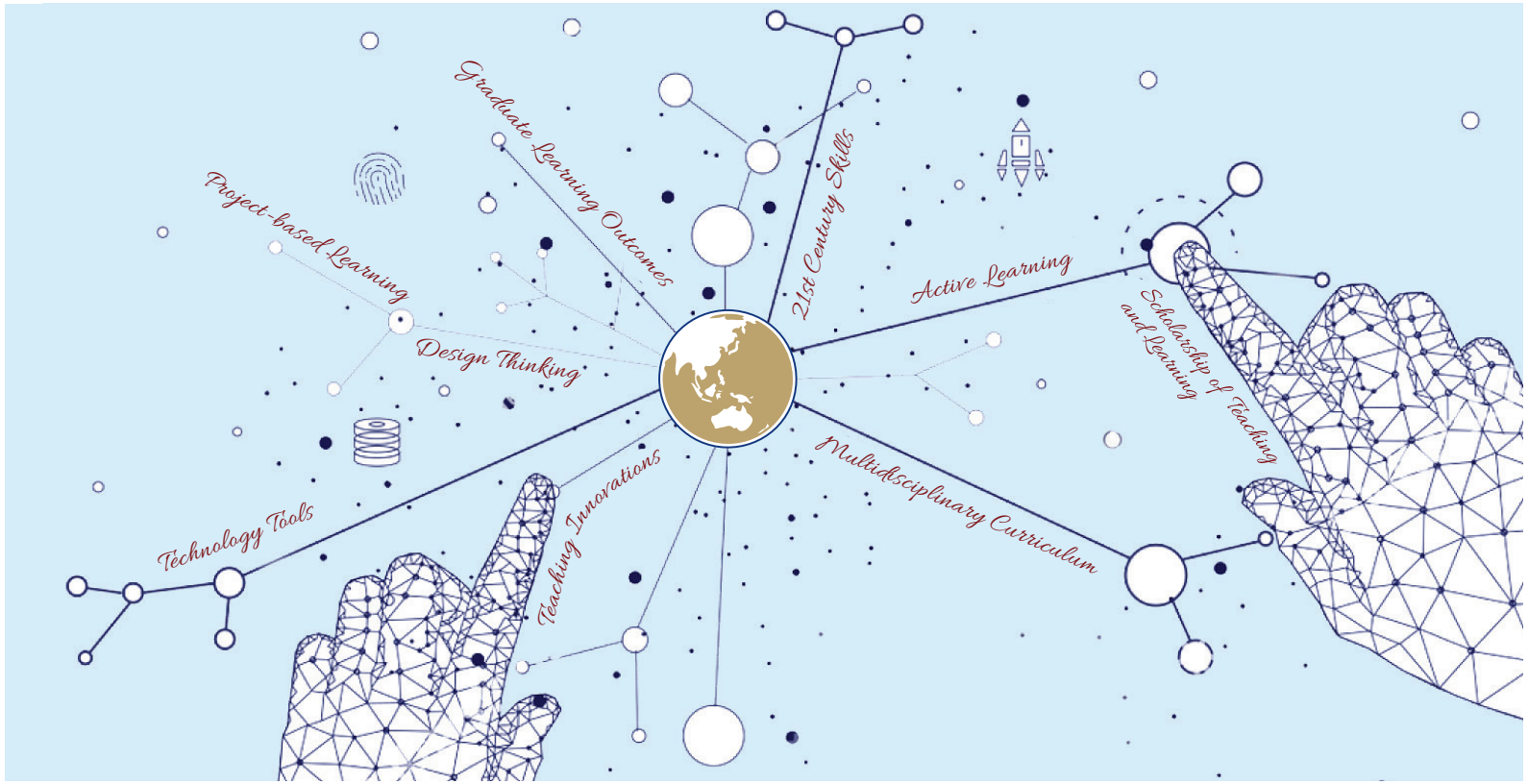
EDITION /002

EDUSCAPES

AN SUTD PEDAGOGY NEWSLETTER



SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

LEARNING SCIENCES LAB
OFFICE OF EDUCATION

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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.

Advisor

PEY KIN LEONG
Professor, Associate Provost (Education, SUTD Academy and Digital Learning)

As a central 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, established at SUTD in July 2016, 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 also 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.

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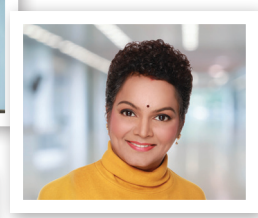

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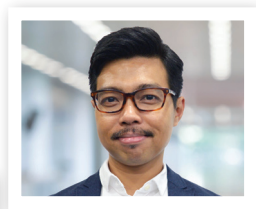

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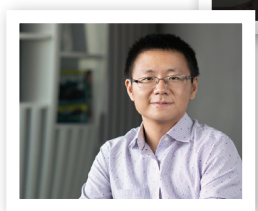


Xingyin Wang

Norman Lee

LOOKING TO CONTRIBUTE?

We accept a variety of articles in the form of:

Current Issues
This could be write-ups 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 share experiences on teaching at SUTD.

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 and views on teaching and learning related matters.

Book Reviews
Reviews of books on pedagogical topics.

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

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

Your article should:

- ✓ Meet the aims and scope of the newsletter
- ✓ Be well-written and easy to follow, without unnecessary technical jargon
- ✓ 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

EDITOR'S NOTE

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

EduSCAPES is named as a newsletter as it brings both news and letters of reflections from diverse members of the SUTD community, in their own voices. We hope to include articles from the community rather than writing on behalf for the community. This is a newsletter for the community by the community. We thank all those who have contributed to this edition.

This edition's cover portrays a galaxy which signifies the openness in SUTD's pedagogical structure in not having a fixation to any particular pedagogical method. The lines represent the various aspects of education at SUTD such as active learning and project-based learning. The fingers point to the critical nodes emphasized in this edition and SUTD, **Teaching Innovations and Scholarship of Teaching and Learning (SOTL)**.

While many of our faculty members may be teaching well and innovating teaching practices, such practices may remain within the walls of that classroom if they are not shared. This newsletter aims to identify and bring to light the various innovative teaching practices at SUTD to recognize the individuals, showcase their work and inspire others towards excellence in teaching.

Teaching innovations are absolutely essential for good teaching. This could be in the form of continuous monitoring and fine tuning or introducing a completely different way of teaching to engage our learners. Often, such innovations tends to be experience-based and inspired by others. Lots of care, time and effort goes into designing the learning experiences in teaching innovations. However, the implementations may not be evaluated or documented.

The Learning Sciences Lab (LSL) at SUTD aims to steer Teaching Innovations towards Scholarship of Teaching and Learning. Scholarship of Teaching and Learning (SOTL) refers to taking a scholarly approach to teaching. That is, researching or inquiring about teaching and learning. This is characterized by literature informed teaching practices, evidence-based teaching and evaluation of teaching, peer-reviewing and public sharing of teaching practices.

The benefits of SOTL are multi-fold. SOTL promotes informed teaching that is implemented in a robust manner, leading to quality teaching and continual improvement in teaching, which will benefit the students. SOTL also helps the instructor to reflect and continually improve one's own teaching. By documenting and sharing through platforms such as this newsletter, professional and academic journals, it benefits the wider community and leads to a deeper understanding of teaching and learning in a context-specific manner. This newsletter aims to serve as one of the mediums for sharing of SOTL works on teaching innovations at SUTD.

The layout of this edition remains similar to last year's but brings you more examples and news. This edition has 4 sections: (1) Different Perspectives, (2) Research, Awards, Grants and Student Works, (3) Reflections, and (4) Teaching Resources. In order to optimize the limited space and make the newsletter interactive, we have linked certain articles to websites or online videos through web links and QR codes so that readers can access more information if they are interested. That will be something different from last year's.

In the first section on Different Perspectives, we have two interviews. The first interview is with our President and Acting Provost, Professor Chong Tow Chong, on what we can expect from the change in leadership at SUTD. The second interview is with Professor Art Markman, who is well known for his works in learning sciences. We ask him for his opinions on teaching in the SUTD context. The third article brings you the plans for faculty educational development at

SUTD from Learning Sciences Lab. Resonating messages in the first section are that faculty members at SUTD need to focus on both teaching and research and that researching teaching will be one way to improve and professionally develop in teaching.

The next section on Research, Awards, Grants and Student Works, a new addition this year, brings you a compilation of various achievements from SUTD in relation to pedagogy over the period of 2017 and 2018. The achievements are reflective of SUTD's emphasis on teaching at SUTD, as mentioned by Prof. Chong in the first interview.

The various research articles on pedagogy, presented as abstracts, take an evaluative approach and report the use of technology, design thinking, collaborative and experiential learning on teaching and learning of computational, engineering and entrepreneurial subjects in SUTD. Such documented practices add to the existing knowledge, and being peer-reviewed in an academic setting, provide strong validation. This will be valuable especially since SUTD is a pioneer in its innovative pedagogy.

The third section brings you reflections by instructors on teaching at SUTD in different areas of discipline such as programming, biology, architecture, mathematics and teaching. The instructors use varied approaches such as jigsaw activity, virtual laboratories, robots, gamification and experiential learning (microteaching) to innovate teaching. They share their experiences, challenges, possibilities, and lessons learnt.

The fourth section brings you teaching in non-academic settings at SUTD such as the 5th Row EV club and Library. As the saying goes, "It takes the whole village to raise a child". Similarly, the entire SUTD community is involved in shaping our SUTD students' learning journey through teaching in both academic and non-academic settings. LSL, as its logo suggests, aims to be a catalyst in bringing together the various stakeholders in shaping teaching at SUTD, in academic settings and beyond if possible.

We hope that you find the newsletter informative, enjoyable and inspiring. This would be an annual newsletter and we 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.

NACHAMMA SOCKALINGAM
PROGRAM DIRECTOR, LEARNING SCIENCES LAB
OCTOBER 2018

THE JOURNEY AHEAD FOR SUTD: PERSPECTIVES FROM PROFESSOR CHONG TOW CHONG

INTERVIEWED BY **NACHAMMA SOCKALINGAM,** LEARNING SCIENCES LAB, OFFICE OF EDUCATION

Our Founding Provost, Professor Chong Tow Chong, was appointed as the new President of the Singapore University of Technology and Design (SUTD) from April 2018. Learning Sciences Lab caught up with Professor Chong for an interview to gather his thoughts on what lies ahead for SUTD, in particular on matters related to teaching and learning.

Typically, changes in leadership in an organization lead to changes in strategies, directions and new initiatives. Will there be drastic changes with your Presidentship? What are your directions? What can we look forward to? Tell us more.

I see this as a continuation rather than drastic changes. Being a young university, we have planned strategically for the long term. When we make changes, it will not be making changes for the sake of changing. It will be further improving or refining what we do.

Although I am the acting provost now, there will be a new provost in time to come. We are in the process of searching for the best candidate, both internally and externally. We also have a new vice-president to take care of administration. So we have already made some changes.

As we grow it is not just about faculty and the student enrollment, but also the supporting administrative staff members. We have many departments and offices that work with the pillars and clusters. Each cannot have their own objectives. We need to have more unified objectives and commonalities. Shared services would be one way of doing that. In this way, we can achieve organizational excellence. These changes in the administrative aspects will help to improve the processes to support our undertakings.

On the academic side, universities now need to look beyond education and research to lifelong learning. This is going to be an important focus area for SUTD.

When we educate a student today to get a degree, the learning does not stop with the undergraduate programme. Education now extends beyond university to the workplace.

We have digital platforms that allow students to continue to learn. Working professionals can come back to take our ModularMasters courses with us. This is actually a full-time program with a lot of flexibility.

Students can opt to take a certain portion of the course online and get certified at the end. Or they can continue to enroll as a fulltime candidate and complete the rest in boot camps. The boot camp and Micro-Masters concepts are something we learnt from MIT. This allows flexibility for both the working adults and the employers. It will be upskilling of working adults. The Office of Education is currently working on this through the SUTD Academy.

In our undergraduate curriculum, we will continue to improve and refine the courses, especially the Freshmore courses by strengthening and supporting the teaching and learning efforts at SUTD.

Speaking about Freshmore courses, Freshmore and Pillar year courses may be perceived to be rather different – Freshmore being fundamental knowledge of STEM subjects and the Pillar year courses as more applied. Is that true? How do you think the Freshmore courses and pillar years' courses complement and build on each other?

The whole idea of the Freshmore year is to give students a solid foundation of fundamental knowledge and skills that are directly relevant to the Pillar courses which is necessary for all technically grounded leaders.

Some Freshmore courses broaden our students' perspectives. In addition to Physics and Maths, our students have to take courses like Introduction to Design Thinking and World Literature. These courses prepare our students holistically.

> "Look beyond education and research to lifelong learning."

The Freshmore year also help our students to transition from pre-university to university-level courses. Our students come from diverse backgrounds. Some have taken Physics and others have not. We have students from the JCs, polytechnics and so on. Some of them are international students. So the first year helps to make sure that they can transition smoothly and pick up the necessary foundational knowledge and skills for their Pillar years.

Also, the Freshmore year gives time for students to explore their interests. We do not ask the students to elect their pillars and we allow them to choose. And from our statistics, about 30 percent of students change their mind from the first day of initiation at SUTD to when they actually have to decide on the pillar that they want. So, it is good to have this whole year to explore, think and choose something that they are interested in, so that there is motivation to learn.

What do you think is SUTD's X-factor in terms of pedagogy?

Our design-centric, project-based learning that is multidisciplinary, collaborative and authentic is the key differentiating factor. Our cohort size is actually smaller- which means students get more interaction time with instructors.

We are actually smaller than other universities, but it is deliberately so, because we provide a different pathway for students.

You can see from our graduate employment statistics that our graduates are well-received by the industry. Our graduates get better pay.

The reason is because of our pedagogy. There are many design projects which emphasize teamwork and collaboration. Having the students living together in the first year, working together, there is team bond. Our students are very collaborative and resourceful.

The other added advantage is that this pedagogy is not just in specific courses - it is throughout the entire curriculum. Hence, you will find that a SUTD graduate stands out from others.

We have to really be very careful about what we do here. Sometimes, there is a tendency to compare ourselves with other universities and follow what they do. But, if we keep following, we lose our uniqueness. The differentiation is SUTD's vision and mission, and our pedagogy.

> *"The differentiation is SUTD's vision and mission, and our pedagogy."*

That indicates the importance that SUTD places on pedagogy and teaching. SUTD is a research-intensive university.

A common belief is that research intensive universities value research over teaching. Is that so? What do you see as the interplay between research and teaching and how can they complement each other?

One of SUTD's mission is to advance knowledge. We have to be able to do original research through which we discover new knowledge or push the frontiers of knowledge. Hence, when we say that SUTD is a research-intensive university, it means that the faculty will have time set aside for them to do research in addition to teaching. This is certainly not at the expense of teaching.

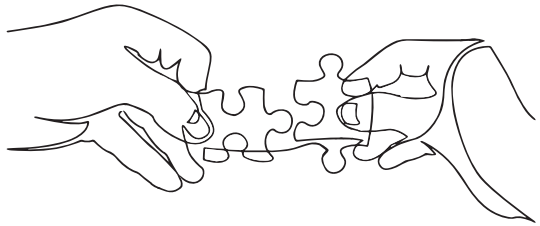
If we show excellent research only, then we are not a university but a research institute. Hence, teaching is important as well.

We do not think that the focus is on either teaching or research. It is both.

For tenure-track faculty, we expect them to do well in both teaching and research. So in our evaluation of faculty, either for a tenure promotion or during the annual appraisal, we look at both aspects.

Many universities focus on ranking. A large percentage of the ranking criteria is on research. If you do well in teaching, but not in research, you will never be in the rankings. So, a research component is important for the university as well.

In other words, we need both research and teaching. We will question faculty who do research well but do not teach well, and vice versa.



> We do not think that the focus is on either teaching or research. It is both.

We do not just look at the number of publications. In some cases, research projects may not result in publications due to their sensitivity, such as projects with the Ministry of Defence. However, we will still recognize the research contribution if we can see the impact of it.

Teaching-track faculty can publish in pedagogical journals to advance teaching and pedagogy.

So I think we should balance all these things. We place a lot of emphasis on teaching at SUTD since our pedagogy is unique and innovative.

In a way, teaching and research are not decoupled. When I was a faculty in NUS, I was very active in research. Interestingly, I found that students were excited and inspired when I brought a lot of the state-of-the-art or cutting-edge knowledge into the classroom.

We notice that MIT faculty who teach well also research well. And when you listen to their lectures, it is not just the teaching of textbook knowledge. It is how you can apply the knowledge to solve real problems.

How can we use teaching to help research?

When faculty have a research project they can design a problem that is based on the research project for students to discuss and work on. Then let the students come up with fresh ideas, unhindered by pre-conceptions. Faculty can also incorporate other activities like simulations and experiments. You can get student engagement and participation and that also helps to bring in fresh new ideas.

In summary, we will continue to emphasize research, teaching and learning at SUTD and venture into lifelong learning.

One last question. What would be your thoughts for students choosing the right university?

If you ask me, I would say that students should see what universities can offer. They will have to consider if the education they get will prepare them for the future and industry.

Students have to consider their individual preferences. For example, if you are someone who likes a multidisciplinary curriculum, with a cohort-based, active and interactive learning environment, then, SUTD would be a good choice for you.

In a nutshell, it is important for students to ask themselves what they really want to get out of a university education. Students should take time to reflect on that. If you just want a degree and do not consider the experience that you will get, you are missing something.

So, knowing oneself, knowing what is available, knowing where one wants to get to will help the student in making the decision.

LEARNING THROUGH PROJECTS: PERSPECTIVES FROM PROFESSOR ART MARKMAN

INTERVIEWED BY **NACHAMMA SOCKALINGAM,** *LEARNING SCIENCES LAB, OFFICE OF EDUCATION*

Professor Art Markman is the Annabel Irion Worsham Centennial Professor of Psychology and Marketing at the University of Texas at Austin and Founding Director of the Program in the Human Dimensions of Organizations.

Professor Art was invited to SUTD in February of 2018 to talk on Using Analogy in Design. He elaborated on analogical reasoning/thinking, how analogies could help in designing products and systems and shared how one could innovate and design using analogies.

We found the session to be inspiring, and since Professor Art is well established in various fields, especially in cognitive sciences and is deeply interested in teaching and learning, we pursued the conversation beyond the seminar. We asked him his thoughts about learning through projects at SUTD, how he thinks students and teachers could be better prepared, and if there are differences between interdisciplinary and multidisciplinary projects, what he values in these projects and how one could assess projects. He shares valuable tips and strategies.

SUTD uses a lot of projects in our teaching and learning. What are your thoughts on this?

SUTD's set up is so unique and enviable in the sense that one could implement collaborative, interdisciplinary projects across the entire cohort swiftly. That would be difficult to implement at a university which has a tradition of using lecture-based teaching methods, or a large number of students. Say 30,000 students. The way the pedagogy is structured allows students at SUTD to integrate active learning and enables them to apply what they have learnt in designing and prototyping products. Compare this to a university which has the infrastructure such as Fabrication Laboratories with 3D printers. If the curriculum does not require students to apply what they have learnt in interdisciplinary projects, these infrastructure and facilities may be under utilised. So, the way the pedagogy has been formulated, implemented and used in conjunction with the facilities is key to learning through projects at SUTD.

What will be your suggestions on preparing students for learning through projects?

Often, students come into universities thinking that the lecturers will be teaching them; that is, lecturers will be the drivers of their learning, and they, as students, will be the back seat passengers. So it is important to tell students from day one that they will have to change the mindset and break the habits. Learning is about a set of habits and in particular, the right set of learning habits. Students need to understand that learning is not about getting "A"s. It is good to have "A"s. But it is not all about "A"s. Other skills such as working with people, managing time etc. are what matter at work. No one will look at the transcript beyond the point of entry. Academic success is not the same as workplace success and students need to be prepared for that as well. So it is important to communicate and set clear expectations, encouraging students by explaining to students why there needs to be a change.

What will be your suggestions on preparing lecturers for teaching through projects?

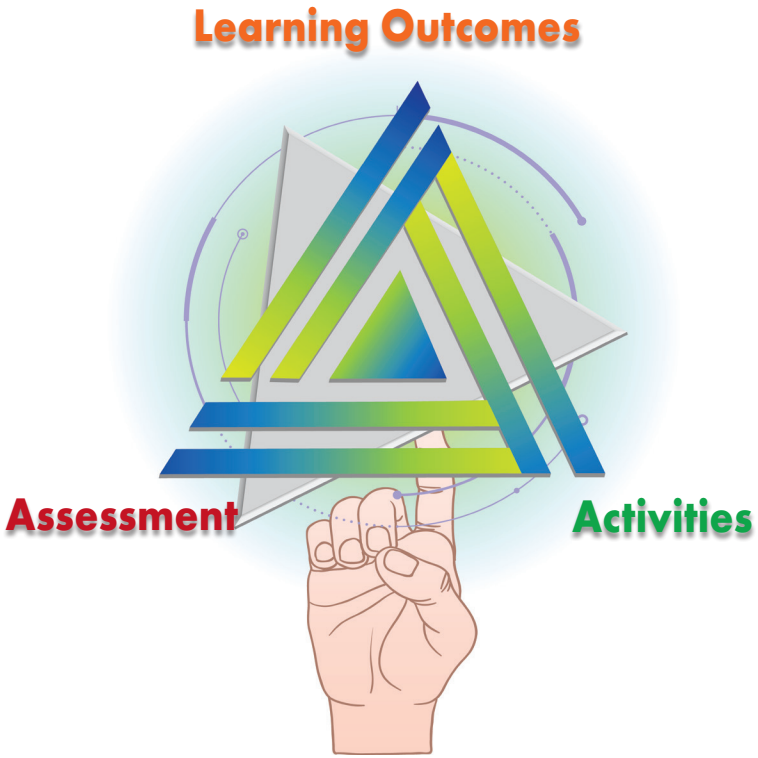
We know that traditionally, lecturers at universities are lecturers because of their expertise and experience in their research field. They are there for the research work. Although they have to teach, they are typically not required to have had any pedagogical training. So often times, lecturers practice what they have been accustomed to. This would often be lecturing rather than the new type of pedagogies associated with project-based, authentic learning. I have been teaching for 30 odd years, and it was only after the first decade that I got to know about "Backward Designing". When I first started, and if I had to plan a curriculum, I would look at sample curricula, maybe identify couple of good textbooks and plan based on those. It was not about starting with the learning outcomes. But now I know I got to start with the end goal in mind. So I think it is useful that lecturers have some learning and development opportunities related to teaching and learning.

Tell us about the differences between "multidisciplinary" and "interdisciplinary projects" and if one is better?

To me, interdisciplinary project is one in which "I" as an individual learner am able to relate the various disciplines I am learning from and formulate a common understanding, or weave together the similarities. Now, this is at the individual level and it requires the individual to have a good knowledge of the various disciplines.

Multidisciplinary projects on the other hand could involve a team of students working on a common project, and team members could for instance come in

> "Backwards designing starts with learning outcomes."



with different expertise. One may be good in programming, other in marketing, other in business modelling, and they, together as a team, work on different aspects/disciplines of the projects. It could also be that in multidisciplinary projects, the approach to the problem is from the angle of different disciplines rather than as an integrated approach. So the knowledge is packaged in discrete packets of discipline and may rely on working together with multiple experts to complete the package.

Each have their strengths. Interdisciplinary on abstract thinking and multidisciplinary on team work etc., and both are valuable workplace skills. You need a good mix of both interdisciplinary and multidisciplinary projects.

Projects are known to be very difficult to assess. What would be your suggestions?

Yes, projects can be more complicated than exams. But it is more rewarding. On the other hand, it does take up time. Overall, I would still give the thumbs up for projects.

Now, to assess projects, having a well-developed rubric is important. Such rubrics will have to focus on cognitive (reasoning/abstract thinking), technical knowledge and skills and 21st Century skills so that it can be applied across the various projects. One thing to note is that rubrics may not be that appropriate for certain content based knowledge. This may be better assessed by other traditional methods and at an individual level of learners. So you need a mix of assessments, that focus on various types of knowledge and skills, and that is spread across the semester, so that there is no heavy reliance of one final exam. You need to also have a good mix of both formative and summative assessments. Formative assessments would be assessments spread throughout the course duration while summative assessments are assessments at the end. Formative assessments would be useful for assessment for learning and summative assessments for assessment of learning. It would be useful to plan the entire curriculum, assessment and rubrics right at the start, before teaching starts and this takes time. It is good to have the lead time to prepare. Preparation is key.

EDUCATIONAL DEVELOPMENT AT SUTD

NACHAMMA SOCKALINGAM, *LEARNING SCIENCES LAB, OFFICE OF EDUCATION*

Singapore University of Technology and Design started out in collaboration with Massachusetts Institute of Technology (MIT) in 2012, and the educational development of faculty members at SUTD was initially taken care by the MIT Teaching and Learning Lab (TLL).

Educational Development broadly refers to learning and development in teaching and it is usually supported by units known as teaching and learning centres. According to the Professional and Organizational Development network, educational development includes instructor, instructional, and organizational development.

In the early years of SUTD, educational development with MIT TLL involved selected faculty members attending the Training to Teachers (T2T) Program at MIT. A total of 30 faculty members had attended the T2T program over the course of 5 years. This is about 25% of faculty members then. At the same time, there were also several support initiatives offered by the Office of Education. This included the annual Pedagogy day and Pedagogy innovation fund, with periodical pedagogical workshops and talks by experts.

As the university began to mature, the Office of Education decided to set up a central unit to take care of the educational development work at SUTD. So the Learning Sciences Lab was founded in July 2016.

Currently, the LSL team consists of myself and Clement Lim, under the advisory of Associate Provost for Education, SUTD Academy and Digital Learning, Professor Pey Kin Leong.

The aim of learning Sciences Lab is to inspire teaching excellence at SUTD. LSL's motto is Engaged Teaching for Engaged Learning and Engaged Learning for Effective Learning. We named the unit as Learning Sciences Lab to emphasize the research element in teaching, and to signify a multidisciplinary approach to innovating and evaluating teaching.

Our goals are that

1. We move from individual-oriented educational development to include community-oriented educational development
2. Include all types of instructors such as graduate teaching assistants in educational development
3. Include staff members who play supportive roles in teaching and learning in educational development
4. Induce a change from teaching to scholarly teaching that is evidence-based, reflective and peer reviewed
5. Shift from short-term training workshops to self-directed and lifelong learning to enhance teaching through Scholarship of Teaching and Learning
6. Leverage training opportunities for professional recognition
7. Connect SUTD members with local and overseas universities and other industrial partners/stakeholders on educational development

We hope to achieve this by working with key stakeholders in SUTD to come up with a holistic guideline to identify the development needs and offer suitable programs and services that fit the SUTD context. In addition, we hope to build in recognition for engaging in educational development activities.

The educational development blueprint at SUTD caters to all levels of instructors, be it teaching assistants or faculty members, teaching track or tenure track, early career or established. Our current focus at present is mainly instructors as a community, and we also engage in some degree of organizational educational development (in contributing to policy making on teaching and learning etc.). All our activities, in particular, talks and workshops are typically open to all at SUTD, including students. This is one of our ways of reaching to the entire SUTD community.

In the first year of LSL, we focused on initiatives for graduate teaching assistants. The graduate teaching course on "Teaching at SUTD: Engaging the Learners" was established and we have now completed 5 runs over the 2 years, reaching out to nearly 130 GTAs, with good and positive feedback.

This year, we focus on initiatives for faculty members. The faculty educational development blueprint in Figure 1 captures the overview of the initiatives.

The blue print was designed based on the following factors: (1) Open and collaborative organizational culture at SUTD, (2) Existing educational development initiatives, (3) Existing recognition system for engaging in educational development work and (4) Needs as indicated by various stakeholders such as faculty and heads of pillars and clusters. Several discussions and focus groups were conducted with key stakeholders.

The blue print was also passed through various categories and levels of faculty and staff members to seek consensus and fine-tune.

Based on the blueprint, LSL provides four types of support initiatives for faculty: (1) Pedagogical courses/workshops, (2) Community-oriented initiatives such as talks, pedagogy newsletter and pedagogy day, (3) Consultations and collaborations. The fourth and new addition that we are working on in 2018 is setting up an opportunity for professional recognition in teaching for faculty members through an educational fellowship program.

The traditional pedagogical courses are kept minimal for three main reasons. One is the belief that pedagogical workshops that are theoretical may not be sufficient. Instead, we would like to encourage more practice-oriented, reflective teaching which are long-lasting. So we have identified Scholarship of Teaching and Learning (SOTL) to be the main mode of faculty educational development at SUTD.

The second reason is tied to the first. We believe that educational development at SUTD should be faculty-owned. This is in line with SUTD's pedagogy of student-centered learning approach which suggests taking ownership of self-development. Hence we would like to move away from instructor/specialist-oriented teacher training to practitioner driven experiential learning.

The third is the resource limitation in running many workshops at this juncture. Therefore, we have kept the pedagogical courses minimal.

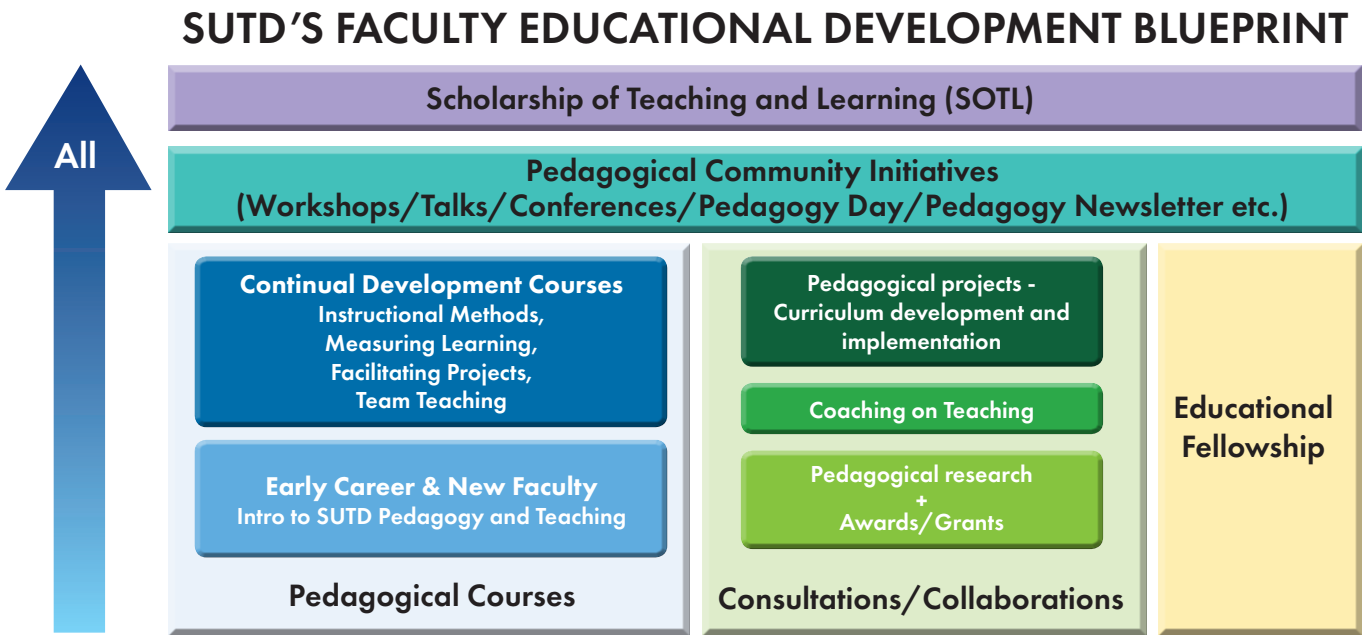


Figure 1.

At present, the introductory workshop on Teaching at SUTD for new and early career faculty members is the main pedagogical course/workshop offered by LSL. This is run bi-annual, starting from June 2018. SUTD's pedagogy and teaching context is unique and different from many other universities. Teaching at SUTD involves multi-disciplinary curriculum, teaching in teams, student-centered teaching, design projects as signature elements. So early career and new faculty members are to attend the introductory session to SUTD teaching context.

In line with SUTD's pedagogy and student-centered learning approach, our aim is that all faculty members are engaged in some form of Scholarship of Teaching and Learning (SOTL), which is characterized by (1) Scholarly teaching, (2) Reflective, evidence-based teaching, and (3) Peer-reviewed teaching. This could be in partnership with LSL or independently. But our hope is that such explorations are fed back into the SUTD community to inspire teaching innovations and excellence. LSL's pedagogical presentations, consultations and collaborations on pedagogical projects, teaching, and educational research support this. Community initiatives such as Pedagogy day, Pedagogy newsletter, LSL website and blogsite add to this.

Learning from experience that lack of participation in educational development work is often linked to perceived value and recognition, we are introducing a pilot scheme of educational fellowship. The educational fellowship involves faculty members taking a reflective journey to document their experiences and experimentations as a teaching portfolio, which is then submitted for peer review and certification, leading to international recognition. Our aim is that the educational development is bi-functional, as a professional development tool as well as a recognition scheme.

So in a nutshell, educational development at SUTD aims to take a holistic, inclusive, community-based approach that is innovative in embracing SOTL as the primary medium for educational development.

To assess the impact of educational development work on teaching and learning at SUTD, LSL takes a multi-pronged approach. While traditional workshops tend to rely on end of workshop feedback, this may not be applicable for SOTL work.

The measures of impact of SOTL work are better assessed through measures such as the number of faculty involved in SOTL work, presentations, publications in professional and academic media and student feedback of teaching and course etc. Studies and reflections from faculty members on their teaching, as evident from this SUTD pedagogy newsletter, would be one such measure.

We also take a qualitative feedback approach to gain a deeper understanding on what works and what does not, since our reason for feedback is developmental rather than evaluative.

LSL also conducts self-evaluations of its own works. Two of the projects that we are currently working on are:

1. A study of educational development centres in Singapore
2. A study on the impact of the graduate teaching course on conceptual beliefs and practices of teaching assistants.

In addition to this, LSL also participates in various conferences to share insights on teaching and learning. In general, we believe that reflective, evidence-based and community oriented development practices benefit practitioners and lead to continual learning, improvement and excellence.

Our hope is that such a community-oriented, self-developmental approach, practiced at multiple levels in the university will inspire our students to take a similar approach and therefore excel and contribute.

The way forward is towards excellence, through continual learning.

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ABOUT THE AUTHOR

Dr. Nachamma is Program 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.

EDUCATIONAL RESEARCH ARTICLES

Several of our faculty members have published their educational research in leading journals and reputed conference proceedings.

Here are the academic publications from 2017 and 2018. LSL is featuring all the published educational literature at SUTD.

So keep us posted of your publications!

Effectiveness of Physical Robot Versus Robot Simulator in Teaching Introductory Programming

OKA KURNIAWAN (ISTD), NORMAN TIONG SENG LEE (ISTD), SUBHAJIT DATTA (ISTD), NACHAMMA SOCKALINGAM (OED) & PEY KIN LEONG (EPD)

ABSTRACT

This study reports the use of a physical robot and robot simulator in an introductory programming course in a university and measures students' programming background conceptual learning gain and learning experience. One group used physical robots in their lessons to complete programming assignments, while the other group used robot simulators. We are interested in finding out if there is any difference in the learning gain and experiences between those that use physical robots as compared to robot simulators. Our results suggest that there is no significant difference in terms of students' learning between the two approaches. However, the control group that uses the physical robot shows a more positive response in their attitudes towards computing. We discuss the implications of our findings in relation to engaging students and challenges in using physical robots from the learner perspectives and ways to alleviate this. Finally, by considering the insights from students' comments, we also suggest an alternative that may give both benefits of using both physical robots and robot simulators.

Year: 2018

Cite:
Kurniawan, O., Lee, N. T. S., Datta, S., Sockalingam, N., & Pey, K. L. (2018). **Effectiveness of physical robot versus robot simulator in teaching introductory programming**. To be published in the proceedings of IEEE 7th International Conference on Teaching, Assessment and Learning for Engineering (TALE).

How Education Background Affects Design Outcome: Teaching Product Development to Mechanical Engineers, Industrial Designers and Managers

ARLINDO SILVA (EPD), MARCO LEITE, JOÃO VILAS-BOAS & RICARDO SIMÕES

ABSTRACT

Product design and development (PDD) is a current topic of academic and industrial research. Emphasis on innovation and entrepreneurship, as well as design thinking and creativity has been recently pulled together into the teaching and research on PDD. This paper looks into a multidisciplinary setting made up of three similar but independent PDD masters courses taught at three higher education institutions, having the same assessment, syllabus, assignments and outcomes. As expected, students' projects foci are different. The outcomes of this experience were confronted with an ex-post literature review, which generated thorough guidelines that supported an innovative proposal for PDD education, to be implemented into an interdisciplinary Summer School. Significant generalizable contributions for educating modern engineers, designers and business entrepreneurs are expected, instead of just teaching methods of engineering, design and entrepreneurship at the case universities. The limitation of the used inductive reasoning concerns 'truth' being suggested but not assured.

Year: 2018

https://bit.ly/2DSRGPT

Cite:
Arlindo Silva, Marco Leite, João Vilas-Boas & Ricardo Simões. (2018). **How education background affects design outcome: Teaching product development to mechanical engineers, industrial designers and managers**, European Journal of Engineering Education, DOI: 10.1080/03043797.2018.1465029.

For the full article, scan me:

Learning by 'Design': How Undergraduates in Singapore Learn to Become Engineers

ARTHUR C. K. CHIA & MIHYE CHO (HASS)

ABSTRACT

In this paper, we explore the evolving norms and dispositions of creativity and enterprise of engineering students using data gathered from a newly established technology and engineering-focused university called 'UniTech' 1 located in Singapore. Based on interviews with students, we seek to explain (1) what they learn, reject, adopt and appropriate; (2) the kinds of challenges they face and (3) the unexpected and serendipitous outcomes of their learning. Through an integrated engineering curriculum focusing on design, students learn to be technically competent, creative and entrepreneurial persons. This paper considers how the curriculum works as a set of formal procedures preparing students for a future 'knowledge-based economy' imagined to be technology-intensive, dynamic and filled with opportunities but also increasingly uncertain. We analyse how students at UniTech negotiate this design-focused curriculum where experiences of creativity, openended possibilities and holistic perspectives intersect with the national economic agenda of a knowledge-based economy.

Year: 2018

https://bit.ly/2DxjQzx

Cite:
Chia, A. C., & Cho, M. (2018). **Learning by 'design': how undergraduates in Singapore learn to become engineers.** Children's Geographies, 16(1), 27-38.

For the full article, scan me:

Crowdfunding Campaign as a Design-Based Pedagogical Approach for Experiential Learning of Technology Entrepreneurship

JIANXI LUO (EPD), PEY KIN LEONG (EPD) & KRISTIN L. WOOD (EPD)

ABSTRACT

Engineers are increasingly expected to master the knowledge and skills for entrepreneurship. Academic courses on entrepreneurship have been adopted in engineering schools around the world. However, the experiential learning of technology entrepreneurship remains challenging because it requires not only the experiences of ideation, design and prototyping in classrooms and fab labs but also broader engagement with users, manufacturers, marketers, and investors in business contexts. To conquer this challenge, we developed an approach to use an online crowdfunding campaign as a pedagogical approach to intensify the experiential learning of students in a technology entrepreneurship course. This approach, as part of a course module, provides a real-world context of uncertainty and resource constraints that characterize the entrepreneurship process, and it allows university students to discover and interact with actual users, investors, manufacturers and other stakeholders of their products around the world. We experimented with the use of a crowdfunding campaign as a pedagogical approach for experiential learning in the Entrepreneurship course at Singapore University of Technology and Design (SUTD). We found evidence of increased prototyping quality; learning intensity; empathy toward users, manufacturers, marketers and other stakeholders; and an increased interest in pursuing an entrepreneurial career.

Year: 2018

https://bit.ly/2xFwib5

Cite:
Luo, J., Pey, K. L., & Wood, K. **Crowdfunding campaign as a design-based pedagoical approach for experiential learning of technology Enterprenerurship**. Proceedings of the ASME 2018 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference.

For the full article, scan me:

An Inductive, Design-Centric Approach to Control Engineering Education with a Competitive Atmosphere

FOONG SHAOHUI (EPD), KARUPPPASAMY SUBBURAJ (EPD) & KRISTIN L. WOOD (EPD)

ABSTRACT

Control engineering is a cornerstone of most undergraduate engineering programs in colleges and universities around the world. The analysis and synthesis of automatic controllers, in particular, the PID controller, is a central focus of these courses and modules. However, due to its highly abstract nature, students usually find the content challenging and difficult to comprehend. This is aggravated by the employment of traditional lecture/recitation deductive teaching formats as means of delivery of the content. Here, an inductive-based week long design activity strategically held in the middle of the semester was conceived to introduce and motivate the notion of feedback control. During the course of the week, students in teams design, analyze and synthesize automatic controllers to enable a standardized differential wheeled robotic platform to traverse a line circuit autonomously. The strategy to achieve this capability is intentionally left to be open-ended, and students have the design freedom to select and position sensors needed to sense the track, as well as implement and troubleshoot the programming required to enable autonomous control. The activity culminates with a pulsating head-to-head single elimination tournament to decide the overall champion.

Year: 2017

https://bit.ly/2IksTCZ

Cite:
Foong, S., Subburaj, K., & Wood, K. L. (2017, October). **An inductive, design-centric approach to control engineering education with a competitive atmosphere**. Proceedings of ASME 2017 Dynamic Systems and Control Conference American Society of Mechanical Engineers.

For the full article, scan me:

NATIONAL-LEVEL AWARDS

MOE-TRF 2017 AWARDS

The annual Ministry of Education's Tertiary Education Research (MOE-TRF) Fund aims to promote innovation and research in higher education teaching. This highly competitive and prestigious fund supports applied educational research projects across Singapore's publicly-funded universities, polytechnics and Institute of Technical Education (ITE).

Contact us at **lsl@sutd.edu.sg** for consultations and collaborations on educational research projects.

Assistant Professor Ate Poorthuis from **HASS** clinched the 2017 MOE-TRF award under the individual project category for his proposal on **Explorable Explanations: An Interactive Learning Framework to Enhance Student Learning.**

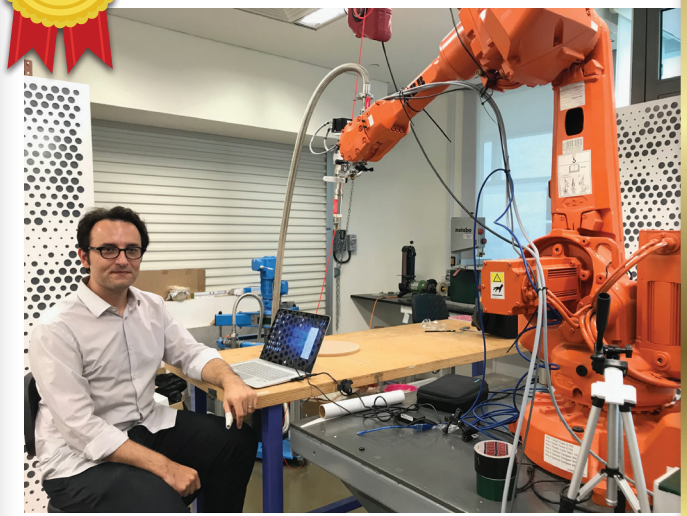
This project aims to develop a framework and course curriculum for interactive, visual modes of learning. The interactive learning framework would enable educators to convert their academic curriculum from static text to an "environment to think in,' whereby students would be able to interact with their learning materials such as through simulations, interactive explanations and visualizations that help students to test and understand the consequences of various alternatives.

SKILLSFUTURE FELLOWSHIP AWARDS 2018

Nachamma Sockalingam (LSL) was conferred the SkillsFuture Fellowship award by Singapore's President in recognition of lifelong learning and services in the field of educational development.

SUTD TEACHING EXCELLENCE AWARDS 2017

Assistant Professor Stylianos Dritsas (ASD)



In recognition of his continuous effort over the years to improve student learning and make SUTD/ASD the best design computation program in Asia.

Senior Lecturer Zhu Yajuan Julia (SCI)

In recognition of her passion for continually innovating teaching through integration of chemistry and biology, flipped classroom, active learning to engage students and maximize their learning.

PEDAGOGY INNOVATION 2018 PROJECTS

Pedagogy innovation is an important aspect of education. Office of Education funds Pedagogy Innovation projects to promote innovations in teaching and Scholarship of Teaching and Learning. Faculty members are invited by Office of Education to submit project proposals bi-annually through email announcements. Submitted proposals undergo criterion based selection by a review team. The theme for the Pedagogical Innovation projects vary from year to year.

Following are successful proposals from 2018, under the theme of SMART Campus**:** Technology-enabled Learning. Office of Education would like to encourage all faculty members to innovate teaching and engage in a scholarly teaching, evidence-based evaluation and inquiry into teaching and learning, and participate in the fund application.

Contact us at **lsl@sutd.edu.sg** for consultations and collaborations on educational research projects.

Digitizing and Visualizing Flowers and Aromatics in Classical Chinese Poetry

Lecturer Zhenxing Zhao & Prof Sun Sun Lim (HASS)

One of the most culturally unique aspects of classical Chinese poetry is the use of flowers and aromatics, few of which have counterparts in the English language. This digital humanities project at HASS is the first of its kind to focus on images of nature in classical Chinese poetry. Digitizing and visualizing the flowers and aromatics in classical Chinese poetry will help learners quickly familiarize themselves with the local flora versus exotic flora, and understand their significance in the context of classical Chinese poetry.

Revision App

Lecturer Massimiliano Colla (SCI)

When it comes to revising study materials to prepare for an impending exam, some students do not really know what they require the most. This project addresses this problem in a personalized and interactive manner. This project aims to develop a mobile app that would help students to self-assess and identify gaps in knowledge so that they would know what to focus on. The app will allow students to choose the course and topics. The app is linked to a library of past questions, case problems and concept questions. At the end of the test, the student will receive a score and an indication of the topics that are to be studied further. The test can be repeated and the questions will be randomized and a new score will be obtained every time.

Adaptive Notes

Lecturer Massimiliano Colla (SCI)

Study notes given to students are intended to be both a reference textbook and a set of revision notes. Instructors use them to present the various topics they need to teach. However, these notes may not be ideal to prepare for tests and some students may not relate the notes to assessment questions. This proposal aims to get students to team up and collate and curate a set of meaningful notes as well as past exercises and test/assessment/exercise papers. These notes will eventually include links to a library of videos and case problems. In other words, this will help students to create and contribute to a meaningful set of comprehensive notes that are linked to assessment questions. The enhanced notes will be made available over eDimension Learning Management System at SUTD or a Wiki page, to anyone who wishes to use them, royalty free.

Better Learning by Collaborative Design Cloud

Assistant Professor Sam Conrad Joyce &
Verina Cristie (Ph.D. student), (ASD)

Design is a complex activity, it involves individual creativity and innovative thinking. Teaching design is arguably even more difficult, not only does it involves teaching the goals and requirements of the final design, but importantly teaching the methods with which they go about to archive such solutions. Existing design tools (specifically in Architectural 3D CAD) focus on modelling as a singular activity. The 3D model is a singular representation and stored as a single digital file; which is typically saved over as it is updated, and typically only one person can work on a file at any one time. This means that most design steps and explored options are often lost, the data overwritten. Whilst only one single design is needed in the end, understanding and exploring a living collaborative design process is invaluable to help capture and support design learning, especially for students. Capturing and visualizing this progress and allowing students users to be involved in this process in an explicit and easy to understand way is the aim of the tools outlined in this proposal.

Smart Prediction of Students' Programming Performance for Early Intervention

Senior Lecturer Norman Lee & Senior Lecturer Oka Kurniawan (ISTD)

All SUTD students have to take a course in computer programming in the third term of the freshmore year. Every year, students come from various academic backgrounds. The majority of them have little or no background in programming. Student feedback from previous years show that students find the learning curve to be steep as they approach week 4 of the term. Some who were confident at the beginning performed badly at the end of the course. The purpose of this work is to develop a smart prediction system of student performance based on their online activity data as well as their code submissions. Machine learning techniques will be used. Such a system could possibly allow instructors to identify underperforming students early on during the course. This will allow the course instructors to provide targeted early intervention for this group of students.

STUDENT WORKS

The following are some education related student projects from their course work. These exemplify how we can creatively integrate teaching and learning with disciplinary subjects to engage learners and enhance learning.

Do check out the videos via the **QR codes** for more information.

ScholarPlus

Work by: *Pinardy Yang, Joshua Lim, Yin Ji Sheng, Darius Chow & Eiros Tan*
Course: *User Interface Design and Implementation (ISTD)*
Course Leads: *Assistant Prof Hyowon Lee*

The project focuses on the user experience of academic search engines, specifically Google Scholar, and enables users to dynamically change the visibility level of the results page.

Reactosis

Work by: *Justin Ang, Huang Qiuhong, Laura Lee, Justinian Siah & Wu Shangjing*
Course: *Engineering Systems Architecture (ESD)*
Course Leads: *Prof Peter Jackson & Assistant Prof Stefano Galelli*

This is a fun and engaging Chemistry board game that helps players to visualize chemical compounds, teaches the science in real life applications and promotes active discussions among the players.

Travel Go

Work by: *Chen Zhaoyuan, Gan Jia Min, Gerald Pan Jia Xiong & Tan Huan Yu*
Course: *Engineering Systems Architecture (ESD)*
Course Leads: *Prof Peter Jackson & Assistant Prof Stefano Galelli*

This is an educational and entertaining board game that allows players to learn the origins and history of Asia's landmarks by immersing in unique cultural experiences of 30 Asia countries.

ACTIVE LEARNING USING JIGSAW ACTIVITY IN A COMPUTING COURSE

OKA KURNIAWAN *(ISTD)*

What does active learning actually mean? For some, it maybe actively asking questions to students, for others, it is simply more hands-on activity, and others, group discussion. Active learning is defined as "a method of learning in which students are actively or experientially involved in the learning process and where there are different levels of active learning, depending on student involvement" (Bonwell & Eison, 1991). Several activities are considered as active learning in the literature, such as think-pair-share, concept questions, gallery walk, jigsaw activity, etc. In this article, we present how we implement jigsaw activity into one of our ISTD pillar course called Computation Structure (50.002).

Jigsaw activity facilitates students learning through peer teaching. It was first proposed by Aronson in his book "The Jigsaw Classroom" (Aronson, 1978) and it follows several steps. The first step is to divide students into several expert groups (Figure 1). In this expert group, students are to learn the materials on their own with the help of instructors as facilitators. Students also gather in this expert group to discuss and plan how to teach their peers related to the topic assigned to that particular group. Different topics should be assigned to different groups. At this point, instructors can help the expert group to make sure that they get the knowledge properly and are able to deliver that knowledge to their peers. In the next step, students return from the expert group and form another group called the teaching group. This teaching group is composed of different students from different expert group. Time is then given for each expert in that group to teach their peers. Again, instructor's role is crucial at this point to facilitate learning in the teaching group. Jigsaw activity allows students to be accountable for the topic that they are to teach. Moreover, it helps students to learn by teaching that topics and at the same time by receiving teaching from their own peers.

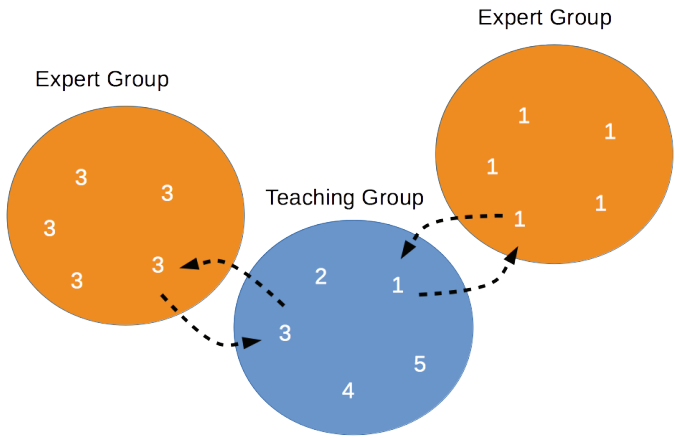


Figure 1. Jigsaw activity consisting of teaching group and expert group.

We implemented Jigsaw activity in one of the lessons of Computation Structure course. The topic that they are to learn is the design of an Arithmetic Logic Unit. The week before, students are told to read the handout material before they come to the lesson. When the come to the lesson, they are told that there will be a quiz at the end of the activity. We learn that having a quiz at the end of the activity ensures students to take the activity seriously and be accountable to their peers. During the briefing, students are divided first into their teaching group. Within the teaching group, they are to be divided to different expert groups. The students are then split to each expert group to discuss the topics. Four topics are assigned ranging from Adder and Subtractor module, Comparator module, Boolean module, Shifter module, and the integration of all these modules. They

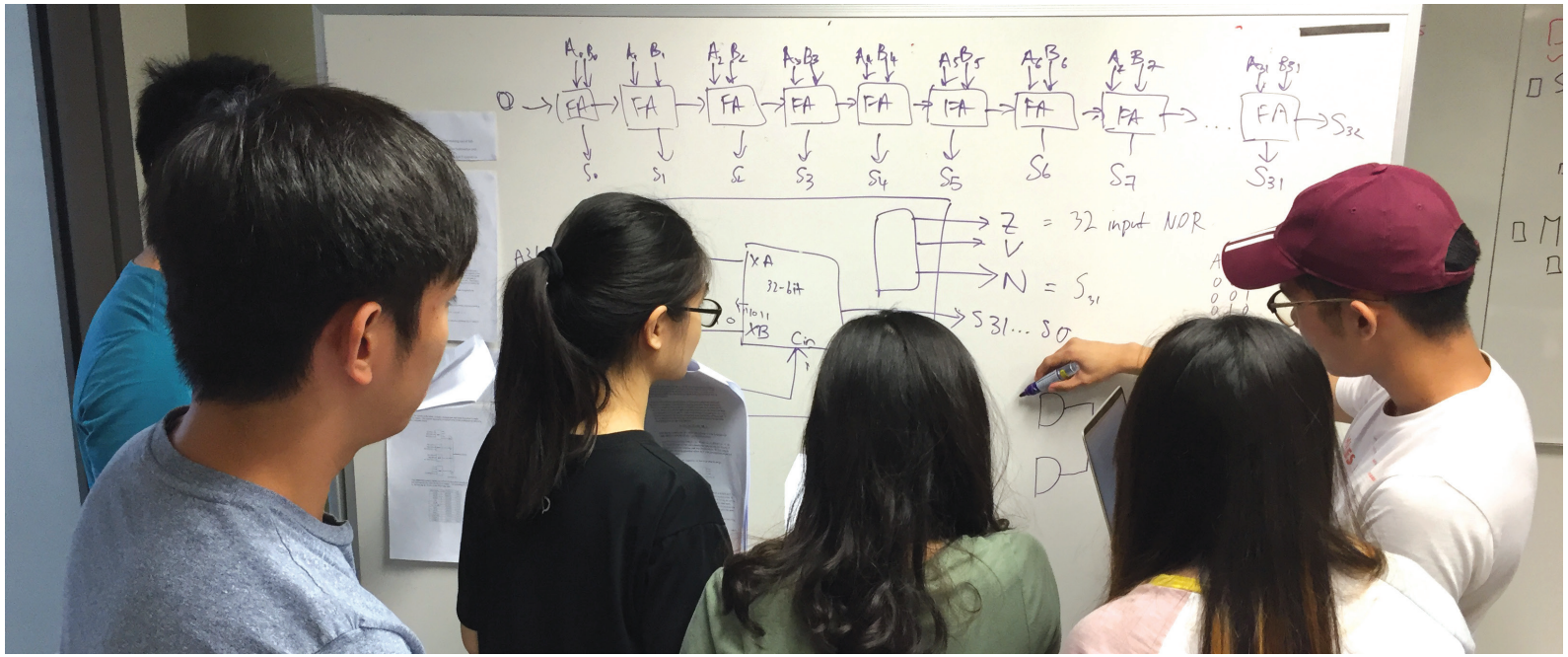


Figure 2. Expert group phase allows students to learn the material and discuss how to teach the materials to their peers.

were given 15 to 20 minutes to discuss the design and plan how they are going to teach their peers (Figure 2).

Once discussion in the expert group finished, each student returns to their teaching group and are given about 30 minutes to do peer teaching (Figure 3). Each expert should teach their peers within five to seven minutes. A team lead is appointed to make sure that each expert has enough time and do not exceed the time allocated. At the end of this peer teaching phase, we close the lesson with a 15 minutes quiz. The next lesson is used by the instructor to go through the design in more details, to give feedback to some of students design and to let students to implement their design in a simulator.

Though we did not do a more proper academic study on the effectiveness of Jigsaw in our course, we observed such activity brings benefit for students' learning. Jigsaw has been used relatively little in Computer Science courses. Portillo and Campos reported to use Jigsaw to teach class diagrams in object oriented design (Portillo & Campos, 2010). The feedback from students was shown to be positive and the results of the tests taken showed an improvement of students' performance after the activity. Kordaki even creatively implemented Jigsaw for an online course in Computer Science (Kordaki & Siempos, 2010). She utilized LAMS (Learning Activity Management System) to manage the learning activity. LAMS is an open source tool for designing, managing, and delivering online collaborative learning activities. However, she did not report on the effect of this online collaborative learning.

On our part, we requested our undergraduate teaching assistant to give his comments and observation on this learning activity. Bernard, one of our undergraduate teaching assistant commented about the Jigsaw activity,

Figure 3. Peer teaching phase where each expert teaches his or her peers on their expertise topics.

"The Jigsaw activity encouraged students to learn, digest and disseminate information from their expert groups to their peers. The process of teaching helped to refine information in the student's mind, compelling them to understand it better and look for more logical fits in order to link from
one topic to another. Compared to a traditional lecture, students are given a greater responsibility in actively processing their taught material, which ensures that students follow along the lesson, something that traditional activities struggle with. However, students with weaker foundations may find such activity stress-inducing, as they might not follow the expert group discussion and therefore fail to reteach these information back to their peers. A solution might be to use the Jigsaw activity for lessons that have little foundational requirements (more standalone), and also send the weaker students to the expert groups that focus more on foundational material rather than the more abstract counterparts. I believe that the Jigsaw activity, with its unique ability to ensure all students play an active role, makes learning more personal and fun and calls for a stronger presence of mind
than conventional methods of lectures."

As we have been doing this jigsaw activity for several years, some points of reflection on lessons learnt are due. First, we realize the importance of accountability by students. Students can choose to ignore the task and did not try to learn their expertise topics. At the end, the group will not learn that topic well. Having an assessment such as a quiz at the end helps to ensure that students are accountable to learn their expertise topics. This should be announced before the activity starts so that students know their role and responsibility.

Handouts and learning materials play an important role in Jigsaw activity. Since the lecture is replaced with peer teaching, a good and concise learning material must be available for students. This learning material should be chosen so that it can be divided into several topics for each expert group. Each expert topics from this material must be self-contained as much as possible so that each expert group can learn the topics without recourse to other expert groups. Preparing such materialand choosing the topics for each expert group is fundamental in Jigsaw activity.

On the other hand, classroom management is as important as the other two. The instructor must brief the students, facilitate the learning in expert group and teaching group, as well as manage the time. There is always a tendency for group discussion to exceed the given time. The instructor must ensure that each activity is done within the planned time and at the same time to ensure that discussions and learning do take place during these time.

We felt more than one instructor is also required to facilitate such activity. This can be done with the help of teaching assistants. At the same time, teaching assistants must be briefed on their role as facilitator rather than as teacher. They should help students to discover the knowledge and teach one another rather than themselves teaching the students. Their role is to facilitate peer teaching. This is important because we believe the actual learning takes place when students teach their peers.

As mentioned by one of our teaching assistant's quote above, one challenge in implementing Jigsaw activity is towards the weaker students. These students may not be able to follow the discussion in the expert group and therefore may affect

their teaching group members. We realize it is important for instructors to pay attention to these students and help them during the expert group discussion phase to make sure that they can grasp the concept and is able to pass it on to their peers. A follow up session may be helpful, which can be done after the lesson itself. In our case, our second session related to this topic is used by instructors to review and discuss in details such designs. This may help these weaker students to catch up and able to do their assignments at the end.

We believe that active learning can be applied to many courses in Computer Science. McConnel for example use active and cooperative learning to improve student's final exam score in a Theory of Computation course (Mcconnell, 1996). Thomas shows that cooperative learning is natural to teach object oriented lessons (Thomas, 2003). Such cooperative learning has also been successfully implemented in a large class sizes. In fact, Jigsaw was listed as the method that improves students' scores the most (Carpenter, 2006).

In summary, we found Jigsaw activity facilitates students learning through active peer teaching. Each student is responsible and is called to be accountable to their peers' learning. We, as instructors, found that such learning activity engages students and can be done effectively with careful planning. There has been ample evidence from the literatures that Jigsaw methods improves students learning. Since SUTD's pedagogy promotes active learning, instructors should be trained and supported to experiment with Jigsaw in their courses. On the other side, instructors should pay more attentions to the weaker students who may not be able to catch up with the activity and the demand of such active learning.

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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 four years at SUTD. He also helps Learning Sciences Lab in facilitating and assessing the teaching assistants in their Microteaching sessions of the graduate course "Teaching at SUTD: Engaging the Learners".

THE DESIGN AND EVALUATION OF VIRTUAL LABORATORY SIMULATIONS FOR BIOLOGY NON-MAJORS

BINA RAI *(SCI)*
JULIA (YAJUAN) ZHU *(SCI)*

The traditional way of teaching advanced Biology to undergraduate students relies on lectures, tutorials and laboratory classes. While lectures and tutorials are one of the ways for the students to learn key biological theories and concepts in the classroom, the amount of knowledge retained by the students through this traditional way of learning is less than 70% (Dale E., 1969). Laboratory classes, on the other hand, are more effective in providing hands-on training in biological techniques to reinforce and "visualize" concepts learnt in the classroom. However, the feasibility of conducting laboratory classes is often limited due to the constraints of class time, cost and laboratory facilities.

To solve this problem and achieve the highest level of knowledge retention (90%), the better method of teaching is to simulate the real laboratory experience (Dale E., 1969). Research regarding the effectiveness of simulations for science education is only beginning to emerge. In a noteworthy study, researchers from Denmark (Bonde M.T. et al, 2014) showed a 76 % increase in learning outcomes by using a gamified laboratory simulation compared to traditional teaching and a 101 % increase when used in combination, suggesting an untapped potential for increasing the skills of science students and graduates.

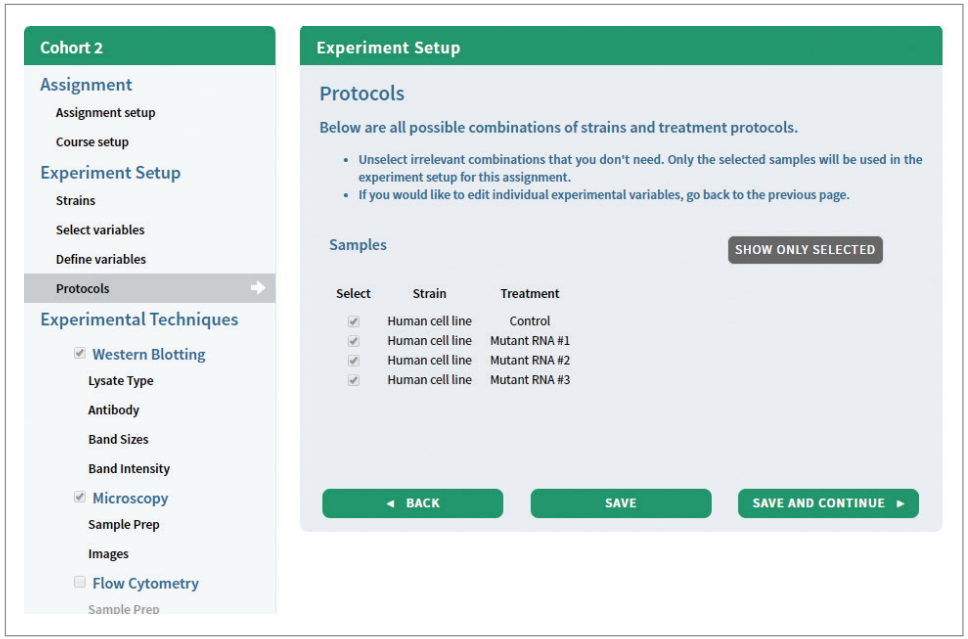

Figure 1. The flow of information within a representative vLAB assignment.

The "Introduction to biology" module at the Singapore University of Technology and Design (SUTD) has a unique curriculum centered on students acquiring literacy in biology at the freshmore level. The course focuses strongly on students' competencies in formulating hypotheses, analyses of experimental data and application of knowledge. The profile of the students over the last 3 years revealed that half of them studied biology up till secondary 2 level only. As SUTD offers degrees predominantly in engineering and architecture, it can be predicted that the majority of the students will not likely pursue a future career in biology. Taking all these points into consideration, we were left with an interesting challenge of developing hands-on activities that were well-aligned with the course's goals and simultaneously compatible with the students' needs.

By enabling experimental manipulations (that may take weeks in real-life) to occur at the click of a mouse button, virtual lab simulations not only allow students to undertake these studies but, more importantly, to have an enhanced freshmore learning experience at SUTD. Combined with the advantages they offer in terms of flexibility in time, location, pace, and process, they can offer a potentially more efficient mode of teaching and learning. In particular, students will welcome the fact that they are guaranteed results, experiments are repeatable, and they can work at their own pace and make mistakes. (Dewhurst, D.G. et al, 1994; Gibbons, N.J. et al, 2004; Flowers, O.L. 2011).These lab simulations are particularly useful and engaging for the non-biology majors, who represent the majority of the freshmores at SUTD.

Our research question was "Do virtual laboratory simulations (vLAB) lead to an increase in student knowledge, analytical skills, intrinsic motivation to study biology and self-efficacy in an introductory biology course for non-majors?" We decided to customize and generate virtual lab simulations (vLAB) using existing software builders (StarCellBio and StarGenetics, MIT). VLABs allow for repetitive practice in techniques manipulation and data interpretation that students cannot otherwise experience in the usual 3-h period of the traditional teaching laboratory. The vLABs designed and evaluated in our course were related to the topics of cell signaling, cell cycle regulation and genetics. Each vLAB assignment consisted of design, experiment set-up, running of experiment using selected techniques, followed by generation and analyses of data (Fig. 1). Students were requested on a voluntary basis to complete an anonymous questionnaire consisting of six multiple-choice questions and one open-ended question at the end of the course to measure students' perceptions of vLAB and the impact of vLAB on their learning experience and self-efficacy.

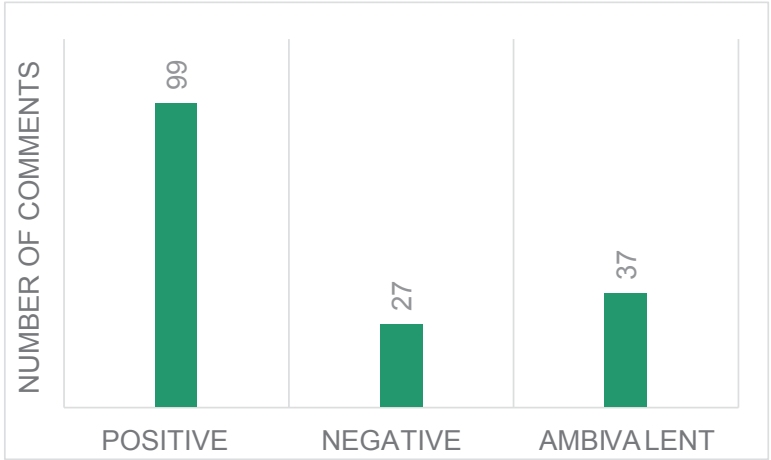

Figure 2. Students' feedback to the open-ended question in the survey was organized into positive, negative and ambivalent comments.

Data received from 229 students who responded the survey revealed that approximately 80% agreed or strongly agreed that they

1. Learned about experimental design and how to carry out experiments,
2. Discovered how to analyze data generated by biology techniques, and
3. Increased knowledge and understanding of biology concepts through participating in vLAB.

One hundred and sixty-three students responded to the open-ended question, which asked if they found vLAB helpful and if they did, explain how (Fig. 2).

Three representative examples of positive comments were;

"The virtual labs are engaging as they let us have an experience of what it is like to apply what we learnt and analyze the experimental data."

"It allow us to do the experiment without being in laboratories and everyone can observe the result."

"They allow us to react and see changes in our simulated environment, enabling us to see clearly the relationship between our input and output dynamically."

Three representative examples of negative comments were;

"The worksheets for the virtual labs can be a little wordy."

"Most of the classes, because of time constraints, we just go into the activity and we get so confused about what is happening."

"I would prefer an actual lab session."

In conclusion, student gains are promising and a majority were actively engaged in the vLAB learning experiences. We will continue to refine the vLAB assignments to make it more concise and clear for our unique student population.

VLABs have the power to change the roles of instructors and students, and the respective parties must prepare themselves for this transformation in order for vLAB to be meaningful. Instructors will, instead of teaching, now be facilitating students' learning. Students suddenly become responsible for their own learning in class. We also learnt that preparation for vLAB assignments that includes designing the activity per se, generation of simulations using software builders and integration into lesson plan is time and resource consuming. Hence, we advise educators to be sure that students' gains will be promising before committing to launch a vLAB simulation. It is worth mentioning that the vLAB we evaluated in this study was utilized more as an experimental data generator. We are in the process of considering fully interactive, gamified lab simulations to further improve students' learning experiences.

Acknowledgements

1. "The Introduction to Biology" Team of Instructors from SUTD: Khoo Xiaojuan, Dawn C-I Koh, Ong Eng Shi, Lakshminarasimhan Krishnaswamy, Rajesh Chandramohanadas and Leo Chen Huei.
2. All students who participated and provided feedback.
3. Funding support from the SUTD Pedagogy Innovation Grant, 2017-5032.

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ABOUT THE AUTHORS

Dr. Bina (Left) and Dr. Julia (Right) are award winning lecturers from the Science and Math Cluster at SUTD. They teach Freshmore science subjects. Their expertise and research interests include active learning, flipped classroom, and virtual laboratories. They have presented in several international educational conferences.

A DIGITAL PERSPECTIVE IN MATERIAL AND FABRICATION FOR ARCHITECTURAL EDUCATION

STYLIANOS DRITSAS *(ASD)*

The materials and fabrication processes used in architecture and construction have changed very little since the 1800 where Portland cement was invented and low carbon steel was massively and cost-effectively produced. Despite technological innovations which propelled the automotive, aviation and general manufacturing industries since then, architecture is still being produced and by implication upstream designed fundamentally in very similar fashion today as it was hundred years ago. If anything, digital design technologies have further broadened the hiatus between conceptual design and the material world of physical space.

The objective of digital design and fabrication, a course offered jointly to both undergraduate and graduate students of architecture as the Singapore University of Technology and Design, is to approach architectural design from a bottom-up perspective: from materials, to tectonics (logic of first order sub-assemblies) to spatial configurations (larger-scale high-level assemblies). It is to motivate and empower prospective architects to investigate, experiment and think like inventors. This is contrary to traditional top-down hierarchical decomposition logic of design education where conceptual designs are embedded with functional requirements and material considerations in a mode akin to art direction motivated by social commentary and reinterpretation of classical design inquiries such as housing, work space and leisure.

Students in teams, of typically three to five each, are provided with an industrial robotic arm, a toolkit of electromechanical components such as programmable logic controllers and motor actuators, and bespoke CAD/CAM software that eases learning, developmental processes and technical nuances of creating a novel material transformation machinery for design. The requirement for successfully achieving the learning objectives of the course is to demonstrate a new process and an indicative artifact that could have never been conceived or materialized in the past. The educational work presented demonstrates an active-learning, design and technology education paradigm where STEAM components are integrated under a personalized design mandate.

As a research-to-design course taught at both undergraduate and graduate levels, students are required to develop attitudes pertaining awareness of state-of-the-art in the field of digital fabrication through literature review of recent

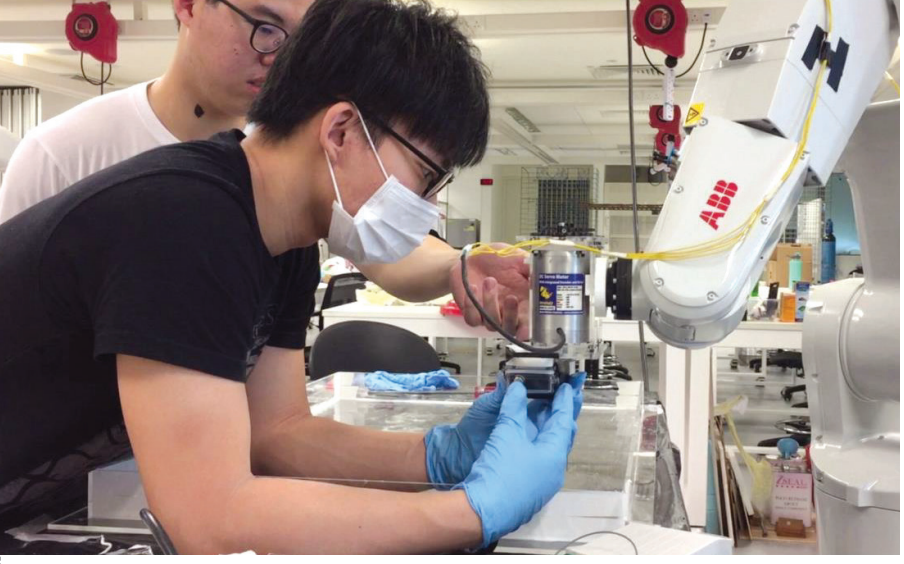


Figure 1. Undergraduate student calibrating servo-motor injector for dynamic modification of concrete panels.

Figure 3. Computer software developed by PI eases translation between digital and physical world through simulation, communications and visual programming paradigm.

Figure 2. View of the laboratory and robotic equipment developed for the Advanced Topics in Digital Design and Fabrication course. Each of the four systems is compromised of 5kg, 0.9m reach articulated robot mounted on a mobile purpose-built base containing the controller and additional support units.

publications; learn how to effectively write research project proposals in the form of abstract and summary of objectives; to perform experiments for collection and analysis of data; to write in technical fashion for communicating with expert audiences; and present their work through conference style presentations. In the four past years, over a dozen SUTD students from the ADDF course have authored, submitted and published through peer reviewed technical papers in international conferences including receiving the best paper award in 2017. As such within only a short time period SUTD's architectural computing, and in particular digital fabrication, has emerged a strong contributor in the scholarly community in Asia.

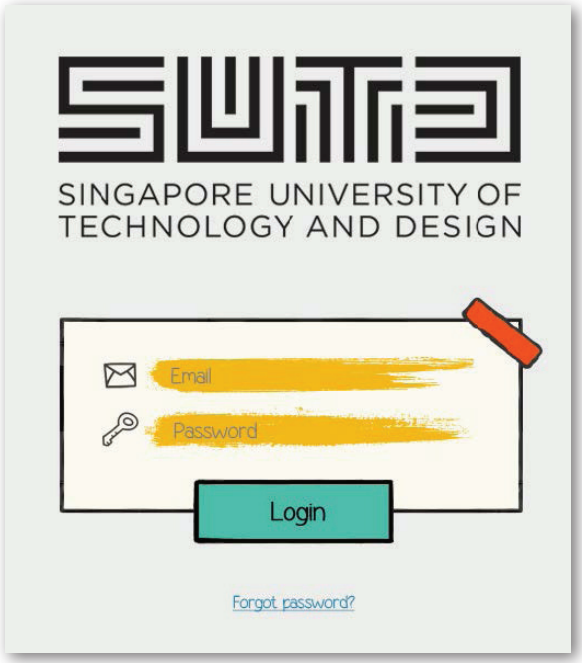
Looking forward into the future, as the broader building and construction industry in Singapore and overseas, updates itself by progressively incorporating and integrating information technologies for design and the production of architecture, our students will be one step ahead and take lead in a new world of technology and design.

Figure 4. Tutorial by PI to Korean faculty and students introducing electrical prototyping using programmable logic controllers and mechanical units using servo motors and pneumatics.

Figure 5. SUTD students presenting at the computer aided architectural design research in Asia 2018 event. Half of the students conducted the work while still undergraduate and by now in the Master's program, while the other half have already graduated and working in the Singapore architecture practice.

ABOUT THE AUTHOR

Dr. Stylianos Dritsas is an Assistant Professor in Architecture and Sustainable Design at the SUTD. He has been teaching at SUTD since 2012, and he was the recipient of SUTD's Teaching Excellence Award Winner 2018 for his exceptional and innovative teaching.

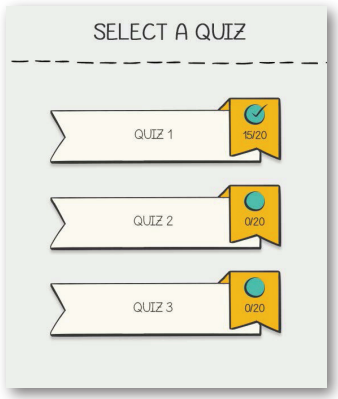


GAMIFYING STUDENT ASSESSMENT

OMAR ORTIZ *(SCI)*
SERGEY KUSHNAREV *(ESD)*

Gamification can be defined as the incorporation of game elements in a product or service to encourage engagement. An old example is flashcards, which resemble playing cards and are used as a memorization aid.

With the recent rise of smart devices, videogames have expanded beyond the traditional console setting, reaching far more users than ever before. This has enabled gamification to take a whole new dimension and rapidly become a trend in multiple fields – pedagogy being not the exception.

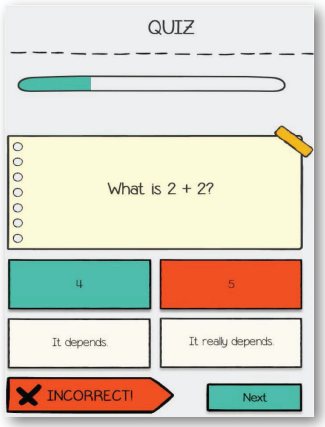


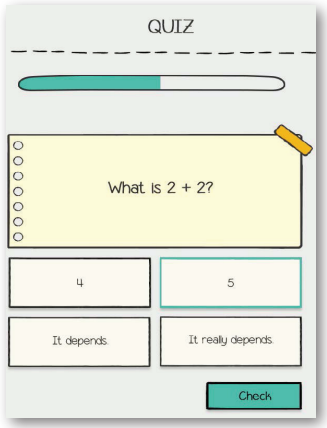
As part of SUTD's Pedagogy Innovations programme, the authors prototyped a gamified online quiz application. In this article we will describe our project, current challenges and future directions.

Our premise was to make an approachable platform where online quizzes don't look tedious or intimidating, but rather

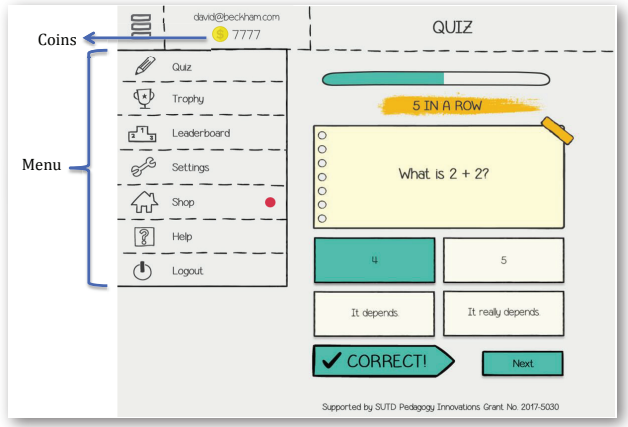
friendly and fun. For the visuals we pictured a colourful, cartoonish theme complete with sound effects and simple animations, away from the formal and dull-looking interfaces typical of most learning management systems.

Within the app, a quiz consists of a sequence of questions together with a progress bar that increases with each correct answer and decreases with incorrect ones. A unique feature is that the app will continue to show new questions until the progress bar is complete, meaning full marks, or when the user chooses to exit the quiz and record the current score. This offers all students the opportunity to get full marks on the quiz, provided that they work (or play!) long enough.

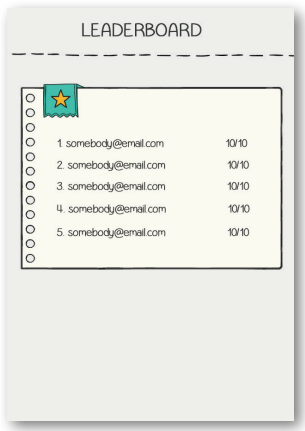


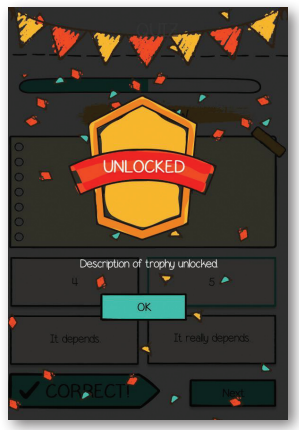


To make things more playful we implemented a few classic game elements. First is an internal currency: When a student consecutively answers a number of questions correctly, some coins will be earned and, similarly, a few incorrect answers in a row will deduct coins too. This coins may later be used in a virtual shop to redeem helpful game items or "lifelines" which, for instance, can reduce the number of answer choices, switch question without penalty, freeze the progress bar, etc.

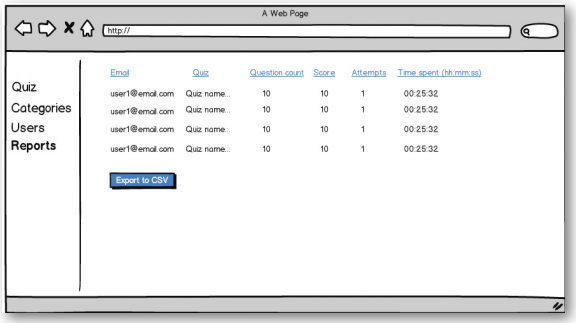


Other game elements include a leaderboard where students can compare their score against other classmates, masked under aliases to protect their identity. There are also trophies to be unlocked by completing certain tasks like ending the quiz in a very short time, answering all questions right, saving several coins, and so on.





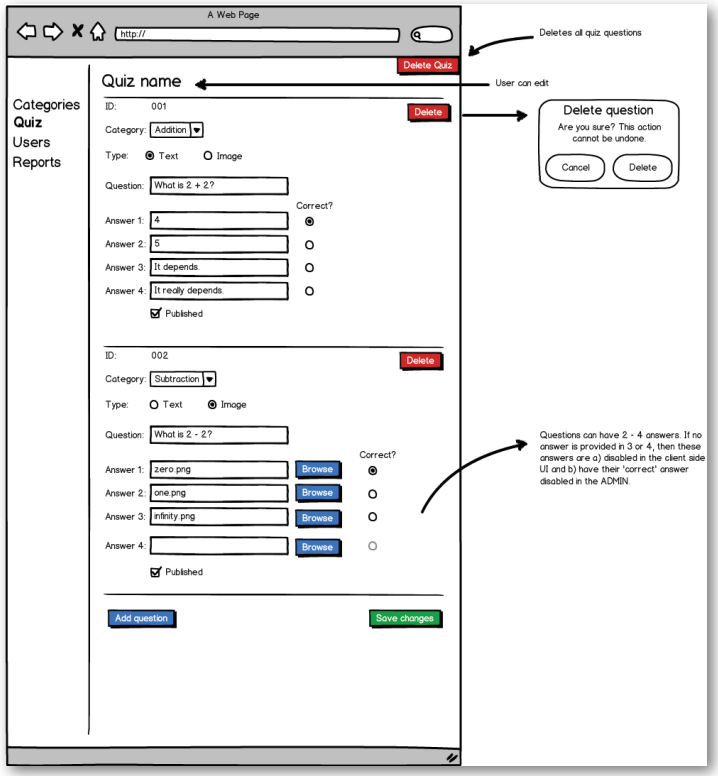
On the admin side, instructors have a system to create and edit quizzes, categorize questions, manage users, and track data: scores, number of attempts, time spent...



One of the current challenges we face to make the game mechanics work well, is to build a vast repository of questions or an automated question generator, so that a user will not get the same question twice even after a large number of attempts.

Another difficulty, common to all online quiz platforms, is to provide an efficient interface to input math symbols and expressions. Many alternatives exist, and handwriting recognition technologies are facilitating promising solutions, but at present all options are still a long way from optimal.

With this prototype we hope to lay a foundation upon which a fully functional app can be developed in the future, providing students at SUTD and beyond with an engaging and fun resource to test their knowledge and skills.



ABOUT THE AUTHORS

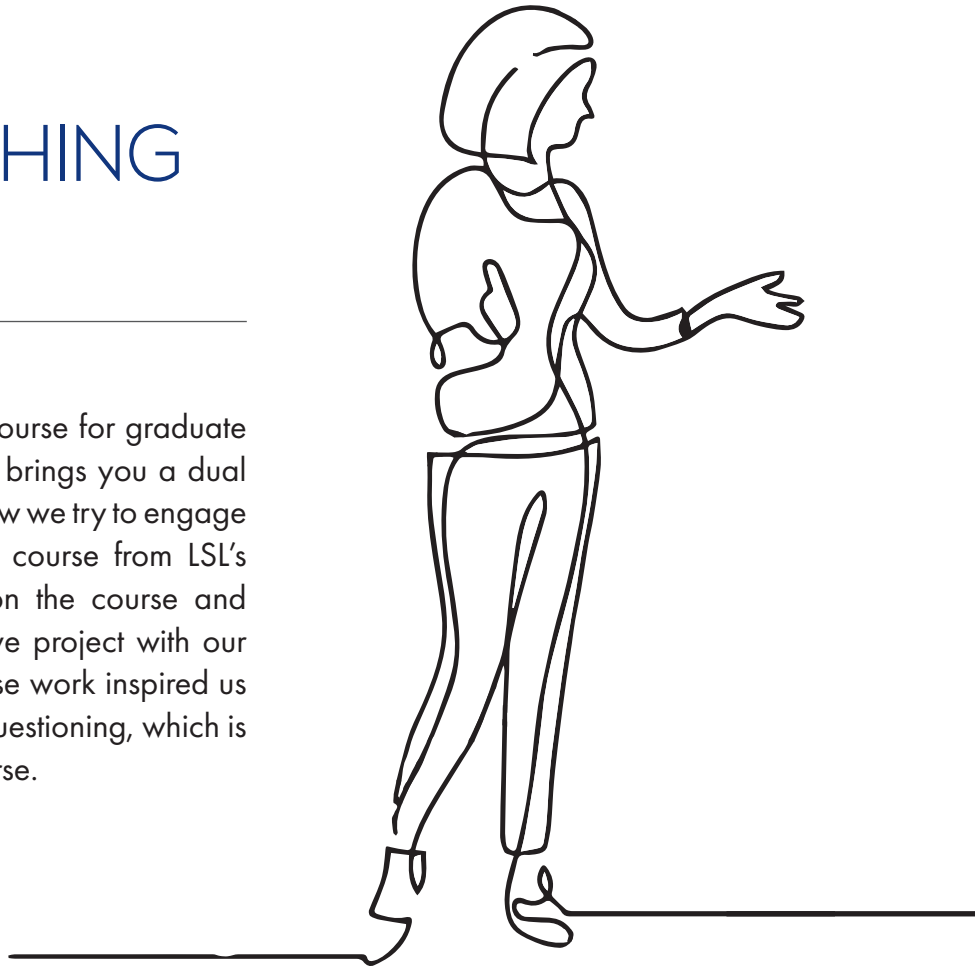
Dr. Omar is a Lecturer at ESD. Omar obtained his PhD in in pure mathematics at the University of Melbourne. His research interest is gamifying math learning. He is currently designing an educational application for this purpose.

Dr. Sergey is a Senior Lecturer at ESD. He has been teaching Freshmore Maths 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. One of his interests is Math Modelling.

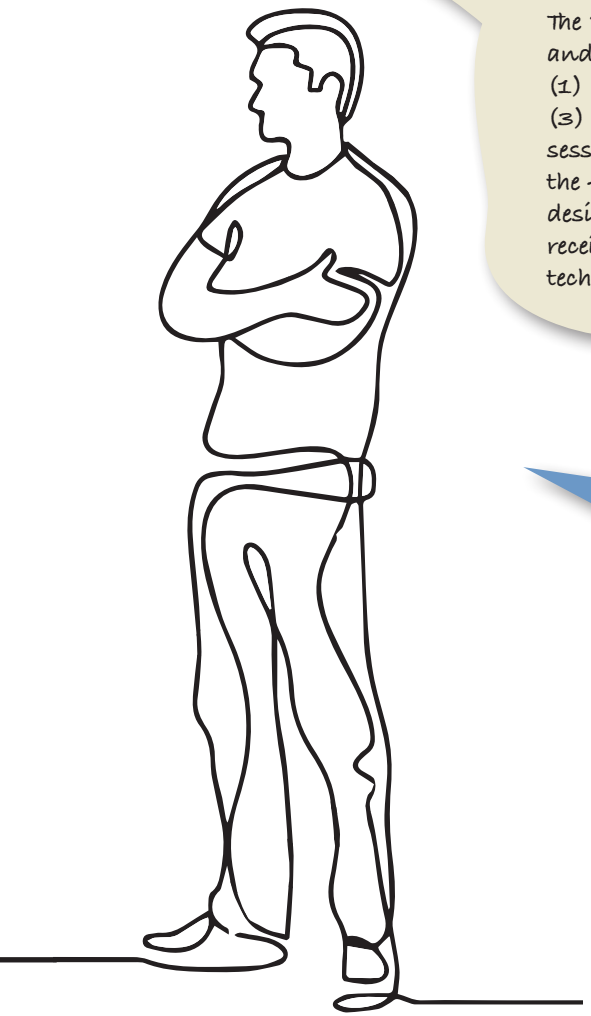
ENGAGING STUDENTS AS PARTNERS IN TEACHING

JOHN CHAN YOU EN *(EPD)*
NACHAMMA SOCKALINGAM *(LSL)*

The Learning Sciences Lab (LSL) runs a pedagogical course for graduate students to prepare them to teach at SUTD. This article brings you a dual perspective. It gives information about the course, and how we try to engage with our students as partners in teaching beyond the course from LSL's perspective, as well as a graduate student's views on the course and collaboration. This write-up results from a collaborative project with our student, John Chan whose presentation during the course work inspired us to get him and his peer to do a short skit on Socrative Questioning, which is now being used as a teaching resource in the same course.



About The Course



Nacha:

The "Teaching at SUTD: Engaging the Learners" course encompasses 4 lessons and 2 microteaching sessions, totalling 18 hours. The 4 lessons cover aspects such as (1) Educational context at SUTD, (2) Teaching methods to engage students, (3) Questioning skills and (4) Assessing student learning. The microteaching session gives students an opportunity to synthesise what they have learnt during the 4 lessons and design a mini-teaching activity. Each student will showcase their design of learning activity during the microteaching session and provide as well as receive peer feedback. The course infuses several different student-centric and technology enabled learning methods.

John:

The takeaway for me from this course was to have clear learning outcomes to start with and good assessment rubrics to measure learning through out. The learning outcomes provide purpose and structure to a teaching activity. Moreover, the outcomes help me to narrow down relevant topics and emphasize key points so that students can follow during the lesson.

As teaching can subconsciously become more of a presentation than an interaction, I realized that some form of assessment is useful to find out what aspects students have or have not understood from the class. The assessment is two-way; as much as it reflects the student's level of understanding, it also reflects the effectiveness of the teaching, which the teacher can improve on. It also helps to identify gaps in understanding and misconceptions so we can address as teachers.

Why do we need the course for GTAs?

Nacha:

Teaching at SUTD is different in many ways given the unique SUTD pedagogy of multi-disciplinary curriculum, infused with project-based, collaborative, experiential and active learning. Our graduate students come from diverse backgrounds, in terms of nationalities, and have varied prior teaching and learning experiences. Most do not have any prior training on teaching. So it is essential that we prepare them to teach at SUTD and our hope is that this course prepares them for a longer journey ahead as an academic, and not just stop at the teaching assistantship at SUTD.

John:

I think that attending the course is sort of fulfilling the university's requirements so that graduate students understand their roles as teaching assistants and are equipped with basic knowledge about teaching methods. It is quite important because we have no prior training.

The microteaching session was a valuable experience for me. I had the opportunity to conduct a short class and also watch others teach and learn from them. When I was put in the shoes of a teacher, I had to plan materials ahead of the class and ponder about how to engage students in class. It made me realize that teaching involves a lot of intentional effort, more than what appears on the surface.

During the actual session, I had to multitask - monitor and observe the students, while managing the slides and trying to interact with the students. I realised that teaching is not an easy task.

From the students' feedback, I reflected on what I did well and what I could do better in the future. While watching others teach, I was impressed that some of them. Some had very good intonation in their voice, which kept me attentive. Others used interesting interactive activities.

So the course helped me prepare for teaching and improve my presentation skills. I believe that as a graduate student, I will need to present my ideas and interact with audience, say in conference. So the learnings will come in handy.

Collaborating with students as partners in teaching

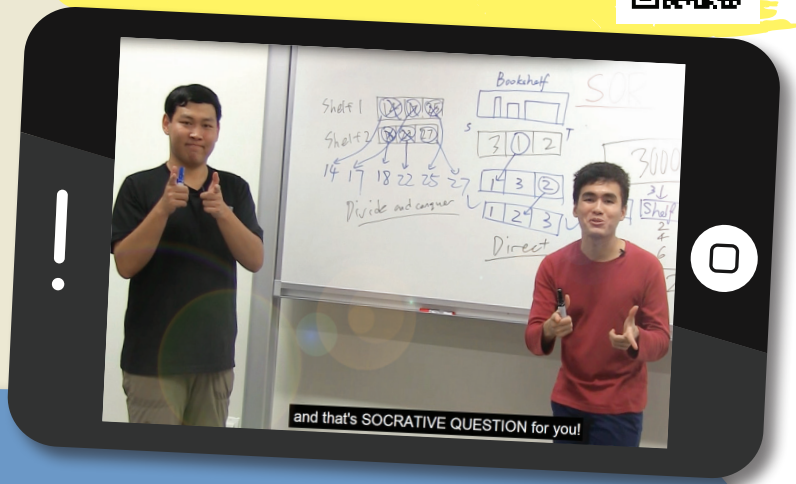
Nacha:

LSL tries to involve our GTAs, staff and faculty members as co-partners in our course in various capacities, as content providers, facilitators and assessors. We find that our graduate students are very enthusiastic, creative and innovative in their teaching as observed during the lessons and microteaching sessions. So when we find interesting and creative ideas, we try and engage them as our student partners.

John and team did a skit on Socrative Teaching to teach programming during one of the lessons. So we invited them back to video-record. Our LSL team and the students worked on the skit and the video production. We use the video as one of the resources in our teaching course.

Check out the video here!

Senior Associate Clement Lim, LSL worked with the students in creating the video and LSL acknowledges the contributions.



John:

I thoroughly enjoyed the co-development, working with another student volunteer and the course instructors on a skit about Socratic questioning. In this skit, I took on the role of a teacher whose objective was to convey the concept of sorting algorithms to the student.

Instead of using a conventional lecture style, the teacher would engage the student by asking leading questions, helping the student to think deeper and discover their answers. The course instructors provided feedback on the skit and acting, and video-recorded the sessions.

Through the co-development experience, I could apply knowledge learnt from the course and this also gave me ample practice for future teaching.

Furthermore, it helped me to discover that there is so much more to teaching than what a course can cover, such as responding to changing situational nuances, which comes with experience.

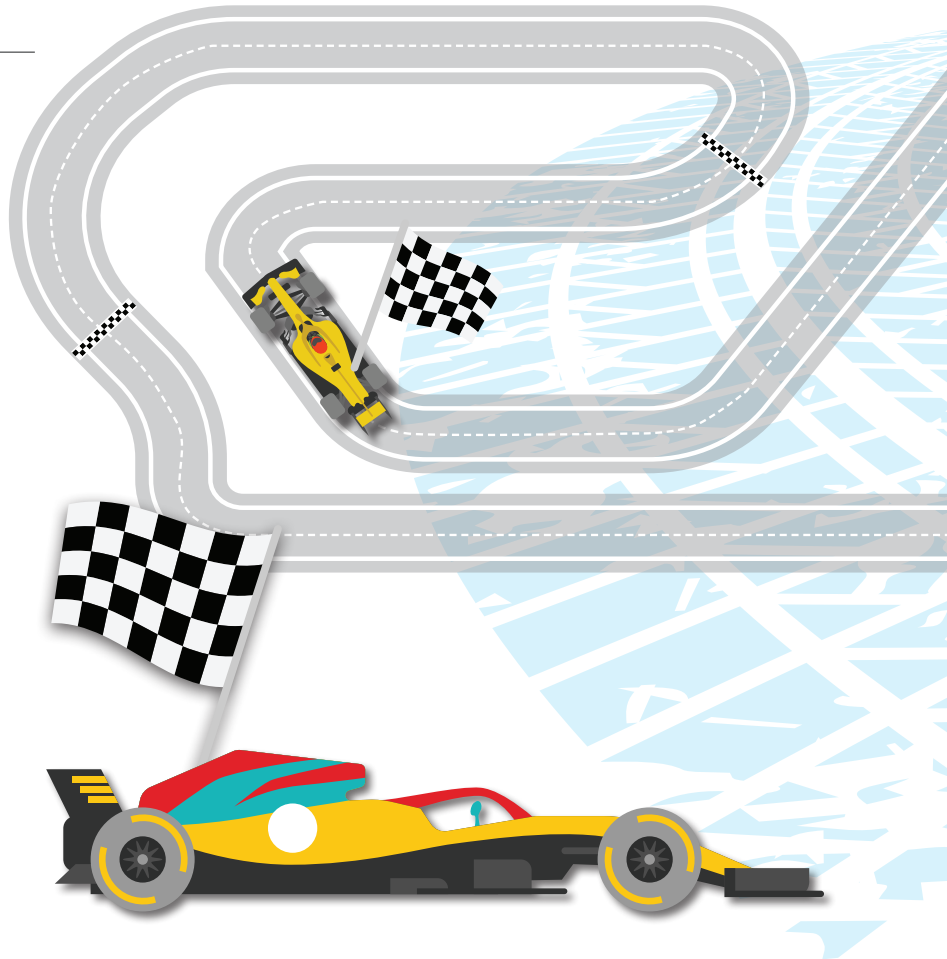
EDUCATION OUTSIDE OF THE COHORT CLASSROOMS – THE SUTD EV JOURNEY

HE FULIN *(OED)*

For those who are not familiar with the SUTD "5th row" concept: Every undergraduate student in SUTD is to take a maximum of four credit courses per term with each designed to have 12 hours of study per week on average. SUTD has named the co-curricular activities as "5th row" – the fifth activity or "subject" students do every term in addition to their four academic courses. To fully support this, Wednesday and Friday afternoons from 1pm to 7pm are set aside as 5th row time, giving all SUTD students a common time slots to come together to pursue their interest and passion.

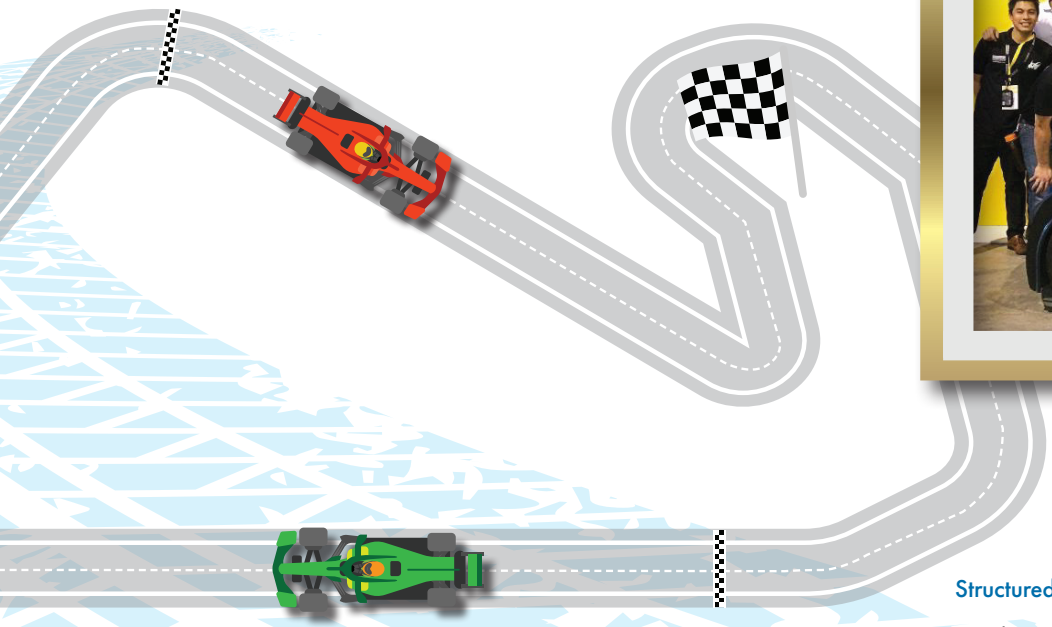
One such 5th row activity EV Club whose student members design and build vehicles of different types, powered by different energy sources. While the SUTD EV Club projects are normally non-credit-bearing, student members have continued to be actively involved in them.

Under the advice and support from both Professor Pey Kin Leong and Professor Lim Seh Chun, Mr. Liew Zhen Hui and I took on the role as the 2 technical mentors to the EV club. Zhen Hui mentors the students in terms of all the engineering aspects and I mentor them in terms of the design and styling aspects. Hence, I thought of sharing some learning strategies and personal experiences I encountered throughout my time thus far with the EV club.



The Challenges

As all 5th row activities are not academically credited, a key challenge we faced was keeping the students engaged with sustained interest and participation in the EV projects throughout their time in SUTD.



A second challenge is that freshmore and senior year students have quite different needs and limitations which we need to consider in our EV program planning. Another thing would be that many freshmore students join several 5th row clubs at the beginning but might only remain in 1 or 2 as they move into their pillar years. Hence for the EV club, this meant that we experience quite significant fluctuations in our membership strength as the year progresses.

Furthermore, as there is not any automotive or vehicle design and engineering specific modules offered in our undergraduate programs, we face the challenge of

Figure 1. E17 core + extended team picture

how we could effectively teach our EV members on the necessary technical know-how required to build cars/vehicles, especially with their limited 5th row contact time with us.

Structured Learning Methodology

One key strategy we tried (and seems to have worked best) was to structure and tailor the student's learning according to their academic years (i.e. "freshmore learning" vs "senior learning"). In this way, as the student progresses, they could then engage in designing and building more complex vehicles.

Through our past discussion with the students, we found that the freshmore members typically need to feel as if they are actively contributing to the design and fabrication of an actual vehicle. However, they lacked the foundational knowledge in automotive engineering and design. As such, we decided to first conduct some lecture-based (LB) workshops for the freshmores, which focused

on the 1st principles and were not directly linked to any specific project. Concurrently, we would complement these LB workshops with project-based (PB) learning whereby they would immediately apply their knowledge and build a simple working vehicle. Hence, this mixture of LB and PB learning allowed the students to not only feel engaged but also experience designing, building and riding their very own vehicle from scratch. We found this structured learning helpful in instilling interest for the students to stay.

"Senior Learning"

As members progress into their 2nd year, we would decrease their LB workshops to only 1-2 sessions and increase the depth of the topic (e.g. CAD modelling or Computer simulations). On the other hand, most of their learning would also be project-based (PB), whereby they would be leading the design and planning of an actual EV project.

Through PB learning, not only would the students learn project-specific knowledge from their respective technical mentors; they would also get exposed to real-life constraints (e.g. budget, logistics, manpower, space) and pick up valuable soft skills like project management which can be used in their future careers after graduation.

Once the members progress into their 3rd and 4th year, it would be a 100% PB learning model. Here, these senior students would design and build of an eco-car for participation in the Shell Eco-Marathon Asia Competition. The first entry from SUTD, Codenamed E17 (for Eco-2017, see figure 1), took the team 6 months to complete, just in time to take part in the March 2017 Competition. Owing to the vehicle's complexity and many competition deliverables, we found the PB learning to be the most efficient manner to mentor, design and build the car in time for the competition.

Looking back, this structured learning model, complemented by matching each batch of student to a suitable EV project, had allowed us to grow from building 1-2 vehicles in 2016 to 3 or more vehicles in 2017! Its was also through this structured learning model that we could begin formulating our 3 main project pipelines which has now become a hallmark of the EV Club (see figure 2).

Figure 2. EV projects (before 2016 to 2017), with the 3 main pipelines

"Hands-on Training"

One thing that the EV club has always adopted since the beginning was the "hands-on" approach. This is because everything the students learn has to ultimately be applied to building a working vehicle. Hence, whether it is LB or PB learning, the "hands-on" (or applicational) aspect is always present in one form or another.

An example would be the hand sketching workshop conducted by me (see figure 3), whereby I would first introduce some the guiding principles and let the students understand the rationale behind each action. Then followed by practical or hands-on session/s with close supervision from the mentor. From my personal experience, I found that this form of "hands-on" learning more effective than a purely lecture styled teaching. As seeing the instructor execute it "live" and receiving immediate feedback during the practice sessions usually helps the students to overcome the initial fear of making mistakes. This then helps to increase their confidence to further practice and deepen their mastery of the skill later in their own time.

Extended Family

Being a 5th row club, motivating the students is a big part of the job and that may mean delivering "pep talks" to the students at the beginning of each project. However, often having a strong working relationship with the students is the key factor to the success of the project. To do so, we as mentors might have to work above and beyond our normal office hours. Take for example when we were building the E17 eco-car, just 2 days to the competition and the team found that the engine couldn't start. Without hesitation, Zhen hui and I agreed to stayed up and worked with the team till 2am (on a Sunday night) until we finally got the engine to fire up. This then sent a strong message to the team that regardless of our age and roles, we are in this together to get the car to work! This then forms a connection between mentor and students (much like an extended "family") which helped us achieve so much more than I could have imagined.

In summary, structuring the lessons in a LB and/or PB learning manner had enabled us to tailor to the different learning needs of the students at different levels. That in turn allowed the students to feel empowered to actively participate

Figure 3. Hand sketching workshop

in the EV projects, which then helped to sustain their interest. Complementing that with appropriate methods like hands-on training, we not only managed to overcome the learning gaps and limited contact time, but also broaden our breadth and depth of our projects in a few short years. Lastly, having that strong working relationship between mentors and students made it possible for the team to overcome the many unforeseen challenges which we had to face along the way.

On a personal note, I am honoured to be one of the mentors to the EV club as I get to play an active role in the student's education outside of the cohort classroom throughout their career in SUTD. That meant being able to guide the students in terms of their non-academic skills (e.g. soft skills like project management, working with resource constraints) and journey with them as they grow to become a more holistic engineering or designer after graduation. Also, getting to guide the handful of passionate students to excel and realise their true potential makes it a truly satisfying and humbling experience for me.

ABOUT THE AUTHOR

Fulin is Senior Specialist with the Office of Education and is also an instructor for the "Introduction to Design" course. He used to be a Car Designer in Fiat (Italy) before joining SUTD in 2016. Fulin is also the design mentor for the EV club.

Our Support to the SUTD Community: Value-added research and trainings

As information professionals, we acquire relevant resources and aim to equip every SUTD students and researchers with efficient and effective information searching skills. This is to enable everyone to exploit the authoritative academic resources and add value to their research reports or innovations. These skills not only aid the students and researchers in their assignments but equip them with life-long skills that will be useful in their future work life.

To support teaching and curriculum, dedicated Librarians are assigned to the Pillars and Clusters. These librarians work closely with faculty to acquire teaching resources and conduct specific trainings to the students.

Library trainings and workshops are classified into three main categories: In-Class; Workshops and Specialised Database Trainings. The content of workshops and trainings cover areas such as 'Research Skills', 'Research Strategies', 'Research Tools', 'Information Search Strategies', 'Scholarly Writing Skills', 'Authoritative Sources based on specific topics', & etc. To supplement teaching and learning, the library conducts more in-depth workshops on the various topics mentioned above.

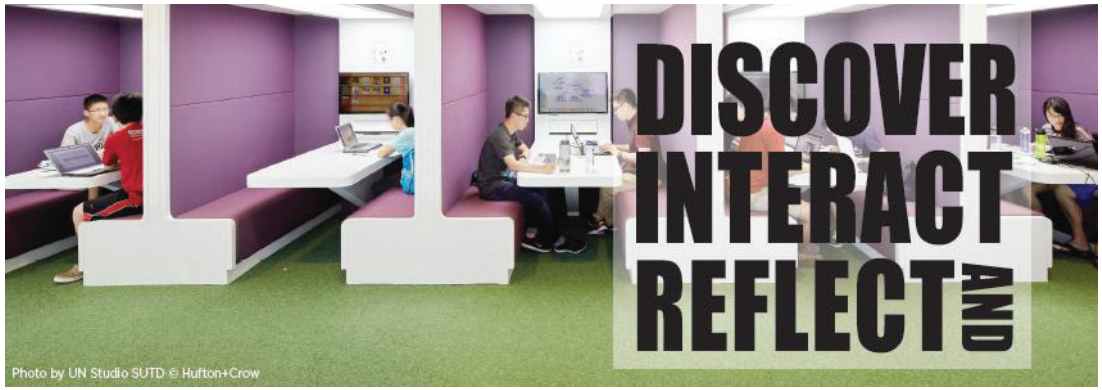
The library team provides research support to faculties and staff by conducting on demand research. To ensure the quality of our research, we work very closely with the requestor to clarify the requirements of the research area before embarking on the work. We have since seen a growing number in these requests and received positive feedback on the work done.

Besides offering just-in-time research support, the library team pro-actively curates trending and current alerts to keep our research community updated with the latest development in key research areas. These comes in the form of weekly alerts on trending topics as well as topical alerts.

The library also partners with publishers and organisations to conduct talks and workshops that offers new perspectives and insights on the research and publishing world. For example, a recent symposium on the Future of the Scholarly Book brings together publishers and academics to discuss e-books publishing and its future trends that will impact teaching and learning.

The library offers smart gadgets, writable walls, together with a variety of discussion spaces for groups to collaborate and learn. The interactive wall and tables allow sharing of initiatives and projects on a large screen. Faculties are welcomed to use the library to conduct their classes too!

With the suite of value-added services and training, the Library hopes to add value to the teaching community as well as the learning of students.



ASK Library and **LEARN** how to exploit the services and resources available for you!

Email: library@sutd.edu.sg

The SUTD library offers an innovative collaborative space for discovery and learning. Our library provides an array of technology tools and online resources to support the SUTD community in their learning and research journey.

Value-Added Research Services

Our library offers Just in Time research support by our competent and responsive team of librarians who are equipped with the knowledge and research skills. Our team pro-actively curates trending and current alerts to keep our research community updated with the latest development in their research areas.

Research Analytics

To ensure that the SUTD community keeps abreast of their standing in the research arena, our team produces research analytics reports using our online resources and provides quarterly analytics reports on SUTD research performance.

Info-Literacy Training & Talks

Our library conducts info-literacy training and workshops to equip our SUTD community with the required knowledge and skills. Our team also works closely with faculties and industry partners to organise workshops and talks to offer additional value-added programs which gives different insights and viewpoints.

Variety of Info Resources

Discover our library's collections and a rich selection of online resources through the iSearch.

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- Web of science
- Wiley Online Library

Variety of Info Resources

Our pillar librarians provide dedicated support for the pillars and clusters. We work closely to support the information and research needs of both faculties and students.

LSL SERVICES

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- 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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