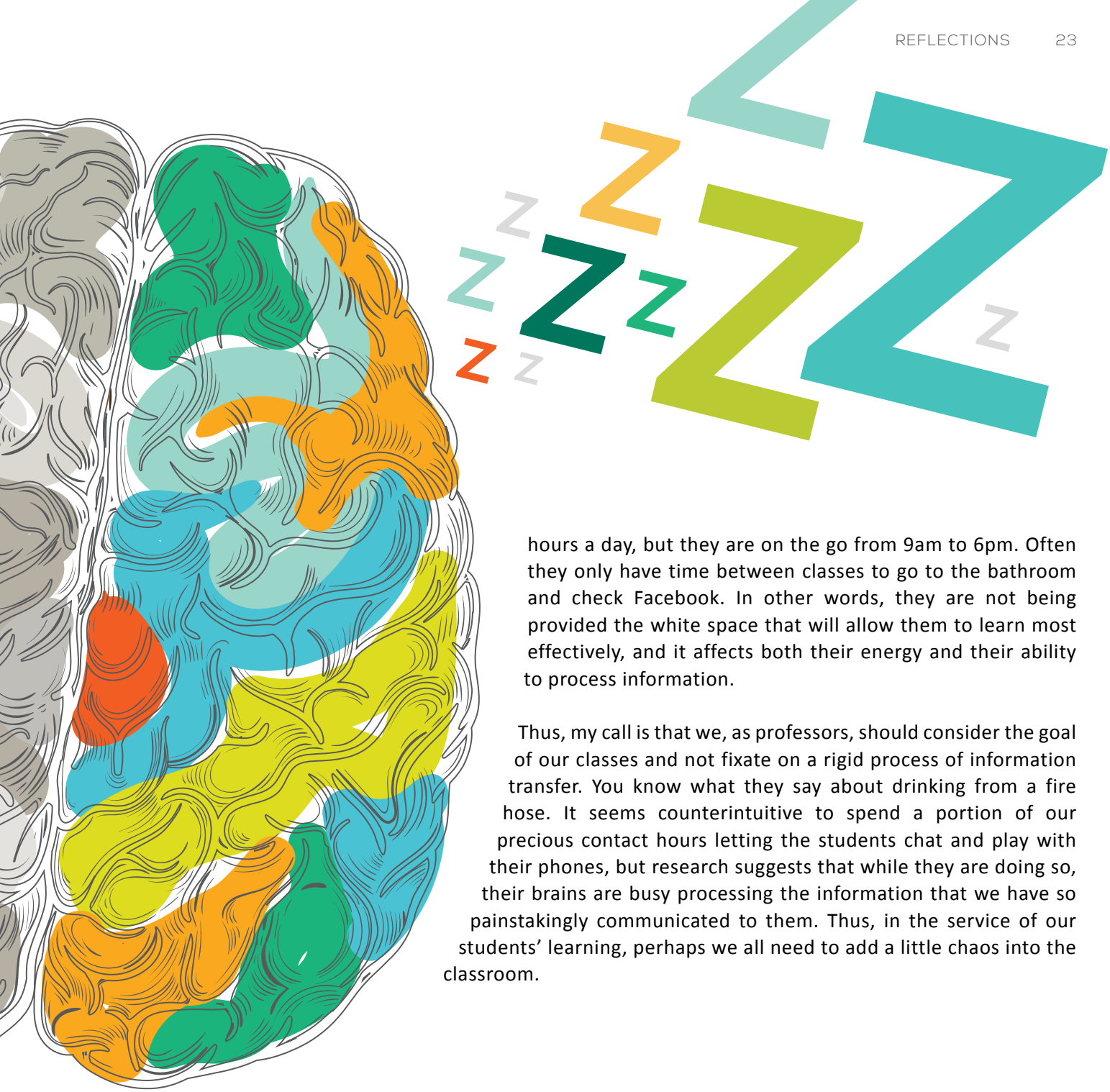
I constantly fight with the clock in my classroom. Three hours just isn't enough. There are so many things I want to do, and so little time, only about 39 hours, give or take, over the course of 13 weeks. That's only slightly longer than it takes to fly from the United States back to Singapore! Faced with this crunch, the temptation is to pack more and more in, to regiment the three hours down to the minute. It turns out, however, that this approach might be counter-productive.

Recently I read "The Chaos Imperative", by Ori Brafman, a professor at Stanford's business school. In it, he argues that we stifle critical thinking, innovation, and the ability to synthesize material when we rigidly structure our lives. He talks at length about the idea of mental white space, a sort of downtime for the brain, during which it synthesizes information on a deep unconscious level. If you've ever had the experience of working on a problem all day without coming up with a solution and then waking up after a good night's sleep with the answer suddenly at hand, you've experienced the power of white space. Neuroscientists have studied why this happens.

According to journalist Josh Shear, "MRIs show that when someone is focused on a task, one part of their brain is active. When the person moves off that task, however, the 'focused' part of the brain goes inactive, but the rest of the brain goes active, processing and synthesizing the information from the task." These two brain systems typically operate in a mutually exclusive manner. When you are taking in new information, you aren't processing it, and vice versa. Of course, you might say, well the students can have white space in the other 165 hours of the week; I need my whole three hours! The problem is that research suggests that individuals can only concentrate on new information for about 45 minutes at a time.

After that, their short-term memory becomes overloaded and they need some processing time. Brafman notes that Japanese schools, despite their famed rigor, give students far more unstructured time than American schools; Japanese students spend approximately 25% of their day in white space. Despite this down-time, they have, on average, higher test scores than American students. Moreover, they work diligently with little complaint. Some researchers surmise that the larger proportion of unstructured time might be the key. Brafman believes that it is. He cites another study which demonstrates that American primary school students who are given ten minutes of white space at the end of every hour are more successful across a range of indicators, even in disadvantaged schools with a reputation for discipline problems. Researchers at the Albert Einstein College of Medicine, he says, "discovered that the children with more recess time learned more, developed better emotional and cognitive skills, were healthier, behaved better, and managed stress better."

Yes, you say, but that's primary school, it's different from college where students are expected to have already developed strong concentration and more discipline. How different is it though? The researchers at Albert Einstein College of Medicine concluded that this need for hourly white space is as true for adults as for children. Few people, they note, can concentrate effectively for more than an hour at a time. We only have our students for a few



hours a day, but they are on the go from 9am to 6pm. Often they only have time between classes to go to the bathroom and check Facebook. In other words, they are not being provided the white space that will allow them to learn most effectively, and it affects both their energy and their ability to process information.

Thus, my call is that we, as professors, should consider the goal of our classes and not fixate on a rigid process of information transfer. You know what they say about drinking from a fire hose. It seems counterintuitive to spend a portion of our precious contact hours letting the students chat and play with their phones, but research suggests that while they are doing so, their brains are busy processing the information that we have so painstakingly communicated to them. Thus, in the service of our students' learning, perhaps we all need to add a little chaos into the classroom.

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Dr. Tara is an Assistant Professor in Philosophy and is a member of the HASS cluster. She holds Certificates of Distinction in Teaching from Harvard University. Tara's interest is on literature, apocalypse, popular culture and sexuality.

TACTILE MATHEMATICS

Sergey Kushnarev (ESD)

Can mathematics be taught in a fun way without losing its gravitas? Certainly, if you speak to Professor Jessica Libertini of Brown University.

Jessica and I have known each other for more than ten years. We studied together in graduate school at Brown. I have always been impressed by how passionate she was at teaching, trying to relate calculus and mathematical concepts to students. Having worked at SUTD for a few years now, I realised that Jessica was doing exactly what SUTD propagated in our pedagogy -- active learning. Generally, there is a lack of math-related resources dedicated to active learning, whether this is online or in a form of the workshop. This is what motivated me to invite Jessica to SUTD to deliver a talk on active learning for teaching mathematics.

Although Jessica's talk was held in mid-January of 2017, the time when most of the faculty members were not around, we still saw a participation of about 10 to 15 people, which was a good turnout for an off-term. Jessica touched on a few topics in her talk. For example, she attempted to answer the question: "Why do we need to use active learning in teaching?" She did not have to hard-sell us the "why" part. Luckily, SUTD is already actively involved in this pedagogy. However, she provided a few responses to the questions that our faculty might not have had already. One notable point she made was that active learning makes abstract concepts more accessible. They create touchstone experiences for students that instructors and students can refer to throughout the semester. They allow students to connect to the material which is either "too hard" (because they have never seen it before) or "too easy" (in the eyes of the student). Which could be a problem as well: if the material is too easy, then students would not spend time on it, and thus run the risk of not seeing the deeper concepts behind it.

Jessica mentioned that all the math courses she taught allow for the use of activities: starting from pre-calculus, calculus, ordinary differential equations and up to introduction to proofs, real and complex analysis as well as other upper Math electives.

Then she proceeded to address few questions from skeptics such as "Isn't this too "babyish" for my college students?" Her answer to this is a resounding "no". The majority of students commented that they were grateful for opportunities to really engage with the concepts.

She addressed another skeptical question: "I don't have time for this! I have too much material to cover! How do you fit it in?" In response, Jessica said: "I make time. These touchstone experiences often save me time later in the course because I can say 'remember when…' and draw an easy fast connection to the activities."

The hands-on workshop that Jessica conducted right after the talk with some of the possible math activities one can implement in class was a nice touch to me. They were all from her upcoming book Tactile Learning Activities in Mathematics: A Recipe Book for the Undergraduate Classroom (MAA Publishing, CRM) to be published towards the end of 2017. To explain the activities that Jessica conducted would not do them justice. These are best experienced in the true spirit of active learning. Still, I will try to outline some examples.

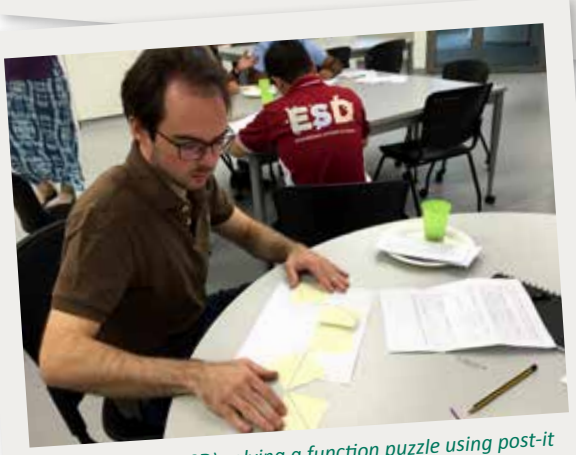
For instance, we used the waxy threads (known as Wikki stix) that stick to paper to plot functions with required properties. We also tried a similar activity

with post-it notes with straight and curvy lines drawn on them (see picture with Omar). We have completed a “proof puzzle”. The pieces of a certain proof were printed on small paper cards. We were supposed to organize the cards in a correct order to produce a mathematically rigorous proof. This is less intensive for students than coming up with the proof from scratch, and introduces the “fun” part into the activity by making it into a puzzle.

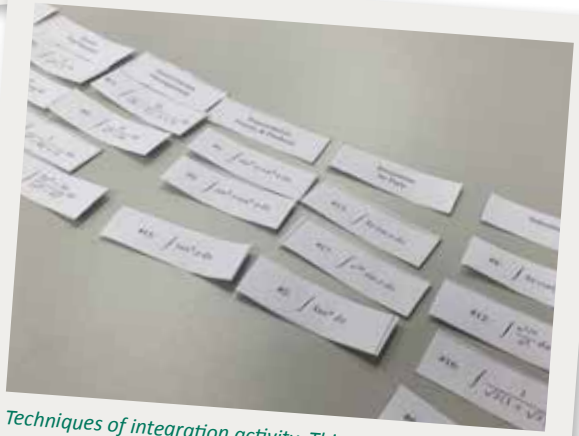
Another example involves using M&M’s to simulate death, birth and immigration processes. We would throw a handful of M&M’s onto a table (each M&M candy would represent “a person”) and would discard the ones that turned “belly up” (letter “m” facing up). This would symbolize a “death” of a person. Then we collect all the “alive” ones and would repeat the process again: throw the candies onto a table and discard the deceased ones. After doing a few iterations of that process students would discuss difference equations (or differential equations) and would try to write down an equation that would describe this process. The list of activities goes on. The pictures accompanying this article would give you some clues about the workshop.

Having gone through the workshop, I can attest to the fact that instructors had fun doing these activities, which would in turn translate to students too having fun. As a follow up, the Wikki stix, post-it notes and techniques of integration activities were used in Term 1, 2017, Math 1 class (course lead: Wong Wei Pin) and found to be very engaging.

Chee Hui and Norman plotting functions with Wikki stix.



Omar (Lecturer, ESD) solving a function puzzle using post-it notes.



Techniques of integration activity. This activity tasks students to name the method of integration associated with the problem printed on the paper slip.

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Dr. Sergey is a Senior Lecturer at ESD. He has been teaching Freshmore math at SUTD since 2013. Sergey obtained his PhD in Applied Math at Brown University. He has always been passionate about teaching and making learning of mathematics fun.

DIAGRAMMING CASE STUDYING

Oliver Heckmann (ASD)

The 'Urban Housing Typologies' - a vertical elective course for ASD Bachelor, Master and PhD student, discusses the complex nature of urban contexts as a framework to formulate design strategies for human habitation at its various scales of the neighbourhood, the building and the residential unit. The aim is to enable students to understand the relevance of housing typology research, but also its potentials as procedural knowledge and design expertise.

Courses on housing typology - an important knowledge-base for informed design practices - are often taught as a somehow passive reproduction of an existing, systemized body of work; as an immutable, instructional catalogue of architectural strategies considered to be typical, objective and generally relevant. But such knowledge can also emerge as organic output of one's very own ongoing typological practice - rather becoming a procedural expertise and used to continuously acquire a holistic understanding of techniques, strategies, attitudes and ideas that are embodied within architectural projects. To prefer such an ongoing approach of procedural knowledge to that of a solidified repository is also more adequate to respond to the increasing complexities and challenges of design practices emerging with the processes of rapid urbanization, radically changing and diversifying demographics, and pressing environmental and economic issues.

One essential format of teaching housing typology is to conduct case studies. In most other disciplines such as law, medicine, business or social sciences, case studies are instructional materials presented to students as class assignments to solve. They are often real or realistic but constructed events or situations- representing particular issues or conflicts to be solved. Information shared as part of the case study might be historical, economic or social data or on the roles of involved stakeholders. In architecture, case studies focus on realized or theoretical building projects. Their scope varies - they can simply be project descriptions or refer to precedents as "good examples" for a particular project to be designed. They can be conducted with various levels of resolution, either being reduced to a few aspects or evaluating the building's performance with a multitude of criteria.

Beyond this focus on the precedent though, case studying is also taught as itself as a holistic tool of design research for both design practices and schools. As a procedural expertise, it is meant to inform design decisions and solutions, to identify, understand and develop relevant criteria and strategies for aspects such as the spatial or social performance of a building. These can naturally become important guidelines for evidence based design approaches.

Conducting case studies as a structured analysis of architectural designs is a form of knowledge acquisition that is somehow specific to designers: namely the ability to draw independent, abstract conclusions from built precedents for one's own research or design practice without simply copying them. Nigel Cross (1982) argues that architectural knowledge is embedded in designs and that architecture students learn to decipher projects and draw conclusions from concrete examples about the underlying systems, anticipated demands, design intentions and others. Essential aspects of designs can be deciphered here, for instance, its connection to contextual networks, its internal functional relationships, its experiential qualities and as particular aspect in dwellings the spatial relationships between the domains of an individual and his or her community. Such studies can also be considered as a process of un-formalizing and abstracting, from the physical to formats of analytical representations with a generative potential.

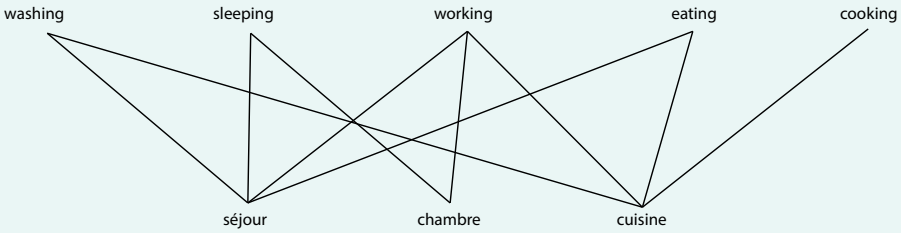
As part of the course work, individual students are required to conduct a case study on a residential building as a final assignment. Students follow a specific graphic layout template with a series of standardized diagrams, which are themselves an output arising from experimentation and numerous iterations of analysing the different aspects and spatial entities of the building. Rather than prescribing the coding of the diagrammatic

representations or leaving it entirely to the individual students to come up with their own ways, we identified promising diagrammatic representations generated in individual assignments and then asked the authors to collaboratively develop a generic diagram for everybody to follow. These iterations were also informed by analysing the methodological and graphical approaches of relevant case study literature.

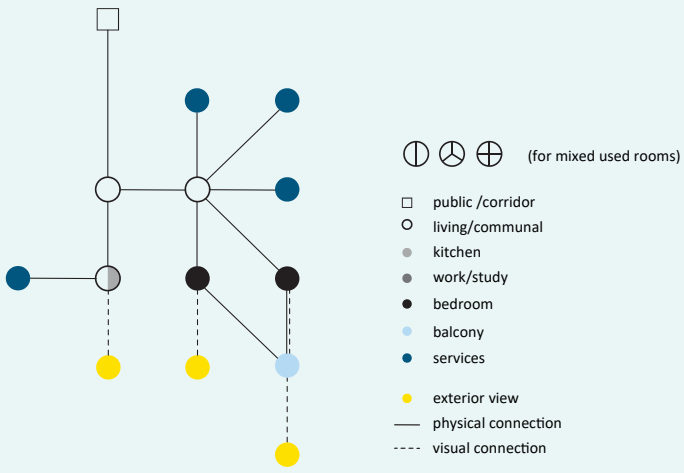
Diagramming, as a practice of developing appropriate means of graphic representation to illustrate specific aspects of a built environment at all its scales consequently became one of the main focus of this course, and the generated diagrammatic representation the predominant format of analysis for the case study research. As Peter Eisenmann (2007) explains, a diagram is "a representation of something that is not the thing itself". The diagram helps to perceive an architectural form as an abstract spatial organisation of relational systems beyond simply illustrating its physical reality. Drawing a diagram then becomes a procedural act of acquiring an understanding of its complexities. Independently from the originally investigated precedent developing abstract means of analysis also have the potential to become generative tools.

Following are three simple examples of diagrams developed by students as analytical tools to conduct case-studies which illustrate how students were able to create frameworks on housing typologies and represent or communicate through diagrams.

MAPPING ACTIVITIES, DIAGRAM EE HUI JIE

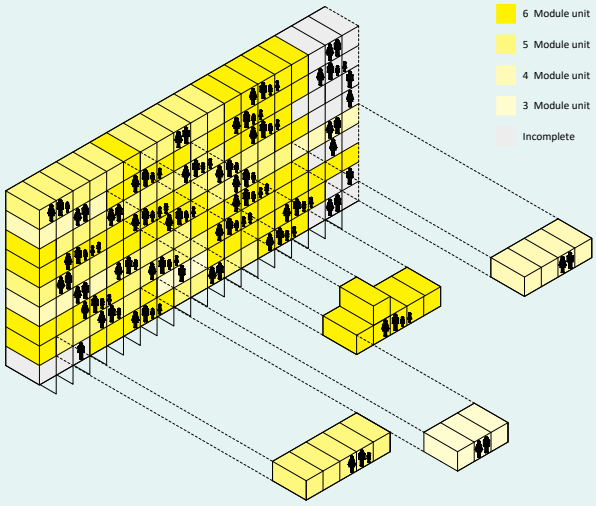


The diagram developed by Ee Hui Jie as part of an apartment layout mapping exercise was inspired by a study of Kiyoyuki Nishihara (1967), who analysed habitats by mapping in which spaces six essential human activities could be alternatively conducted instead of focusing on the deterministic functions of rooms. This format of diagram was then used to evaluate the flexibility of the layouts of the residential precedents through subsequent case studies. Taking this strategy further and eventually applying such diagrammatic approaches as a design instrument and not just as an analytical tool could help to inspire floor plan layouts that are not biased by predominant notions of layout conceptions and functionalist paradigms.



MAPPING ACTIVITIES, DIAGRAM EE HUI JIE

The diagram developed by Lau Xue Yi resulted from a joint study on mapping spatial integrity, an approach proposed by Julienne Hanson (1998) to examine residential units as matrices of a spatially organized social framework, that are designed to formulate a specific balance between common and individual demands within a unit. Abstracting an apartment to a network of nodes differentiated by their functions and connections also has a generative potential that could be explored further in design projects.



FORMS OF OCCUPANCIES, DIAGRAM ROSANNE CHONG SI QI

In the context of discussing forms of urban habitation that are able to accommodate diverse residential groups as a prerequisite to be adaptable to shifting demographics, Rosanne Chong Si Qi developed a simple generic diagram template that relates the different occupancy models to the various apartment types and also illustrates the diversity as a whole.

These diagrams are illustrative of the possibilities of developing and creating knowledge in housing typology as active learners through the case study methods rather than just classifying and typifying architectural spaces. This takes a more inquiry-based approach, engaging both students and teachers, making teaching and learning deeper and more meaningful.

Often teaching of housing typology courses tends to concentrate predominantly on building up a catalogue of projects one could memorize and refer to as a potential repertoire, and often miss to also develop a deeper understanding of the methodologies of typology as a procedural practice and to discuss its graphical means of enquiry and communication. This is also why the plural has been chosen in the course's title - for 'typologies' as individual typological practices developed by the participants rather than having one 'typology' to follow. To pursue this, the Urban Housing Typologies course focused also on the formats of representation that are used to discuss and practice housing typology research. Specifically developing those as diagrams helps to study precedents beyond their physical reality and understand buildings as a conglomerate of relational systems.

There is also a certain automatism to predominantly use diagrammatic illustrations as pure visualizations of. Their function would then be predominantly explanatory. But some of the outputs of this course indicate an interesting generative potential that will be interesting to pursue further in the upcoming courses or even design studios.

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ABOUT THE AUTHOR

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TEACHING ASIA AND THE GREAT BOOKS

Nazry Bahrawi (HASS)

Picture taken at World Literature and Global Core Texts Conference, SUTD, June 2017

What accounts as a great book? Why and how should universities teach them? These questions are pertinent to SUTD, which had introduced a compulsory 'great books' module for first-year undergraduates since its very inception. First developed in collaboration with MIT, the module "World Texts and Interpretation" has undergone several changes to cater to the needs of its students and context. Yet, SUTD is not the only higher education institution to rethink the model of the 'great books' course.

Humanities faculty at many universities around the world show increasing interest in bringing classic works from different cultures within a single study of literature. This rapidly growing interest, however, outpaces the ability of interested humanities faculty to establish a common framework for combining the classic literature of different cultures into a single course.

This is especially true at universities in the West where the sudden rise of Asia has drawn keen attention from many humanities faculty whose formal education and life experience has until now excluded much knowledge of non-Western cultures. At universities in Asia, on the other hand, humanities faculty have long been aware of the sway of Western culture, but years of reading Western literature, whether in the original language or in translation, has not yet produced a consensual set of ideas about how to combine Asian and Western literature into a unitary study.

To address this deficiency, SUTD held a conference over two days in June 2017. Titled "World Literature and Global Core Texts", the conference brought together academics from both Asia and the West who are seeking to develop theoretical underpinnings and practical guidelines for a curriculum of global literature. It was organised by J. Casey Hammond, Michael D. Reid, Nazry Bahrawi and Rhema Hokama from the Humanities, Arts and Social Sciences cluster. Among the leaders in this endeavor is the Institute of World Literature (IWL) based at Harvard University, which is now in its sixth year of existence. The IWL is constituted by affiliated universities in North and South America, Europe, the Middle East, and Asia, whose faculty members are eligible to participate in its annual four-week workshop that seeks to "provide its participants with a solid grounding in approaches to literature in global perspective".

Other leaders, who work from a different angle, are the Chinese University of Hong Kong (CUHK) and SUTD, neither of which is affiliated with the IWL, but both of which have pioneered mandatory global core texts courses for all first-year undergraduates starting from 2012. Although CUHK and SUTD coincidentally designed similar reading lists for their courses, each has developed distinct pedagogical methods. There is valuable complementarity to the work of academics based at these three institutions. The IWL, by attempting to develop a general framework for thinking about literature across cultures, focuses more on the overarching nature of world literature. CUHK and SUTD, by investing substantial faculty resources in teaching global core text courses, focus on practical issues related to a similar curriculum. Bringing together theorists and practitioners from these three institutions, along with other interested scholars, to initiate a joint ongoing conversation will help narrow the gap between naïve enthusiasm for teaching global literature and teaching it within a rigorous common framework.

The conference addressed theoretical questions related to the establishment of world literature as a discipline in its own right. These include:

- What, in the first place, is world literature? What are its fundamental concepts? And what are the strengths and weaknesses of these concepts?
- What are the new directions in which world literature is moving towards?
- What qualifies or disqualifies a particular text as world literature?
- How does a globalising world affect the study of any literature? And how might a de-globalising world affect the study of world literature?
- Does world literature presuppose a global perspective? If so, then what does world literature offer to those who have not developed a global perspective?
- How can we give a fair reading to texts drawn from foreign cultures we are unprepared to think about in deeply meaningful ways?

The conference had also addressed practical questions related to designing and teaching a humanities core course based on a multicultural syllabus of texts, as well as questions that arise out of the mission statement of the Association for Core Texts and Courses (ACTC), the primary academic association for so-called 'great books' courses:

- How does an academic immersed in one culture effectively teach the literature of another culture with which he or she has no meaningful familiarity?
- Is the inclusion of non-Western literature a subtle vehicle to reaffirm Enlightenment values by teaching students to read it critically as part of an exercise that, according to the ACTC, will allow students to "free themselves from instant truths and local passions"?
- Alternatively, is non-Western literature included for the sake of fitting it into a scheme of Enlightenment-derived universal questions that are, according to the ACTC mission statement, "timeless in their philosophical significance and timely in their relevance for us"?
- Where in a global core texts course is there room for particular cultural beliefs and dogmas that can neither be easily raised to universal values nor reduced to "instant truths" and "local passions"?
- How can a global core texts course balance Enlightenment values with particular cultural beliefs and dogmas?

Sun Sun Lim, SUTD's head of HASS, opened the conference by speaking of the value of literature in shaping a nation's socio-cultural imaginary. The conference also featured keynote speakers David Damrosch of Harvard University and Deborah Martinson of Columbia University. In his talk 'All the World in Time', David demonstrated the ways in which literatures from both East and West can be taught in tandem. Drawing from his experience, David argues that less is more. He believes that students respond better to excerpts and short texts that speak to them rather than lengthy books. Deborah, meanwhile, spoke of the need to include women and minority writers into the canon of great books in her talk "Expanding the Great Conversation". The conference was well-attended, seeing participation not just from current undergraduate students at SUTD but also academics and researchers from outside of SUTD and the discipline of literature.

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A MULTIDISCIPLINARY 2D PROJECT ACROSS MATHEMATICS, PHYSICS, HUMANITIES, SOCIAL SCIENCE AND DESIGN

Arlindo Silva (EPD), Christine Yogiaman (ASD), Huang Shaoying (EPD), James G. Wan (ESD), Nilanjan Raghunath (HASS), Pey Kin Leong (OED)

Teaching design in the foundational years of engineering and architecture education has been growing in popularity in recent years. However, the problem of teaching design at the freshman and sophomore levels is best explained from a constructivist approach in that design is the summit of the learning curve. This makes it challenging because students lack the technical background to make good design decisions. This paper analyses this perceived difficulty and presents a case of design teaching in which mathematics, physics, humanities and social sciences explicitly come together in a design project at the Freshmore level. The experience of setting up this project and assessing the outcome is described, from the perspective of the mathematics, physics, humanities, social science, engineering and architecture instructors involved. The specific focus of this short communication is on the 2D project for term 2 of the undergraduate program. In term 2, students will take four required subjects out of the following five: Theorizing Society, the Self and Culture (TSSC) or World Texts and Interpretations (WTI), Introduction to design (ID), Advanced Mathematics II (M2), and Physics II (P2). It is within this context that a 2D project emerges along the term.

1. FRESHMORE DESIGN: HOW MULTIDISCIPLINARY CAN IT BE?

Design is universally perceived as multidisciplinary, in the sense that it involves multiple disciplines to devise something new to the world. Historically however, each discipline or field of research has evolved separately. Nevertheless, the complex problems of society today cannot be analyzed, let alone be solved, by dividing the problems into smaller and smaller sub-problems and dealing with each one separately. There are inter-related complexities, social issues, sustainability concerns, political influences, etc. (Tryggvason and Apelian 2012). These global problems are not solely within the confines of engineering, or urban planning, or social problems. They are design problems in which each discipline plays a role.

Retrospectively, design and manufacturing became separate entities with the industrial revolution. Before that, design was performed basically by the manufacturer, without any distinction between the two. The practice of design being done in one place and manufacturing in another, has led to a complete divide between the two.

Design thinking has emerged to tackle these (and other) design problems. Design thinking, teaching and learning is difficult because of this multidisciplinary nature, but there are varying studies that point to specific methods and techniques that are commonplace as far as engineering is concerned. Engineering curricula have always made an attempt to integrate all the disciplines through a capstone project (in the pervasive North American nomenclature) that tries to bring together all the knowledge acquired by the students. This is now generally considered “too little, too late” by the accreditation bodies across multiple countries. Although the integration of design at the Freshmore level has been happening at least from the 1990s onwards (Dym 1994), a lot more has to be done to incorporate design across the engineering curriculum and provide a bridge between design and the other disciplines.

On the contrary, design and manufacturing have steadily converged since the 1980s with a push

towards the integration of manufacturing earlier in the design cycle, both in practice and in education (lean manufacturing, lean design, design for manufacturing and assembly, and so on), the convergence of design with the natural sciences (such as mathematics and physics) as well as the social sciences has been a more recent effort. At the Freshmore level, there are several examples of convergence between design and the natural sciences. Another perceived divide is the one between engineering and the social sciences. Engineering students are often weary of learning new concepts outside their comfort zone. The learning of this type of concepts is challenging due to the complexity of the content, the method of delivery, and the assessment process. Raghunath and Li were able to bridge this perceived divide by enabling their engineering students to apply theories and concepts from sociology to real-life examples, such as from the students' internships or interpersonal relationships (Raghunath and Li 2016).

The recent emphasis by the design community on design thinking has raised awareness for the need to also formally incorporate social sciences in the design loop. What was previously clustered under "market studies" and seen as being in the realm of marketing in the form of market segmentation or voice-of-the-customer, has more recently assumed a more prominent role in the design phase through user empathy, user experience, ethnographic studies and contextual needs analysis. Nevertheless, numerous attempts and reports can be found in the literature stating the commitment from various institutions to introduce design in the Freshmore year such as exhibited in a recent survey of these cases for engineering curricula (Silva, Fontul et al. 2015). Overall, attempts at bringing design into the Freshmore year has resulted in simply adding a subject (design), with none or very limited efforts of actually integrating this subject with the typical natural science and/or social science subjects taught at that level. The present authors are unaware of a convergence, at least at the Freshmore level, between design, natural sciences and social sciences. The bridging of all the subjects has been mostly left to the students. The 2D project in term 2 at SUTD has tried to tackle this, by explicitly instructing the students to bridge this gap between subjects. Students are explicitly asked, in the context of their own design project, to show how mathematics, physics, humanities, and social sciences have influenced their projects or conversely, how their project has helped them understand in more depth those subjects. They can choose two out of the four subjects for their 2D project.

2. THE 2D PROJECT SETTING AND PACE

The ambition of the 2D project in term 2 is aligned with the fundamental design thinking process that ID aims to cultivate through the course. Therefore, the reasoning for ID to lead the 2D project in term 2 comes instinctively. There are several points across the term where the 2D project is explicitly mentioned across all subjects. In 2017, these moments are shown in Table 1.

WEEK	DESCRIPTION
1	ID explains the goals of the design project and the compulsory links to other courses.
6	On the ID lecture, a faculty member of each of the other courses will come to talk to the students about their own subject and give examples of ways in which their subject might be incorporated explicitly into the design project.
6 & 10	In the respective cohort classes for TSSC, WTI, MII (week 10) and PII (week 6) teams will discuss with faculty what is being done in their design projects that include that specific subject. At this time each student team will have to decide which other subjects they will explicitly show links to.
11	Faculty members from MII, PII, TSSC, WTI and ID will discuss 2D project development in a review format (print outs pinned up by the teams to show what they are thinking of doing) during 3.007 cohort class times.
13	Final exhibition – teams will present their ID design projects in the usual way (prototype, video, poster, demonstration, etc.) and they will put up an extra poster where they will explicitly show these links to TSSC, WTI, MII and PII.

Table 1: Specific moments of interaction for the 2D project in 2017 involving the instructors. Other moments of interaction will surely happen informally, driven by the students.

THEORISING SOCIETY, THE SELF, AND CULTURE

MAX WEBER AND TECHNOLOGY

PARDON MY FRENCH

Learning a language is typically thought to be a social experience. One might go to a school, for instance, for face-to-face interactions with a teacher. However, as the capabilities of technology increase, so do the propensities for self-learning. With platforms such as Rosetta Stone and numerous mobile applications, learning new languages has never been so accessible. While this obviously offers a multitude of benefits for the user, it is also important to consider the possible side effects this might bring about.

THE IRON CAGE

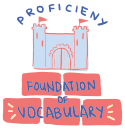
First described in Weber's **The Protestant Ethic and the Spirit of Capitalism**, the concept of an "iron cage" can be associated with the increased rationalisation inherent in society. It was described to be the result of the need for efficiency leading to those born within the constraints of the society being trapped within their respective strata. This relentless drive towards optimisation can be characterised by the increased division of labour in a society. Such division stems from working towards the completion of a goal in the fastest time possible, eventually trapping individuals in systems based on teleological efficiency.

THE TROUBLE WITH TECHNOLOGY

As the convenience of technology increases, the resultant obsession with efficiency in a community grounded in technology might lead to social disconnect. This traps us in the conundrum of Weber's iron cage - is the trade-off between efficiency and human interaction worth it?

ON THE FLIP SIDE

While Weber condemned the negative effects of the iron cage, he also brought up the fact that such convenience was necessary for the continued growth and prosperity of a nation. Due to the hectic nature of everyday life, it is generally impossible to have ideal conditions for language learning in every possible scenario. Therefore, it is beneficial for a person to bolster or kick-start an interest in a new language through technological means such as this Design project! A strong foundation in vocabulary might change the outcome of learning a language for the better, reducing the frustration people might face while integrating the solution in their everyday experiences.



OVERCOMING THE IRON CAGE

Future models of this project have endless possibilities that may balance the negative aspects of technology.

Develop more sophisticated audio and verbal components, such as real-time translation and conversation, to combat the lack of spoken interaction faced by users.

Implement more social features into the software, perhaps allowing users to interact across an international setting, connecting people from all over the world.

Incorporate colloquialisms and local slang in the software, so that users will understand the nuances of a language with greater ease, making connecting with locals more natural.

Enable the software to recognise different facial expressions and emotions of the people around you, enhancing the social and psychological awareness of the user.

PHYSICS II

Material and physical structure of our screen

MATERIAL

In order to be a suitable material, two main criteria must be met:

- Satisfying reflectance $R_{min} < R < R_{max}$, where M is denoted as the quality of the mirror image of the language tag, and I_r are the wave intensity of the incident and the reflected light respectively. By research, R should be around 50%.
- Satisfying transmittance $T_{min} < T < T_{max}$, where Q is denoted as the quality of the user's view of the surroundings. I_t is the wave intensity of the refractive light. In the case of our project,

$$I_t = 40\% I_r = 1$$

FRESNEL EQUATION

From Maxwell's equations regarding the interface and boundary conditions for electromagnetic fields,

$$\varepsilon_1 \varepsilon_0 E_{1n} = \varepsilon_1 \varepsilon_0 E_{1n}, (1.05)$$
$$E_{1t} = E_{1t}; (1.06)$$
$$\mu_1 \mu_0 B_{1n} = \mu_1 \mu_0 B_{1n}, (1.07)$$
$$B_{1t} = B_{1t}; (1.08)$$

The index n and t represent the normal and tangent component respectively. According to the above relationship, we are able to derive the Law of Reflection and Refraction:

$$\sin i_1 = \sin i_1' \Rightarrow \cos i_1 = \cos i_1', (1.09)$$
$$n_1 \sin i_1 = n_2 \sin i_2 \Rightarrow \cos i_2 = \sqrt{1 - \left(\frac{n_1}{n_2}\sin i_1\right)^2}, (1.10)$$

where i_1, i_1', i_2 are the angle of incidence, reflection and refraction respectively.

Then, we also get the Fresnel equation:

$$E_{1r} = \frac{n_2\cos i_1 - n_1\cos i_2}{n_2\cos i_1 + n_1\cos i_2} E_{1i} \Rightarrow \left(\frac{E_{1r}}{E_{1i}}\right)^2 = \left(\frac{n_2\cos i_1 - n_1\cos i_2}{n_2\cos i_1 + n_1\cos i_2}\right)^2 = r_s^2 (1.11)$$
$$E_{1t} = \frac{n_1\cos i_1 - n_1\cos i_2}{n_2\cos i_1 + n_1\cos i_2} E_{1i} \Rightarrow \left(\frac{E_{1t}}{E_{1i}}\right)^2 = \left(\frac{n_1\cos i_1 - n_2\cos i_2}{n_2\cos i_1 + n_1\cos i_2}\right)^2 = t_s^2 (1.12)$$
$$E_{2r} = \frac{2n_1\cos i_1}{n_2\cos i_1 + n_1\cos i_2} E_{1i} \Rightarrow \left(\frac{E_{2r}}{E_{1i}}\right)^2 = \left(\frac{2n_1\cos i_1}{n_2\cos i_1 + n_1\cos i_2}\right)^2 = t_s^2 (1.13)$$
$$E_{2t} = \frac{2n_1\cos i_1}{n_1\cos i_1 + n_2\cos i_2} E_{1i} \Rightarrow \left(\frac{E_{2t}}{E_{1i}}\right)^2 = \left(\frac{2n_1\cos i_1}{n_1\cos i_1 + n_2\cos i_2}\right)^2 = t_p^2 (1.14)$$

s and p: polarization. The behavior of the light wave for the s and p component are independent.

The time average of the Poynting vector is

$$I = \frac{1}{T}\int_0^T \frac{1}{\mu}\frac{dU}{dt}dt = \frac{1}{T}\int_0^T S = \frac{E^2}{2c\mu_0} \propto E^2$$

which is the intensity of the light. The above equation is applied to the relative intensity in the same medium. However, to calculate I in different media,

$$I \propto nE^2, (1.15)$$

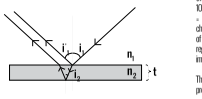
where n is the refractive index. Combine (1.15) with (a) (b) (1.11) (1.12) (1.13)(1.14), we can get

$$R_s = R_s^2, R_s = R_s^2;$$
$$T_s = \frac{n_2}{n_1}t_s^2, T_s = \frac{n_2}{n_1}t_s^2$$

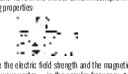
As the consequence of the conservation,

$$R_s + \frac{\cos i_2}{\cos i_1}T_s = 1, \qquad R_s + \frac{\cos i_2}{\cos i_1}T_s = 1$$

In general, with n_1 increasing, **R will increase stably and T will decrease slowly.**



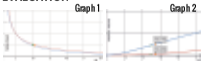
The Fresnel equations can be derived from the Maxwell's equations, from which the plane wave in the infinite uniform isotropic medium have the following properties:



where **E** and **B** are the electric field strength and the magnetic field strength, **k** is the wave vector, ω is the angular frequency, **c** is the speed of light in vacuum, μ and μ_0 are the relative permittivity and the permeability respectively, and n is the refractive index.

In this case, we can take $\mu \approx \mu_0$.

EVALUATION



Considering the density of the material, we target 2 materials:

- Acrylic / Poly(methyl methacrylate) n = 1.49
- Plastic / Polyethylene (in orange) n = 1.54

From Graph 1, we see that the transmittances in p and s direction of both materials are around 50%. (49.08% and 53.48% for acrylics, 46.44% and 51.16% for plastics) So both meet the criterion of transmittance.

From Graph 2, the s-reflectance of plastics (0.1%) is 13% better than that of acrylics.

Thus, we chose plastic as the material for the screen.

PHYSICAL STRUCTURE

As for the physical structure, we need to ensure that the thickness t of the screen will not cause a destructive effect of the reflection on two interfaces, and instead cause a constructive effect. We can choose t either as 2 mm or 3mm. The thin film reflection causes a phase shift of π:

$$\frac{2\pi}{\cos i_2}(n_2 - n_1 \sin i_1) = \mu\lambda_1$$

- Constructive: p = m + 1/2, m = 0, 1, 2...
- Destructive: p = m, m = 0, 1, 2...

To evaluate the effect of the interference, we should calculate p with respect to R, G, B lights (which consist of the white light for the screen of phones. The ratio is 1.4580 : 0.0600. We chose the two colours that matter most: R and G.

- R: λ_R = 700nm. Then p (0 - 2mm) = 535754, p (1 - 3mm) = 80636.31 When t = 2mm, p is closer to the form of m-V2/1, choose 2mm.

- B: λ_{G1} = 546 Nm. Then p (0 - 2mm) = 686738, p (0 - 3mm) = 103010.08 When t = 2mm, p is closer to the form of m-V2/1, choose 2mm.

Hence, we choose 2mm. However, if we modify λ_R to 521nm (also in the range of green light) Then p (1 - 2mm) = 98440.73, p (1 - 3mm) = 107332.64. The answer will be inconsistant. The reason is because 1 mm - 106 nm, which means t >> λ. The value of p will be completely changed even if the thickness change a little. Therefore, the thickness of the reflection sheet have insignificant influence on the image regarding the interference. But the thickness may lead to 2 mirror images, and the thicker, the lighter.

Therefore, we should use a screen with a **smaller thickness** for our product.

THE AUGMENTED REALITY CAP

LANGUAGE LEARNING **REDEFINED**

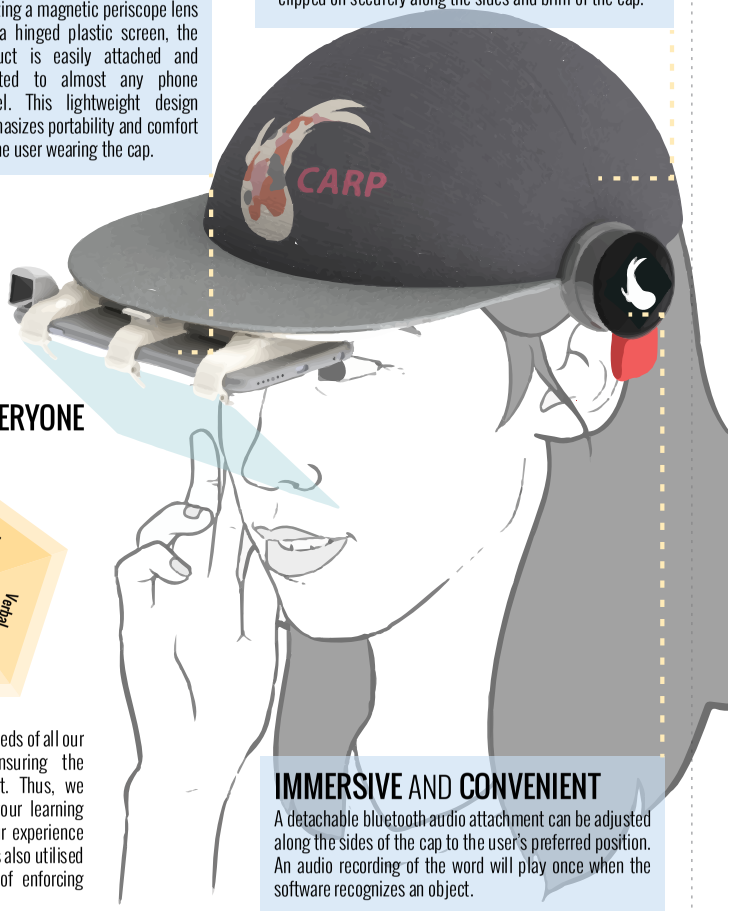
With the world becoming increasingly connected, it is unsurprising that multilingualism has become a skill coveted by many. Our product aims to be an aid in climbing the steep learning curve of new languages, letting users learn effectively and conveniently. **We want to put the fun back in fundamental.**

COMFORTABLE AND **STYLISH**

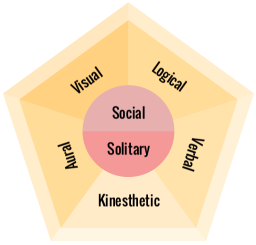
Easily configured to a cap of your choice, CARP gives users the opportunity to make any of their caps an instrument of learning. The sturdy 3D-printed product is clipped on securely along the sides and brim of the cap.

ANY PHONE, ANY SIZE

Utilizing a magnetic periscope lens and a hinged plastic screen, the product is easily attached and adapted to almost any phone model. This lightweight design emphasizes portability and comfort for the user wearing the cap.



LEARNING FOR **EVERYONE**



Understanding the different needs of all our users is imperative in ensuring the effectiveness of our product. Thus, we made sure that no matter your learning style, CARP will enhance your experience positively. Spaced repetition is also utilised as a tried and tested way of enforcing memory retention.

IMMERSIVE AND **CONVENIENT**

A detachable bluetooth audio attachment can be adjusted along the sides of the cap to the user's preferred position. An audio recording of the word will play once when the software recognizes an object.

FOR **ALL WALKS OF LIFE**

THOSE WITH WANDERLUST

Prepare for any number of overseas journeys without crowding your schedule with language classes.

CHILD-FRIENDLY

Learn a language with your kid, or spark a love for linguistics at a young age with this interactive product.

COOL FOR SCHOOL

Having trouble developing an affinity for a second or third language for school? Be immersed in the language constantly when wearing this product, helping information retention.

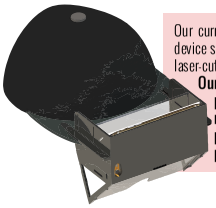
OR YOU JUST HAVE THE TIME

Whenever you're bored at home or have time to spare at work, get familiar with any language you fancy in no time at all and keep your brain active.

YOUR PRIVACY IS **OUR** CONCERN

Rather than using a projection, we have opted to use mirrors and reflections to immerse the user as the tags the user sees are virtual images rather than real images. Thus, other people will not be able to see what is in front of the user's eyes - and hence, will also not able to see any calls or messages that are sent while the phone is in use.

AN **IMPROVEMENT** EVERY TIME



Our current design focuses more on the functionality of the device so we can build a strong foundation. The attachment is laser-cut out of acrylic and can only be fixed to a modified cap. **Our working model is functional, and our ideal product pictured above will improve on it by making the attachment more lightweight and portable, as well as expanding the range of phones the product can accommodate.**

POWERED BY **UNITY** AND **VUFORIA**

Figure 1: An example of a project showcased during the 2016 final exhibition. On the left, the 2D posters (for TSSC and P2) and on the right their main ID poster.

3.DEVELOPING A RUBRIC FOR MULTIDISCIPLINARY ASSESSMENT OF THE 2D PROJECT

A project with a breadth as this is quite difficult to assess and grade. The rubric must work across M2, P2, TSSC and WTI, because the two topics that each individual team will choose to develop during their design project are not known at the start. Therefore, the rubric has to lend itself to interpretations that make sense in each of the subjects. The team that steers the 2D project and the rubric is composed by a 2D project lead coming from the ID faculty team and a 2D lead from each of the other subjects. This team is responsible for drafting, disseminating to the other faculty, and approving the grading rubric. The students are made aware of the rubric in week 1, and they know that each subject instructor for the subjects they choose will look at their 2D project poster together with their design poster and grade it in four dimensions: information, insightfulness, creativity and clarity. It was decided that the best way to communicate their 2D project to the instructors was via a poster.

4.THE FIRST TWO RUNS (2015-2016): RELEVANT OUTCOMES AND LESSONS LEARNED

Typically, the end-of-term ID exhibitions generate a lot of excitement among students and faculty alike. In 2016 it involved some 450 students spread across 90 design teams, with 17 instructors from ID, 4 from P2, 7 from M2 and 9 from WTI and TSSC combined. Figure 1 shows an example of projects showcased during the final exhibition in 2016.

The overall feedback from informal conversations with students was mixed. Whereas some students appeared unclear about their 2D project goals in the beginning of the semester but were quite happy with the way in which the 2D project was conducted in the overall context of term 2, others felt otherwise throughout the term. Setting the stage with a handout from the main 2D project faculty team provided a basis for organization, but it was felt to be not enough. Some comments include "what exactly do we need to do? And how should we do this in a meaningful way?" The general initial reactions amongst the faculty team members mirror the students' feelings to some extent.

5. CONCLUSIONS AND FUTURE DEVELOPMENTS

Overall, the faculty from ID, P2, M2, TSSC and WTI think that this is a rewarding effort and should be repeated and improved over time, as it seems to be a worthwhile learning experience for the students and an important point of convergence for the faculty. In summary, SUTD strongly believes that the 2D project forms an integral part of the SUTD's Big D mission by exposing Freshmore students very earlier in fostering a mindset that the knowledge in science, math, engineering/architecture, social science and humanities subjects can be learnt and integrated into a meaningful way for real-life applications. Eventually, the cornerstone built upon the 2D project experience will enable the students seamlessly progressing to take on 3D and 4D projects easily and naturally in the later part of their undergraduate studies.

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ABOUT THE AUTHOR

Dr. Arlindo is an Associate Professor with Engineering Product Development and brings with him 24 years of teaching and research experience. He has written 2 books and co-edited 2 more, published over 100 articles in journals, conferences and book chapters, and filed over 50 patents with his students on innovative designs. He teaches "Introduction to Design" at SUTD.

LEARNING TO TEACH AS GRADUATE TEACHING ASSISTANTS (GTAs) AT SUTD

Nachamma Sockalingam (LSL), Ng Jia Yi (GTA), Nguyen Thi Ngoc (GTA) and Tan Chee How (GTA)

Picture taken at "Teaching at SUTD: Engaging the Learners" Class, SUTD, February 2017

A recent trend in universities is to move towards a more student-centered learning environment, where classes are taught in small groups. SUTD is no exception. The role of a teacher in this setting is transformed to be more of a facilitator and the student to faculty ratio is kept low so that students get more personal attention from their instructors. To aid this, and to make teaching and learning more inclusive, graduate/senior students are engaged to support the lead instructor and the instructors teach in teams. Hence, it becomes crucial to educate and train graduate students to teach as teaching assistants.

To this end, the Learning Sciences Lab (LSL) at SUTD offers a pedagogy-focused course called "Teaching at SUTD: Engaging the Learners" for graduate students. The course aims to prepare graduate students for teaching assistantship at SUTD. LSL offered the course for the first time in January 2017, and a group of 33 students took the course. This was a 6-week course that introduced participants to SUTD's teaching philosophy, various active learning pedagogies such as design-based learning, studio-based learning, project-based learning, team-based learning, facilitation skills and assessment practices, ending with an opportunity for all participants to

teach in microteaching sessions amongst their peers so that they could learn from each other. The course adopted active learning pedagogies that it promoted and many of the students found the course insightful and eye-opening.

Three participants from the first batch share their learning experiences here. It is interesting to note the change of perspectives on teaching and learning when a student takes on the role of a teacher. Learning outcomes are no longer just a ritual. Assessments are not just a way to categorise students. Active learning is not just about activities. Overall, an immersive experience such as this course on pedagogical skills seems to have been useful to the graduate students, and the hope is that this translates to their teaching and thereby benefits their students. This is just one of SUTD's many efforts to make teaching and learning impactful.

NG JIA YI (GTA)

After going through this course, I see teaching differently. My greatest takeaway from this course is actually the concept of "constructive alignment". Constructive alignment refers to the coherence between learning outcomes, teaching/learning activities, and assessment.

In the past, I paid little attention to the learning outcomes. When professors passed us the course syllabus, I would skip the learning outcomes portion because I thought it was just customary to include it. Now, I learnt that the outcomes are closely tied to the course content and assessment methods and that the intended outcomes could direct our learning more purposefully.

My knowledge on teaching methods has also been strengthened through this course. Prior to the course, I kept hearing terms like "hands-on teaching" and "active learning" without really understanding them. From this course, I learnt about the various teaching and learning activities (problem-based, design-based, project-based, team-based, active learning), and also their differences and advantages. Many of us tried to include active learning during our microteaching session since it is the least time consuming student-centered learning activity.

Appropriate assessment methods are also important. I realize the flaws in grading based on bell-curves from Bigg's article that says good teaching should reduce the gap between "academic" and "non-academic" students than creating a good spread in grade distribution.

Before the course, I was under the impression that "teaching" refers to the teaching and learning activities only. I never realized that clearly defining learning outcomes and assessment is just as important as the teaching and learning activities. I am more aware now that aligning the three of them is essential for impactful teaching.

NGUYEN THI NGOC (GTA)

Going through the "Teaching at SUTD; Engaging the Learner" course has broadened and strengthened my conceptions of teaching. I have summarized my understanding in few pointers

Teacher-centered and student-centered teaching methods: The art of combination

Student-centered teaching method is one of the key concepts covered in this course. In student-centered learning, both students and instructors share the learning focus and are actively involved, interacting with each other. Students are encouraged to learn through group works, collaborations and communication.

However, teacher-centered teaching method has its own merits. The classrooms are quieter and orderly. Students learn to be independent, raise their own ideas, make own decisions and will not miss an important topic as they may in student-centered teaching method environment.

To me, effective teaching is not one or the other but the combination of both. The discussion about the art of this combination deserves deeper investigation and study.

Explore alternative learning and teaching methods

I got an opportunity to explore, differentiate and compare some student-centered teaching and learning strategies, such as problem-based learning and team-based learning, in class. For instance, I learnt that team-based learning is not just studying in teams.

Learn while teaching

During the two sessions of microteaching, I learnt from my peers and from myself by reflecting. Teaching and learning is essentially about collaborating. To become a better teacher, one needs to continue to learn their subjects, how to teach, and continue to improve how they teach in the classrooms.

Do our own homework

When introducing a new teaching method to students, it is important to create a safe environment. We need to get an idea about the diversity in cultures, backgrounds and learning habits of students, as well as students' average work load to balance up our coursework requirements.

No one is perfect

Teaching is a learning journey that does not always guarantee success in spite of being well prepared. We may not know everything but we can be flexible, adaptive and creative in solving problems that arise while teaching.

TAN CHEE HOW (GTA)

Having spent my undergraduate years at SUTD, I experienced the cohort-based learning, hands-on learning, and designette-based learning approach. Unsurprisingly, my prior conceptions of teaching have been shaped by these experiences. My prior conceptions is that teaching is about engaging students in learning activities, such as active learning, collaborative discussion, and designettes, to better understand and apply fundamental principles learnt in class to real world application.

However, having gone through this course, my conceptions of teaching have expanded beyond merely employing interactive learning activities to engage the learners. I am more aware of Bigg's model of constructive alignment - that the learning outcomes, teaching and learning activities (TLAs) employed in class and the assessment tasks need to be aligned.

I had a chance to practice the principle of constructive alignment in preparing and delivering my microteaching session. I realised that choosing the appropriate assessment for the given learning outcomes requires much effort and consideration- it is not so simple. Hence, my conceptions of teaching changed from the naive notion of simply employing interactive TLAs to engage the learners, to the careful selection of TLAs (in conjunction with appropriate assessment) to reflect the learning outcomes.

The course also equipped me with various student-centric teaching methods, each with their unique sets of TLAs and assessments, constructively aligned to achieve a wholly different outcome. For instance, the studio-based learning approach struck me the most. It employs TLAS and assessments in a holistic and authentic way to mirror professional practices in creative fields.

Beyond Bigg's model of constructive alignment and the various student-centric learning methods, the course has also made me more aware of skills needed as a GTA, particularly facilitations skills. Facilitation skills include Socratic questioning, active listening and communications skills. These skills are essential for teaching, for class management, and engaging the learners.

Overall, going through the course gives me a good understanding of teaching skills, and I feel more confident.

ABOUT THE AUTHOR

Dr. Nachamma is Assistant Director of Learning Sciences Lab. She teaches the graduate course "Teaching at SUTD: Engaging the learners". Her research interest includes student-centered learning, technology-enabled learning and faculty educational development.

SUTD CREATES A NEW SPACE: THE ACADEMIC MEDIA STUDIO

Mohamed Idham Bin Mohid (Ed Tech)

Thinking of where to make your next recording for your class or project? Look no further! Come to the Academic Media Studio.

SUTD's Academic Media Studio was officially launched in mid-2017. Located at level 7, Building 2 (2.710), the Academic Media Studio is an exciting new space of about 150m2, consisting of two sections: the Video Studio and the Multitrack Recording Studio. The studio aims to support academic and Fifth Row projects and is available to the SUTD community for video production, photography and audio recording. Interested students and faculty members could enquire more about the studio by sending an email to edi_admin@sutd.edu.sg .

VIDEO STUDIO

The Video Studio has three cameras and can be used for producing video lectures, recordings of up to 4K resolution for educational purposes. The studio is equipped with sixteen LED lights (that need to be manipulated from the control room) to provide ample lighting. There are also two mobile standing lights which offer mobility for close-up shots and studio photography. Several lapel and boom microphones are available to support multi-talent productions.

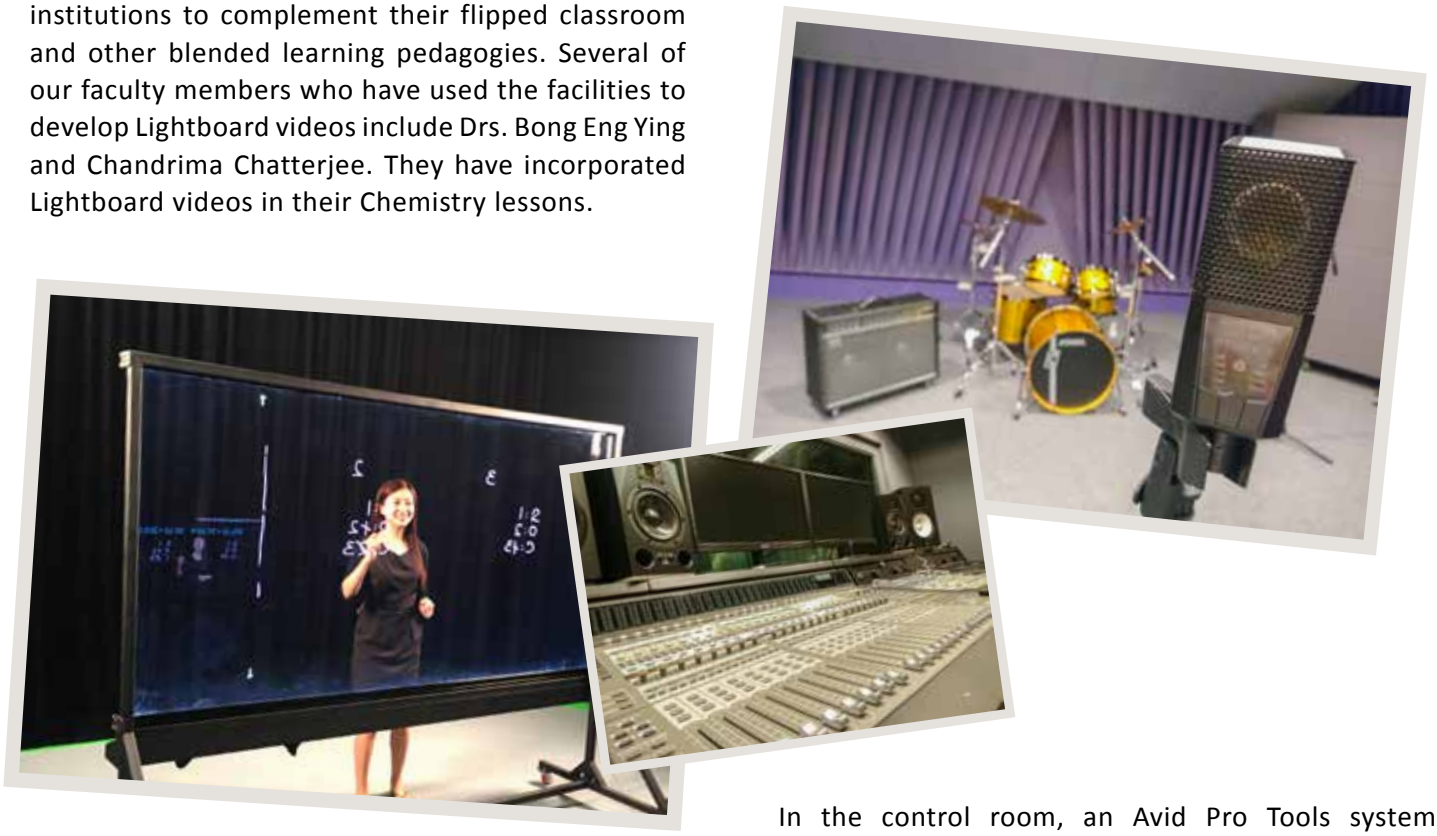
The studio control room houses two iMac computers with Adobe and Blackmagic Design editing tools for post-production.

The main studio is fitted with a cyclorama, which is a large concave wall that allows for photo and video footages to be edited during post-production with chroma keying techniques. With proper lighting, the subject of the footages taken in the studio could be placed virtually anywhere! For instance, one could shoot a video of a lecturer in the video studio and make the final product appear such that the lecturer is in another location by replacing the background in post-production.

In addition, the studio has a "Lightboard", which is an increasingly popular tool to record lecture videos. The Lightboard is an illuminated clear glass Panel which enables lecturers to record a lecture video of themselves writing on the panel using fluorescent markers while facing the camera. Unlike the traditional whiteboard that requires the instructor to turn their back to the audience and students, the Lightboard allows the instructor to face the audience throughout their lecture, allowing them to maintain eye contact with the viewers.

An additional advantage of the Lightboard is that PowerPoint slides and other visuals can be included as a superimposition.

The Lightboard was first developed at Northwestern University and has since been adopted across various institutions to complement their flipped classroom and other blended learning pedagogies. Several of our faculty members who have used the facilities to develop Lightboard videos include Drs. Bong Eng Ying and Chandrima Chatterjee. They have incorporated Lightboard videos in their Chemistry lessons.



MULTITRACK RECORDING STUDIO

The Multitrack Recording Studio is a professional recording studio that supports high-quality audio production. Lecture audios, multitrack album production and voice-over dubbing can be achieved with astonishing results in this studio. The Multitrack Recording Studio can be valuable for recording soundtracks for film-related subjects (e.g. HASS or Fifth Row). Coupled with excellent acoustic treatment, the studio is also suitable for audio-related research.

In the control room, an Avid Pro Tools system complements the setup for great quality audio production and mixing. Equipped with a 24-channel control surface, professional audio engineering can be achieved. Two pairs of speakers are hooked up to the Pro Tools setup to allow comparison of the mix.

Together, the Video Studio and Multitrack Recording Studio offer a new, innovative space for the SUTD community to explore. For booking enquiries, drop an email to edi_admin@sutd.edu.sg.

ABOUT THE AUTHOR

Idham has been a Multimedia Technologist with SUTD since May 2013. He has in-depth experience in filmmaking, audio design, photography, web and graphic design.

EXPLORE AND DISCOVER

EDUCATION AND PEDAGOGY

Studies in the field of Pedagogy are rising as we see a global movement to prepare 21st century learners. A search on google reveals over 61 thousand research has been published in the last 2 years. SUTD Library brings relevant resources to help faculty and students in teaching and learning.

SOME INTERESTING READS

How can we foster creativity in the classrooms even when the curriculum is content heavy?

Seen and unseen creativity by Jim Clack

How can we study the learning process through sociocultural perspectives?

Agency online: trends in a university learning course by Ligorio, M. B., Impedovo, M. A., & Arcidiacono, F.

How can innovative curriculum in Freshmore induction better prepare and enhance student experience?

Easing the transition of first year undergraduates through an immersive induction module by Chung, E., Turnbull, D., & Chur-Hansen, A.

What are the current state of-the-art on virtual reality (VR) and its potential uses in learning?

Virtual Reality based Learning Systems by Yang Cheng

What are the available literature on designing blended learning?

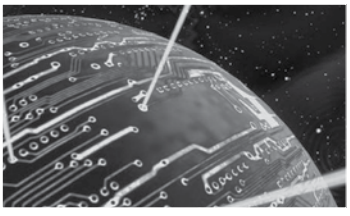
Four key challenges to the design of blended learning A systematic literature review by Boelens, Ruth, De Wever, Bram, & Voet, Michiel

RESOURCES TO STAY ABREAST WITH PEDAGOGICAL DEVELOPMENTS

- Library iSearch
- Cambridge Core
- Chronicles of Higher Education
- Education Research Complete
- JSTOR
- Lynda.com
- Project Muse
- Science Direct
- Taylor & Francis

465,500
EBOOKS /BOOKS

56,080
EJOURNALS/ JOURNALS



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DATABASE

ASK Library and LEARN how to exploit Resources available for you.


HANDS-ON
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TO LIFE


SMALLER
CLASSES
HAVE MORE
ROOM FOR
LEARNING


A DESIGN-
CENTRIC
EDUCATION
KNOWS NO
BOUNDARIES


Robotics
Design Thinking
Active Learning
BRINGING
THE FABULOUS
EXPERIENCE

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- Introductory Teaching Course
- Pedagogical Workshops
- Distinguished Educator Series Talks
- Faculty Educational Development
- Scholarship of Teaching and Learning (SOTL)
- SUTD SOTL Circle Interest Group
- Asian SOTL Circle
- Pedagogical Research Collaborations
- Teaching and Learning Consultations
- Pedagogy Day
- Pedagogy Newsletter
- Online Resources and Communications

ABOUT LSL LOGO

LEARNING SCIENCES LAB
OFFICE OF EDUCATION

The three jigsaw puzzle pieces represent the various stakeholders involved in Teaching and Learning - This could be LSL, faculty members and educational leaders; or it could be LSL internal and external stakeholders, with LSL playing a central and crucial role in connecting the various stakeholders, towards exellence in teaching and learning at SUTD. The three pieces come together to form the shape of "L" signifying the ultimate focus to be on learning and learners.

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