EDITION /004

EDUSCAPES

AN SUTD PEDAGOGY MAGAZINE

SINGAPORE UNIVERSITY OF
TECHNOLOGY AND DESIGN

AIMS

This magazine aims to promote and celebrate teaching excellence and experience at the Singapore University of Technology and Design (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 magazine will serve as a platform for sharing pedagogical resources on technology and library tools.

ADVISOR

PEY KIN LEONG
Professor, Associate Provost
(Undergraduate Studies & SUTD Academy)

MANAGING OFFICE

As a central university lab on teaching and learning, Learning Sciences Lab (LSL) from the Office of Undergraduate Studies (UGS) plays a vital role in shaping and coordinating this magazine, 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 aims to build communities of practices in teaching and learning at SUTD - within and in collaboration with other universities. LSL is led by Dr. Nachamma Sockalingam and she serves as the chief editor of this magazine.

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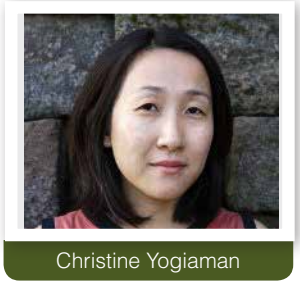
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GUIDELINES FOR SUBMISSION

WE ACCEPT A VARIETY OF ARTICLES IN THE FORM OF:

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

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

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

Different Perspectives
This would be interviews with various stakeholders or opinion pieces

Book Reviews
Review of books on pedagogical topics

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

YOUR ARTICLE SHOULD

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

Please send your articles to lsl@sutd.edu.sg

EDITOR'S NOTE

It is our great pleasure to bring you the fourth issue of **EduSCAPES: the pedagogy magazine 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 was referred as a newsletter in the initial years but we can see that it is more than a newsletter, and we felt it is more appropriate to call it a magazine. EduSCAPES brings research articles, reflections, opinion pieces, information and announcements 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 magazine for the community by the community. We thank all who have contributed to this edition.

It is a great pleasure to note that this year we have contributions from a total of 31 authors and they include undergraduate students, graduate students, staff members and faculty members from all of the various pillars and clusters, and other offices and centres. Many of the articles are authored in teams reflecting the open and collaborative teaching and learning environment at SUTD.

The theme for this year's magazine is "Digital Learning" in addressing the unprecedented and unexpected situation of COVID-19. Our lives have been disrupted, our ways of working has been changed, and there is a new norm in learning to go more digital because of COVID-19. Hence, our theme is "Digital Learning".

Digital Learning is not just merely transferring the teaching and learning materials to an online environment and calling it online or digital learning. It is transforming or redefining the learning experiences using technology in teaching and learning. This is no easy task.

We know that SUTD's signature pedagogy is multi/inter disciplinary teaching and learning using design centric projects in all of the modules. This complements the base-line of technology-enabled active learning where both teaching and learning happens in teams. This learner-centric approach ensures that our students are provided a firm foundation in disciplinary and interdisciplinary knowledge and skills, and are further equipped with the 21st Century skills like collaborative learning, critical thinking, and communicating using digital technologies etc. to be future ready.

Redefining the SUTD pedagogical model for digital learning is not straightforward. For instance, how do we make the practical sessions to be online? How can we teach design thinking and connect the learning with the real-world projects? How can we make it possible for students to collaborate online for their projects? How can we get students to deliver their projects online?

This year's magazine attempts to address such questions on redefining the SUTD pedagogy for digital learning by putting together reflections from various teams on their efforts to overcome the COVID-19 situation and this includes ongoing continual efforts to innovate teaching and learning using technology.

This transition to digital learning, particularly as a result of the COVID-19 is captured as the magazine cover. The cover portrays the various elements of digital learning such as connected and distributed teaching and learning, flipped learning, learning analytics, cloud computing, augmented/virtual reality and automated/remote work flow, and these elements of digital learning are super imposed on a picture of COVID-19 virus to signify how we have used digital learning to overcome the disruptions caused in teaching and learning by COVID-19.

Now, let us see what this newsletter covers. We have five sections this time; starting with Awards and Grants, Educational Development at SUTD, Different Perspectives; Pedagogical Reflections and Teaching Resources.

The Awards and Grants section celebrates the various achievements associated with teaching at SUTD. We can see that this has section been growing over the last 4 years, with more participation and more opportunities at SUTD, reflecting the importance that SUTD places on teaching at SUTD.

In the Educational Development at SUTD section, we bring you reflections from myself and participating faculty members on the SUTD-AHE Educational Fellowship Programme, a first of its kind professional development programme amongst the six autonomous universities which brings international professional recognition to teaching in higher education.

In the Different Perspectives section, we bring you refreshing thought pieces from our Freshmore (first year) students on redefining the university education and a second article from a research assistant on how we can use Artificial Intelligence to assess Design Education.

Following that, we bring you 10 reflections on various digital teaching and learning practices. The first eight bring you case studies of digital learning in response to COVID-19 whilst the last two shares ongoing practices in innovating teaching and learning using technology. SUTD is no stranger to digital learning, and the past year's magazines shares various other efforts to innovate teaching and learning using technology and these innovations come in handy in addressing the COVID-19 disruptions in education.

Finally, we bring you teaching resources from our SUTD Library and a call for participation in our Design Education Summit by the SUTD- MIT International Design Centre.

We hope that you find the newsletter informative, enjoyable and inspiring. This would be an annual magazine 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 your insights, reflections, findings on teaching and learning by emailing us at lsl@sutd.edu.sg.

WARMEST REGARDS
NACHAMMA SOCKALINGAM
Program Director,
Learning Sciences Lab
October 2020

AWARDS AND GRANTS

International Awards

Advance Higher Education Fellowship

The Advance Higher Education (AHE) Fellowship recognizes personal and institutional commitment to excellence in learning and teaching in global higher education and offers professional recognition in the categories of Associate Fellow, Fellow, Senior Fellow and Principal Fellow.

Learning Sciences Lab (LSL) from the Office of Undergraduate Studies (UGS) launched the SUTD-AHE Fellowship programme in 2019 whereby nominated faculty/staff members apply for the fellowship by submitting a reflective portfolio for a peer review and recognition. This is the first international professional recognition programme for educational leadership amongst the six autonomous universities in Singapore.

All of the 7 applicants from the first run were recognized with Fellowship under different categories. There are approximately 1000 Principal Fellows (120 from Australasia) and 135000 Fellows globally.

Principal Fellowship recognizes deep and rich professional experience with sustained and effective record of impact at a strategic level in relation to teaching and learning at the institutional, national and international settings.

Fellowship recognizes effective, substantive and high-quality teaching that support student learning and demonstrates a broad understanding of effective teaching and learning approaches which contribute to significant student learning and excellence in teaching.

Recognized as **Principal Fellow (PFHEA)**
First PFHEA in Singapore
Dr Nachamma Sockalingam
Programme Director
Learning Sciences Lab

Recognized as **Fellow (FHEA)**
Dr Cheah Chin Wei
Senior Lecturer
Engineering Product Development/
Science, Mathematics and Technology

Recognized as **Fellow (FHEA)**
Dr Lee Chee Huei
Senior Lecturer
Engineering Product Development/
Science, Mathematics and Technology

Recognized as **Fellow (FHEA)**
Assistant Professor Nilanjan Raghunath
Humanities, Arts and Social Sciences

Recognized as **Fellow (FHEA)**
Dr Norman Lee Tiong Seng
Senior Lecturer
Information Systems Technology and Design

Recognized as **Fellow (FHEA)**
Dr Oka Kurniawan
Senior Lecturer
Information Systems Technology and Design

Recognized as **Fellow (FHEA)**
Dr Yajuan (Julia) Zhu
Senior Lecturer
Science, Mathematics and Technology

Special Mention as EduTech Leader in Asia-Tertiary Category at the EduTech Awards 2019

Dr. Nachamma Sockalingam, Programme Director of Learning Sciences (LSL), Office of Undergraduate Studies (UGS) received a Special Mention as an EduTech Leader in Asia under the Tertiary Category at the 2019 EduTech Awards. The award selection consists of two rounds; a first round of short listing by a judging panel of professionals in the field and a second round of public voting.

The award recognizes her contributions to pedagogical developments in the field of technology-enabled learning, recaching out to over 1000 faculty members and their students over the years. This is in the areas of faculty educational development (Emergency Preparedness for Online Teaching and Learning), and EduTech projects in blended/flipped learning, learning analytics, gamification, use of robotics and simulations in teaching Programming. She has also served as a NMC-Horizon report expert panel member for 3 years, and been a committee member in organizing Singapore's National Technology Enabled Learning (NTEL) conference in 2015 and 2019, as well as organizing the SUTD Pedagogy Day over the last 4 years.

SUTD Teaching Excellence Award Winners

CHANDRIMA CHATTERJEE

Senior Lecturer
Science, Mathematics and Technology,
Outstanding Education Award 2019
Excellence in Teaching

Recognized for

Teaching a wide range of subjects within and beyond her area of expertise in the Freshmore curriculum. Dr. Chandrima's efforts have been recognized and appreciated by her students as well as her peers.

She takes on leadership roles in 1D and 2D design projects as well as in one of the courses that she teaches. Besides these, she is involved in developing and leading a new Freshmore course on sustainable development.

To innovate pedagogical strategies to facilitate student learning, she developed flipped classroom videos and designed interesting hands-on activities to increase student motivation.

SUBBURAJ KARUPPPASAMY

Assistant Professor
Engineering Product Development
Outstanding Education Award 2019
Excellence in Teaching

Recognized for

Assistant Professor Subbu is recognized for successfully conceiving, designing, developing, and launching a new senior-year elective course on design and development of innovative technology-intensive medical devices for real-life clinical needs in collaboration with local healthcare institutions and industry. This is the first of its kind of elective courses at SUTD that helps students appreciate practicality and empathy in addition to technical complexity and true immersion.

The effort resulted in students filing five patent applications, winning a MedTech device design award, and presenting four technical articles in the international biomedical conference. The team also generated revenue from industry-sponsored projects in just two runs of the course. Prof. Subbu took additional efforts to engage and involve local healthcare institutions and companies with the course and research. This effort resulted in a significant increase in students opting for the EPD healthcare track, healthcare industry internships, industry-aligned UROP projects, and increased the visibility of the track and our students which resulted in a new industry-sponsored innovative medical device design award.

MOE - TRF Grant Recipient

Fully-Integrated Gamified Virtual Reality Environment for STEM Education

Assistant Professor Cheong Kang Hao
Science, Mathematics and Technology

Assistant Professor Kang Hao was a MOE-TRF Award recipient in 2019. His proposed project entails the conceptualization and development of a gamified virtual reality (VR) and augmented reality (AR) environment for Science, Technology, Engineering and Mathematics (STEM) education. As a proof-of-concept, the focus will be on mathematics education catered towards students at an undergraduate level. For a start, we will be focusing on using these tools to aid in the teaching of calculus. The environment is to fully incorporate next-generation augmented-reality aided notes, virtual laboratory and interactive problem-based learning scenarios. This will be done via the fusion and technologizing of pre-existing teaching materials (such as books and notes) using AR and be primarily cloud based and mobile device friendly to fully leverage on learning beyond classrooms and current advancements in mobile technologies. Such a method is proposed to give students access to resources anytime, anywhere without the need of a computer – placing less emphasis on environmental boundaries and requirements for expensive hardware and software.

Pedagogy Innovation Grant Recipients

Smart Online Learning for Digital Professional Practice

PI - Teo Tee Hui (EPD/SMT)

Minds-on Hands-on pedagogy approach for effective assimilation of Physics concepts

PI -Cheah Chin Wei (EPD/SMT)

Co-PI - Tan Da Yang (SMT), Lee Chee Huei (EPD/SMT)

Smart and Fun Exploration of the Physical World

PI - Lakshminarasimhan Krishnaswamy (SMT)

Design and Development of a Virtual Reality Learning Toolkit to Study the Brain and Memory Processes in a Fun and Interactive Manner

PI - Bina Rai (SMT)

Co-PI - Jacob Chen Shihang (Game Lab)

Measuring the effectiveness of an active learning activity using NCBI BLAST1 on students' understanding of concepts in Genetics and Bioinformatics

PI - Lakshminarasimhan Krishnaswamy (SMT)

Co-PI - Yajuan (Julia) Zhu (SMT)

For more information on applying for the Pedagogy Innovation Grant, kindly contact Ms. Huang Weilin at weilin_huang@sutd.edu.sg

Calculus in Physics: Exploring Mathematics-Physics Integration in ILP2

PI - Wu Chunfeng (EPD/SMT)

Co-PI - Apple Koh(EPD/SMT), Lee Chee Huei (EPD/SMT)

AI Enabled Realtime Feedback for Instructional Video to Enhance Learning and Attention

PI - Kenny Choo (DAI/ISTD)

Co-PI - Oka Kurniawan (DAI/ISTD), Natalie Agus (ISTD), Norman Lee (ISTD)

Development of a Tool to Monitor Classroom Health Anonymously in Real Time (CHART)

PI - Khoo Xiaojuan (EPD/SMT)

Co-PI - Oka Kurniawan (ISTD)

Intentional Insight Environment

PI - Douglas Streeter Rolph (ESD)

EDUCATIONAL DEVELOPMENT AT SUTD

The SUTD- AHE Educational Fellowship Programme: Garnering International Recognition for Excellence in Higher Education Teaching for SUTD

Nachamma Sockalingam (LSL, UGS), Cheah Chin Wei (EPD/SMT), Lee Chee Huei (EPD/SMT), Nilanjan Raghunath (HASS), Norman Lee (ISTD), Oka Kurniawan (ISTD), Yajuan (Julia) Zhu (SMT), Pey Kin Leong (UGS)

Excellence in teaching and quality education is the ultimate end goal of every university. According to Elton [1], excellence in teaching is inclusive of (i) the various dimensions of teaching, (ii) continual learning and development opportunities in teaching, and (iii) recognition and rewards for teaching as well as participation in continual development in teaching, and (d) collaboration within the university beyond individual excellence.

We can see that teaching is a fundamental work process of a university, and hence needs specialised attention in terms of the learning and development opportunities and the rewards and recognition. This has been the one of the various focal points for Learning Sciences Lab (LSL) from the Office of Undergraduate Studies (UGS) at SUTD.

While there are existing development and recognition opportunities such as the SUTD Pedagogy Innovation Fund, and Teaching Excellence Awards, LSL wanted to expand this to include a broader opportunity at the international level. To this end, LSL launched Singapore's first Education Fellowship programme in 2019 to garner international recognition of excellence in higher education through Advance Higher Education from the United Kingdom.

The SUTD-AHE Educational Fellowship Programme is meant to build the leadership capability of senior and experienced faculty members in teaching [2]. This programme provides opportunities for nominated faculty members to undergo mentorship to prepare their reflective portfolio for the fellowship submission. This is the first such programme in the six autonomous universities in Singapore for an international recognition in teaching at the university level.

The first cohort of eight applicants submitted their applications at different times. At the time of writing this article, all seven who had applied for various categories of Fellowship had been successful.

SUTD faculty members Dr Cheah Chin Wei, Dr Lee Chee Huei, Assistant Professor Nilanjan Raghunath, Dr Norman Lee Tiong Seng, Dr Oka Kurniawan, and Dr Yajuan Julia Zhu received their Fellowships. Together with them, Dr. Nachamma Sockalingam, Programme Director of LSL was recognized to be the first Principal Fellow from Singapore.

In this article, Dr Nachamma from shares her thoughts on pioneering the programme, and all our four faculty members share their experience of participating in the SUTD-AHE Educational Fellowship Programme and what it has meant for them so far. These reflections were published in Advance HE's websites [3, 4].

Nacha's Reflections on Setting up this Journey

Dr Nachamma Sockalingam
Principal Fellow (PFHEA)
Programme Director
Learning Sciences Lab
Office of Undergraduate Studies

My feelings on being identified as the first Principal Fellow from Singapore

I was absolutely elated to see the email from the AHE Fellowship team that I was a Principal Fellow recently. I also learnt shortly after that I was in fact the first Principal Fellow from Singapore amongst the approximately 120 Principal Fellows from Australasia and over 135000 fellows globally.

To add to this, six other academic colleagues who went through the SUTD-AHE Educational Fellowship program at the same time had also been also recognized as Fellows. It is not that everyone who applies to AHE will get their fellowship and so I was happy to see the 100% results.

I felt that my efforts over the last two years has been well worth the effort. I see these outcomes as a beginning of a new

chapter for me, my colleagues, my university and perhaps other universities in Singapore and maybe beyond.

My journey of starting up the SUTD-AHE Fellowship Programme

So how did I get to know about AHE Fellowship and start up the SUTD-AHE Educational Fellowship Programme and apply for the Principal Fellowship?

While Advance HE Fellowship is global, the outreach in Asian countries is still in the growth stages compared to countries like the United Kingdom. This is understandable as Fellowships are not the typical pre-requisites to teaching in higher education in Asian countries. Most Asian universities use other metrics and pre-requisites. But this is changing now. More and more universities are seeing the value of the professional development in teaching and professional recognitions such as the AHE Fellowships in contributing to the quality of education.

Having been an educational developer for over 16 years in Singapore, and having started up two Teaching and Learning Centres, and introducing Scholarship of Teaching and Learning (SOTL) in three universities, I realized that more could be done to recognize and reward faculty and staff members for their involvement in SOTL and continual professional development efforts in teaching and learning.

While there were existing schemes of recognitions such as grants and teaching excellence awards, these were primarily at the institutional or national levels, and were typically only available to faculty members. These may not include staff members who support faculty members in higher education, and I felt that this group should also be included for quality educational practices.

As the founding Programme Director of Learning Sciences Lab (LSL), Office of Undergraduate Studies (UGS) at SUTD, my responsibility is to take care of the educational development needs of faculty members. So I wanted to identify an international and prestigious recognition scheme that will add value to our faculty members with a scope for sustainability and scalability.

I started researching on suitable initiatives and identified Advance Higher Education Fellowship in 2017 to be the most inclusive and rigorous since it caters to instructors, teaching assistants, staff etc. and is based on a sound teaching and learning framework which aligned with our institution's philosophy.

I invited local universities in 2018 to collaborate on establishing a joint national level AHE fellowship through several meetings and discussions. While other universities were keen, we could not launch this as a national initiative. But these discussions and colleagues have played a part in our journey. You can read more on this here: https://sutdlsl.wordpress.com/2018/07/31/being-an-educational-developer-and-building-the-community-in-singapore/.

I continued to engage the multi-level stakeholders at SUTD and we went through "Invitation to Quote" for the Educational Fellowship Programme and the team found AHE to be the most suitable amongst various applicants.

I was recognized in 2019 as one of the 9 inaugural International Fellows by the International Society for Scholarship of Teaching and Learning (ISSOTL) and this achievement helped in boosting the awareness on Fellowships as international recognitions of teaching quality, and my university was willing to support the AHE programme at the university level. This programme got the approval from our Associate Provost for Undergraduate Studies, Professor Pey Kin Leong and HR Director, Dr. Jaclyn Lee.

Thus, SUTD became the first autonomous university in Singapore to launch this Educational Leadership Programme at the university level. You can find more information on Educational Development in Singapore and at SUTD here: https://www.sutd.edu.sg/SUTD/media/SUTD/Eduscapes-2019.pdf (page 28).

In 2019, I had applied for the ISSOTL Fellowship to understand more on the fellowship procedures and to be familiar with reflective portfolio preparation so that I can support my colleagues. This was professionally developing myself to support others.

On a similar note, I attempted the AHE Principal Fellowship application for the reason I will be facilitating the SUTD-AHE programme, and hence felt that it will be good to have the credential and be knowledgeable on the application preparation etc.

This SUTD-AHE programme is meant to build the leadership capability of senior and experienced faculty members in teaching. This programme provides opportunities for nominated faculty members to undergo mentorship to prepare their reflective portfolio for the fellowship submission by working with me and in peer groups.

The recognized Fellows will in turn will work with me at Learning Sciences Lab to mentor other faculty members at SUTD in teaching. Our aim is to expand to teaching assistants and also staff members in future.

As we know, chartering new waters and pioneering is not easy. But once that "4 minute barrier" is broken, it becomes more possible for all. My hope is that more universities in Asia will also be keen to initiate such an educational fellowship program as it would add value.

Next steps

I feel that the value of the Fellowships is in providing an opportunity for continual development. Water that is stagnant will only become putrid. The value of the SUTD-AHE Fellowship program is not about the one certificate but in providing multiple opportunities to continually develop through the various categories of Fellowships.

Also, the value created is multiplied when implemented at the institutional level, rather than at just the individual level as it leads to a community of practitioners. This will benefit the teachers, learners, university and the society at large by contributing to quality education.

We look forward to expanding on this work and continual learning.

Reflections from Faculty Members on Participating in this Journey

Dr Cheah Chin Wei
Fellow (FHEA)
Senior Lecturer
Engineering Product Development/
Science, Mathematics and Technology

Dr Cheah Chin Wei joined SUTD in 2011, and has been teaching Physics 1 - Classical Mechanics, Physics 2 - Electricity and Magnetism, and Microelectronic Devices and Circuits. He is passionate in teaching and like to work with students closely to enhance learning experience in the courses.

Initially when I was told of the opportunity to apply for Fellowship, I was excited but was also very concerned over the potential time and effort needed that could be difficult to commit amidst the heavy teaching duties. It is not easy to recall and review systematically work over many years, and identify the relevant evidence related to the work. However, after the application process started, I found the experience of doing the Fellowship very good and smooth as plenty of assistance and support was provided by Learning Sciences Lab (LSL).

A very useful workshop was also organized at the early stage of the process which provided valuable learning opportunity for me to be aware of the important knowledge and values that an instructor should possess and focus on. The awareness gave me a good understanding of the framework needed in the application process and makes it easier to focus on the required essay writing.

The writing compelled me to put my journey of teaching professional development over the years in perspective in a systematic way through plenty of reflections. The reflection efforts allowed me to realise how the various techniques that I am applying in teaching today have been developed through years of trial and error, and mistakes made in the past. It is a revision of my teaching and professional development journey, it is also a renewed reminder of the core belief of my teaching philosophy and values. Such experience puts the results I have obtained so far on a firmer footing, so it could serve as a solid foundation for further professional development.

I would advise future applicants for the fellowship to attend the workshop organized by LSL, and also work closely with LSL on the review process.

Applicants need to be patient when working on the written submission, as several iterations are necessary for a coherent and comprehensive account of the professional teaching experience accumulated over the years. In fact, if one decided to apply for the Fellowship, it would be helpful for the applicant to start organising one's work and related evidence systematically with regular reflections.

I found this experience valuable to me, and it also helps me understand the work required for the next stage of my teaching career. There is now a clearer goal of what to work on in terms of continuous professional development, such as developing useful teaching techniques that could have more positive impact on students' learning outcomes in STEM subjects. It is also important to be able to fully develop the ideas so it could positively influence in the field in order to benefit teachers and students on a larger scale.

Dr Lee Chee Huei
Fellow (FHEA)
Senior Lecturer
Engineering Product Development/
Science, Mathematics and Technology

Dr Chee Huei is one of the pioneer teaching faculty member in SUTD. He teaches several first-year subjects, including Physics 1 - Classical Mechanic, Physics 2 - Introduction to Electromagnetism, Engineering in the Physical World (Thermodynamics), as well as Circuit and Electronic in sophomore year. He has won several SUTD Pedagogy Innovation grants and is also an SUTD Teaching excellence award winner.

It is my great pleasure to participate in the AHE Fellowship application. Despite many years of teaching practice and multiple pedagogical initiatives, I seldom sit back and do a holistic and systematic reflection. The workshops and fellowship application have given me an opportunity to review my practice as an educator from multiple aspects.

The application provided me a structural framework of education standards, including content/learning activities development, teaching practice, assessment/giving feedback to students, creating effective learning environment, as well as own professional development/scholarly activities. Through the writing process, I was tasked to consolidate evidences of my effort in teaching and learning. I was reminded that continuous improvement, as part of the professional development, is critical.

It was not straightforward to write up my teaching portfolio. I had spent time in self-reflection of my own practice. Education is not just about information transfer of a subject matter, but also cultivation of personality and positive mindset. I gained further insights in ways of improvement through innovation. It was also sometimes challenging for me to complete the writing task in timely manner, especially there were multiple commitments to be accomplished simultaneously. Thus, self-discipline and good time management are important.

It is an honour to be recognized for quality teaching. I am aware that the fellowship is not the accomplishment, but a reminder for further advancement in teaching and education innovation. I am thankful for the support from Office of Undergraduate Studies - Learning Sciences Lab (Dr Nacha) and Office of Human Resource, Singapore University of Technology and Design. It was a wonderful and fruitful learning journey.

Assistant Professor
Nilanjan Raghunath
Fellow (FHEA)
Humanities, Arts and Social Sciences

Assistant Professor Nilanjan teaches Digital Sociology, Gender Sexuality and Society, Shaping Futures and Sociology of Social Networks and Social Capital and has a Teaching certificate from Harvard Derek Bok Learning Centre. She is also an SUTD teaching excellence award winner.

The Advance HE Fellowship experience was pedagogically enriching, as it encouraged me to deep think how I teach and interact with students and enable them in active learning for sociology.

One of the noteworthy features of this Fellowship process was the brainstorming through workshops by LSL that were held prior to the formal application.

We were able to get together with colleagues and share our ideas on things such as peer to peer learning and theories on pedagogy in a focused and collaborative manner. The other unique feature is the interdisciplinary education at SUTD, which helped this Fellowship process immensely.

I was encouraged by exchanging ideas with people from other disciplines such as Mathematics, Sciences, Engineering and Design related fields. Much of the writing involved research and reflection with ample feedback to develop a concise yet detailed portfolio, which was divided into various themes ranging from our contributions to continuous learning journeys.

I was able to provide my achievements in detail, categorize them and think through things such as building rapport with students and how I helped my students to become passionate learners. This was reflected in the student feedback I have received over the years.

The Fellowship process inspired me to get a teaching certificate from the Harvard Derek Bok Centre. Overall, I feel that teaching is an ongoing process for research and reflection, and I plan to include many of the ideas learnt to create new tools for online and blended learning in sociology and a possible research grant.

For future faculty who wish to apply to this Fellowship, it is good for them to keep a log of their everyday teaching practices, student reactions, achievements, challenges and their responses as educators. They could also use this to publish pedagogical papers due to the reflective research process. Furthermore, this Fellowship will help them put their best practices forward, develop new ones and move above and beyond their personal goals as teachers.

Dr Norman Lee
Fellow (FHEA)
Senior Lecturer
Information Systems Technology and Design

Dr. Norman currently teaches programming at SUTD, in particular, Python and Android programming (using Java). Norman is involved in several educational research projects using data analytics.

The Advance HE Fellowship application was a great way to take stock of what I have done in my teaching career. I am really grateful for this opportunity to reflect on my teaching practice and to see how it can be taken further in future.

Initially, I thought I would just be writing about pedagogies that I have used, e.g. clicker questions. However, as the process of reflection and writing began, I found that it covered all aspects of teaching, from interacting with students to what I did for professional development.

With the excellent advice and feedback given to me during the writing process by Learning Sciences Lab (LSL), I managed to overcome my initial difficulties in writing the portfolio in a clear and concise manner.

I would really recommend all faculty members with the ability and love for teaching to apply for this fellowship.

If you are submitting, it is good to spend some time reflecting on your teaching practice and writing down as much as you can. Even the seemingly insignificant aspects of what you have done can become a good part of your portfolio. Then, just start writing, and seek feedback when it is done! It can always be edited and revised later on.

Dr Oka Kurniawan
Fellow (FHEA)
Senior Lecturer
Information Systems Technology and Design

Dr. Oka has been leading the largest Introductory Programming Course at SUTD from the year 2015 till 2020. He is an SUTD Teaching Excellence Award winner and is involved in various innovative active learning pedagogies to teach programming.

I really appreciate the experience guided by Learning Science Lab (LSL) and particularly Dr Nacha in helping me to obtain the Fellowship. What I like most is the community journey instead of individual effort in getting the fellowship. We had a few workshops that helped me to reflect on my teaching practices.

In the beginning, the framework was rather overwhelming. Nevertheless, the guide from Dr Nacha, the discussion among fellow faculty members, and the activities done during the workshop helped me to see how actually all those components have been present in my teaching practices.

Digging up my memory and recognising that those activities fulfil the Advance HE framework truly helped me to realise how my teaching journey has been. It also gives me a framework on the areas that I continue to work on in the future in my teaching career.

Writing the submission was truly a challenge as I need to find time to write each entry and revise it several times amidst my other work commitment and teachings. However, it turned out to be a worthwhile effort and time well spent. I really appreciated the internal feedback given by LSL as well as by AdvanceHE reviewer which really helped me to improve my submission.

I would like to recommend this Fellowship to my faculty colleagues at SUTD as I am aware that many of them have a similar or even more experiences than me. I would say it is a worthwhile experience to reflect and to be recognized for our teaching work. This is even more true for those who are in the teaching track where their main duty is teaching.

Dr Yajuan (Julia) Zhu
Fellow (FHEA)
Senior Lecturer
Science, Mathematics and Technology

Dr. Julia teaches various modules such as Science for Sustainable World, Science and Technology for Healthcare, and Global Health Technology. She is is interested in pedagogical research which promotes active learning in students. She has multiple research grants which focus on developing multidisciplinary curriculum and innovative pedagogy tools in flipped classroom, visual laboratory, and gamified laboratory.

The application of AHE Educational Fellowship is quite a rewarding journey. It is very different from a traditional teaching statement. The application template is drafted according to five areas of teaching activities: (i) Design and plan learning activities and/or programmes of study, (ii) Teach and/or support learning, (iii) Assess and give feedback to learners, (iv) Develop effective learning environments and approaches to student support and guidance and (v) Engage in continuing professional development in subjects/disciplines and their pedagogy, incorporating research, scholarship and the evaluation of professional practices.

As an applicant, I needed to provide evidences that I had successful engagement across all five areas and demonstrate that my practice meets the UK professional standards framework for teaching and supporting learning in higher education.

I really like this semi-structured approach as it encouraged me to reflect on various aspects of my teaching rather than focusing on my strength. It stretched my mind and motivated me to go beyond my comfortable zone. By comparing my own practice with the criteria listed in the framework, I was able to self-evaluate and identified the areas for improvement.

In my application, I included aspects that have worked for me and those which had not in my teaching practice and elaborated on what I have learned from these experiences to expand my teaching skills. Putting these thoughts down on paper helped me formulate a clear record of past progress and a roadmap for the future.

Completing the whole application package is not an easy job, but it is definitely worth it. Dr Nacha from Learning Sciences Lab has provided tremendous helps along the way, from webinars, to workshops, to paring applicants for discussion. I especially enjoyed the discussion with other applicants which helped me learn from other colleagues. This inspired many new ideas!

I think the journey of this application itself is more valuable than getting the final fellowship. If you are keen on continual professional development, I would highly recommend you the SUTD-AHE Educational Fellowship Programme.

Conclusion

While it is too early in this journey to measure the long term and sustainable impact of the programme at the university level, the SUTD-AHE programme has certainly created avenues for faculty members (and potentially others) to continually develop themselves in higher education and achieve an international recognition. The reflective efforts at the individual level leads to self-development while the cohort-based implementation allows for community building efforts.

The SUTD-AHE programme also weaves in the various exiting existing faculty educational development initiatives offered by the Office of Undergraduate Studies (e.g., Scholarship of Teaching and Learning, Pedagogy Innovation Fund, LSL Pedagogy Seminars, SUTD Pedagogy Day, SUTD Pedagogy Magazine EduSCAPES) to encourage scholarly teaching that is evidence-based and reflective. This allows of improvements in teaching practices, which is often reflected in learning outcomes.

The rigorous preparation for the fellowship feeds into redefining the curriculum, teaching, assessing, and reviewing therefore is expected to lead to a better quality of teaching and learning. As in any evaluation process, it is always a good to use a mutlti-pronged approach and the SUTD-AHE programme and outcomes offer one such indicator of the quality higher education at SUTD. Our students and stakeholders can be assured that SUTD focuses on quality teaching in addition to research. Our faculty members are encouraged to continually pursue innovations and developments in their teaching practices.

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DIFFERENT PERSPECTIVES

The Alternative University Experience

Joseph Low and Tan Jia Yue (Freshmore students)

Over the past decade or so, there has been a rise in compelling alternatives, as well as reasons to avoid pursuing the path of traditional university education. In a technology-enabled and skills-based era, many companies have begun hiring for portfolio, soft skills and demonstrated ability rather than accredited certificates that a degree grants. A quality education can now be attained online and not having a degree no longer puts us at a significant disadvantage in charting successful career paths.

With the shift to an online curriculum in recent months by universities, many have begun to question the value that universities provide. Especially when the learning experience is no different from that of online courses. As lecturers scramble to adapt their curriculum to a digital medium, some might even go further to argue that the remote learning experience that universities provide are inherently worse than online courses, which were optimised for that from the very start.

This article highlights relevant examples from the EdTech world to inspire pedagogy improvements to create better learning experiences.

How might we improve the traditional university experience?

Let us face it. Online collaboration is difficult. Everyone is attempting to provide ideas for online teaching and learning but the implementation is a lot tougher.

We are often criticised for being sluggish in updating the curriculum. How might we keep quality education accessible, and ensure the curriculum is kept up-to-date in preparing students for an ever-changing world when teaching online?

We have given online grading and assessment a disproportionate amount of attention during this period, in a scramble to come up with systems that prevent students from cheating. How might we rework the traditional concept of grades while ensuring the integrity of the degree?

We have resources to tap on, to even create our own learning platforms. How might we design a learning experience that is adaptable for different use cases in physical, blended and fully-remote scenarios?

We have a large network with other educational institutions and overseas exchanges and visits need not be the first touch-point that our students need to have for a wider exposure. How might we provide a more diverse university experience through remote collaboration?

An accessible education with innovative funding methods

With the issue of student loan debts coming to the public spotlight and the criticism of the Higher Education curricula for not adequately preparing students for an increasingly uncertain world, the general public has turned their eyes towards the private sector to provide more innovative solutions.

A compelling alternative to conventional university computer science courses that has come to light in recent years are Online Trade Schools. First pioneered by Lambda School in 2017, they are akin to online coding bootcamps, but run on income-share agreements (ISAs). Being run on ISAs means that students do not have to pay any upfront fees to these schools. Instead, when they land a job upon graduation, a percentage of their income goes to the school, up to a certain cap. If students are not able to land a job or land a job that has a yearly wage below a certain amount, they do not have to pay anything until they find a qualifying job or until the ISA expires. This increases the accessibility of education and allows any student, regardless of financial background, to attain a quality education without incurring debt.

Furthermore, it is likely that the institution's financial incentives are aligned with the students' interests. As these schools do not earn a financial return should the students not land jobs, the quality of education provided must be hyper relevant to suit a constantly changing job market. This would likely increase the chances of launching a students' career.

An efficient education with new ways of assessment

Traditionally, grades have been used as an indicator by schools and firms as a blunt indicator of their level of competency. In recent years, we are trending towards the attempt to reduce the emphasis that students in Singapore place on grades. From the removal of the PSLE T-Score from 2021, to the holistic admissions that universities claim to adopt, or even firms themselves proudly announcing the removal of formal educational qualifications as a requirement in their hiring processes. However, without alternative evaluation measures to replace grades, we will not solve the underlying problem.

Let us look at some examples that eliminate traditional assessment to improve the efficiency of learning. Instead of going through a 12-week module and only knowing at the end whether you are required to retake the module the next semester, Lambda School provides a 'grade' at the end of each week. Students who do not pass the weekly learning sprints, simply retake it the next week. This was done to allow students to learn at their own pace and learn in a way that ensures mastery of each topic. Furthermore, as students receive feedback on their performance throughout the course, the shorter iterative feedback loop allows them to better gauge their abilities and see where they need to place their emphasis on.

Without grades as a barometer, other alternative evaluation measures are more actively sought. For measuring hard skills, industry-relevant portfolios, especially for technical-heavy trades has been widely used. General Assembly, an educational institution, focuses on exactly that, with their 3-6 month intensive boot camps in subjects such as Coding, User Experience (UX) design or Marketing. Projects undertaken by their students are contributed by industries with existing pertinent problems and students graduate from the course with a portfolio of solutions that were used to solve real-world problems. The curriculum focuses on how to make applied learning efficient and effective for students, through a focused

course of learning. This has benefits for those who are seeking a mid-career change as well.

For measuring soft skills, we are seeing more interview rubrics factoring in students' interests, from participation in hackathons, co-curricular activities or even their personal passions. Some start-ups have taken it a step further by using data analytics to codify soft skills. For example, Skilio, a local EdTech start-up empowers organisations to track soft skill development by providing a better alternative to traditional paper qualifications, by placing metrics on what we deem as intangible skills. We hope that educational institutions should be preparing their students through providing more responsive feedback to one's development. At the same time prepare students with more industry-relevant applied learning consistently.

An education that is more collaborative and diverse

We were part of the Special Summer Programme (SSP) for physics and realised that even though SUTD was able to transit to remote learning, good remote collaboration was still significantly lacking. Zoom breakout rooms were still rather awkward, while any further discussion out of class was done on communication platforms such as Telegram or Discord. These platforms may have met the need to communicate, but they were ground-up student initiatives that could have been improved significantly if the school had set up a platform more intentionally from the beginning, for better remote collaboration, discussion and knowledge management.

Educational institutions serve as places where like-minded individuals can work on problems together. But now when challenged to bring the collaborative learning online, many of them fall behind. We highlight an example we can learn from: Minerva Project. Minerva Schools has developed their own in-house online collaboration platform called Forum, which is a real-time learning environment, as part of their Minerva Project. It is similar to Zoom, but with far more capabilities to encourage collaboration such as forming teams within seminars to participate in live competitions, progress monitoring for the educators to ensure productive breakout room sessions and it is in an all-in-one interface which leads to a more immersive learning experience.

When the experience is entirely remote, students from vastly different backgrounds can easily come together to learn, contributing to more diversity of thought, and giving students more exposure to people from all walks of life. Minerva Schools takes diversity a step further, their 4-year course is designed exactly for the purpose of giving students a real-world exposure to different cultures. Through their Forum platform, significant cost savings can be achieved. Minerva students are able to redirect funds to a rather unique, 'learning while travelling' experience, where they learn through online platforms, but work with their classmates in the physical world.

> ***"Education is not the filling of a pail, but the lighting of a fire"***
>
> ***– W.B. Yeats***

Conclusion

Practice oriented pedagogy is always more valuable than just the theory. In the same way that SUTD utilises the lens of human-centred design to enable technology of the future, this same lens should be used with the principles of pedagogy and instructional design to design the education of the future. We should strive to create an open dialogue between institution, educator and student to understand their pain points and needs, and continually experiment with the latest pedagogies and technological tools available, to develop the best learning experience to prepare students for the future.

Assessment in Design Education: The Potential of Artificial Intelligence

Sumbul Khan (SUTD-MIT IDC) and Lucienne Blessing (SUTD-MIT IDC)

Design Education at SUTD

Design is one of the most powerful forces in the world day, impacting humans in all spheres of life and experience, in technology, products, industry, both real and virtual. Design challenges students to find answers to common and to wicked problems and fosters students' ability to act as agents of change. Design education is considered significant to equip students with the skills to address societal and global challenges. It develops students' creative confidence by engaging them in hands-on projects that focus on building empathy, promoting a bias toward action, encouraging ideation, and fostering active problem solving. Design is centric in SUTD's curriculum, for each student, each class, and each term; and across subjects, disciplines and years. One of the important challenges for faculty members in design projects is assessment.

Assessment in Design Education

Assessment is a key component of education as it tells how well students are learning and provides necessary feedback to students and instructors. Especially, students about to enter the professional world need an indication of their competency levels against standards.

Due to the varied nature of the individual or team processes, concepts and solution, assessing students' learning in creative disciplines such as design is a challenge. In Design, the fluidity in process and variety of possible solutions does not lend itself easily to measurable outcomes. Conventionally, students in design courses are assessed through labour-intensive and time-consuming examination of intermediate and final project artefacts including individual journals, prototypes, and reports, relying on rubrics, assessment criteria and discussions. For larger cohorts of students, these conventional methods, necessitate multiple assessors and introduces a potential inconsistency in the assessment due to the required interpretation of the rubrics to the particular project (Table 1). Thus, there is a critical need to develop efficient and effective assessment measures to evaluate students' design learning. One approach is to use Artificial Intelligence (AI).

How can we assess better using AI?

AI based methods can potentially reduce the complexity and subjective nature of assessment in design education. AI based methods can support assessment in Design Education in primarily two ways:

⟺	**Equivalence of design problems**	Students in a cohort may be working on different problem statements.
?	**In-defined problem**	Students define their own problems and establish their own criteria and constraints, thus, allowing many possible routes to success.
	**Assess product or process?**	To evaluate the quality of the products designed or to assess the design process that resulted in the products?
	**Complexity of design process**	Design to be a complex process whereby the solutions to design problems emerge from continual idea generation and improvement.
	**Perceived fairness**	Perceived fairness may be lower when there are multiple assessors
	**Validity & accuracy of assessment**	Grading might be done over a period of several days and in different contexts; Multiple instructors may be evaluating student work
	**Complexity of teamwork**	How to assess individual students working on design projects in teams?
	**Assignment of a single score for a complex subject**	A single score hides the strengths and weaknesses of an individual and does not keep track of how each student is doing in various aspects of the course.

Table 1. Summary of challenges in Design Education Assessment

(i) Use of pattern recognition & analysis: Using machine learning and data mining to analyse patterns from the behaviour of students, latent variables can be identified that predict the efficacy of different instructional techniques for specific individuals. Similar techniques may connect struggling students with appropriate tutors and recommend which issues deserve immediate attention. An example of using AI for assessment is the use of Automated Essay Scoring algorithms, that are trained using engineered features to predict how humans score essays.

(ii) Supporting human judgment: For instance, in massive open online courses, students work is often evaluated by peer-assessment, where students grade each other's work. Such peer assessment is supported by evidence that when guided by a clear rubric, peer-assessment has extremely high correlation with teacher assigned grades. Learning algorithms, in conjunction with peer assessment, offer benefits by tracking students abilities to answer questions, modelling their skill at grading the answers of others, and routing grading jobs to the right student [1]. Similarly, studies have utilized crowdsourcing and engaging experts for crowdsourcing tasks for assessment in creative fields [2].

Previous research has also investigated computer assisted rubrics, which employ database technology to store and retrieve a comprehensive set of constructed comments and feedback. Students can use the feedback to improve upon their work, thus enhancing perceptions of grading fairness and overall satisfaction with their course [3].

Studies have investigated systematic e-assessment of competencies as well as competence based visual analytics and recommender systems for various education disciplines [4]. An example of computer assisted assessment of skills in open-ended problems is the Collegiate Learning Assessment (CLA) that allows the assessment of skills such as analytic reasoning and problem solving [5].

Conclusion

Assessing design learning is a complex and laborious task. There is a critical need to develop new methods of assessing design learning that are efficient and effective. There is a greater need for research in both design process, its relationship with acquired skills and competencies, as well as how to efficiently and effectively assess these to inform students about their specific learning needs and assists instructors in determining gaps in learning. There is a great potential to investigate AI based methods to drive efficiency, personalization and streamlining of assessment tasks to support human judgement in design education.

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REFLECTIONS

Online Lessons via Video Conferencing- Zoom versus Microsoft Teams

Mei Xuan TAN (SMT)

Figure 1. Screenshots of synchronous online lessons on Zoom (left) and Microsoft Teams (right)

Introduction

With home-based learning (HBL) implemented due to the COVID-19 situation, remote learning was conducted for all lessons at SUTD from April 2020 to June 2020. Various formats of online learning were adopted. Some courses had recorded lecture videos, some had synchronous, 'live' online lessons through video conferencing platforms, while others adopted a blended approach of both recorded videos and online synchronous lessons.

In this article, I would like to compare specifically the use of Zoom and Microsoft Teams for video conferencing during online lessons through my personal experience of using both platforms for different courses. Zoom was used to conduct lessons (Figure 1) for Integrated Learning Programme (ILP) 2 Math/ Physics course, which consisted of daily 4-hour lessons with 50 students. Microsoft Teams was used to conduct weekly 2-hour lessons for the three cohort classes that I taught for 10.008 Engineering for the Physical World.

Online Lessons using Video Conferencing Tools

With HBL, one of the teaching formats taken up by instructors included synchronous online lessons because it allowed for real-time interaction between the instructors and students through a virtual classroom setting. A platform that allowed video conferencing and screen sharing would fulfill the basic requirements for online lessons to be carried out. In this aspect, both Zoom and Microsoft Teams met these requirements. Both allowed for video or voice conferencing with many participants. Screen sharing, whiteboard and chat functions were also available. Sessions could also be recorded for students to view later.

The main difference for video conferencing between the two would be the security settings and privacy issues. Since the start of HBL and Work from Home (WFH) around the globe, with the daily participants of Zoom increasing 30-folds since December last year [1], there were several reports on "zoom bombing", where uninvited people joined and disrupted the online meeting [2]. Even on the first day of compulsory HBL for schools in Singapore, there was a reported case of zoom bombing during a Secondary School online lesson [3, 4]. Zoom has since worked on additional security features to include password, waiting rooms and host permissions to share screen [2, 5].

Microsoft Teams, on the other hand, requires login from a registered work, school or Microsoft account [6]. Within Microsoft Teams, the instructor could create a team and students were added to the team through their institution's registered email address. Only team members added to the team could have access to the activities taking place within that team, and this included the video conference meetings set up within the team. There has been little to no security concerns over Microsoft Teams, even as the numbers of users increased 70% from 44 million to 75 million daily active users in a single month from March to April this year [7].

Engaging the Students

The main challenges during lessons included engaging the students and reviewing their understanding from time to time. Zoom added a feature called Poll that allowed polling of participants. This appeared as a pop-up window for participants to answer the question during the online session (Figure 2, left). For Microsoft Teams, Microsoft Forms could be used to create polls in the meeting chat (Figure 2, right). Microsoft Teams also has various third-party apps that could be used in the chat. This included creating polls and surveys in the chat through apps like Polly and Survey Monkey. The chat function was also often used for students to pose questions. Zoom allowed a chat message to be sent to 'everyone' or to the 'host' only. Thus, students could choose to send questions to the whole class or just to the instructor. Other platforms of engaging the students such as the use of real-time quizzes through ClassPoint, Slido, Learning Catalytics and Kahoot! were used via the share screen option in both Zoom and Microsoft Teams.

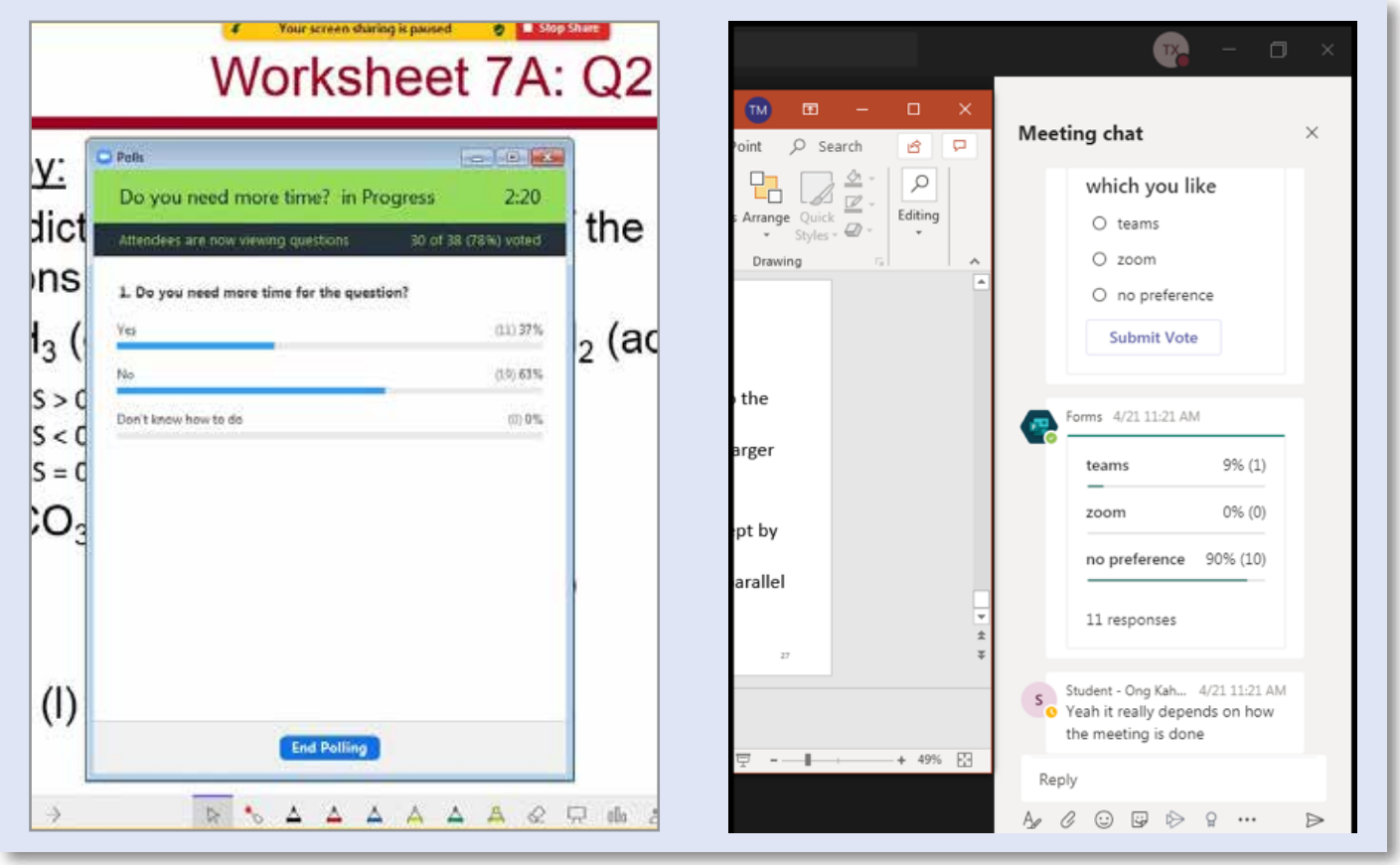

Figure 2. Polls can be used to interact and engage the students with quizzes and prompts throughout the online lesson. Poll used in Zoom (left) to get students' feedback during an ILP class and Microsoft Teams (right) as a polling survey in 10.008 Engineering in the Physical World

Additional Features

So far, the basic requirements for video conferencing and online interaction have been compared between Zoom and Microsoft Teams. However, I have yet to comment about the biggest difference between the two. That is, Zoom was purely a web conferencing platform, whereas Microsoft Teams was built as a multifunctional collaboration tool with various features good enough to form a basic Learning Management System (LMS) on its own [8]. See Table 1.

With Zoom, each session is a one-off meeting with a link and password. Any interaction before or after the Zoom meeting had to be done using other platforms such as communication through emails or sharing of documents and assignments through our university's LMS.

With Microsoft Teams, in each created team, there is a channel for all participants to post messages, polls and schedule meetings. After each meeting or synchronous lesson, the meeting chat and any whiteboard annotations could be easily retrieved from the channel. Instructors could also upload files, assignments and homework. There are also shared virtual spaces such as notebooks. There is a private chat function in Microsoft Teams, where you could send personal messages to anyone in your organisation using Microsoft Teams. This feature allowed students a more informal platform (compared to emails) to ask the instructors any questions at any time. Over 250 third party apps could also be used. In short, Microsoft Teams has the potential to expand beyond online meetings to facilitate real-time collaborations in the digitalised world [8]. For example, user statistics and average assignment scores can be monitored through data visualisation apps such as Power BI dashboard in Microsoft Teams. Such information would be useful for students to track their performance. Microsoft Teams also worked with University of New South Wales (UNSW), Sydney, to develop QBot, a bot that uses artificial intelligence (AI) to answer students' questions automatically in Microsoft Teams [9]. This would be particularly useful for classes with large number of students.

Feature	ZOOM	Microsoft TEAMS
Function	Web conferencing software	Team collaboration tool
Security and Privacy	End-to-end encryption for paid accounts only [5]	Organization-wide and team-wide two-factor authentication with single sign-on, encryption for all data [6]
Ease of use	User friendly, easy to use without training	Various functions and tools, will need training to fully utilize its functions
Interaction amongst users	Use of chat and poll during online meeting	During online meeting: chat, poll, survey Before or after online meeting: personal chat, team chat, collaboration spaces
Additional Features*	• Breakout room feature to form small discussion groups amongst students • Webinar feature for seminar and events	• Assignments, gradebooks, notebooks • Stream recorded videos • Use over 250 third party apps such as Turnitin, Survey Monkey, Power BI
Recommendations	If you need a simple, easy-to-use web conference tool to facilitate your online synchronous lessons and have other robust LMS platform for after-class discussions, sharing of documents and uploading of assignments.	If you are meeting the same group of students regularly and like to have continuous engagement and interaction outside of lesson time, it would be good to set up a team and use it as a collaboration tool on top of the video conferencing function in Microsoft Teams.

Table 1. Comparing Zoom vs Microsoft Teams

**Zoom and Microsoft Teams have been continuing to improve their additional features. Information in Table 1 is accurate at point of writing.*

Students' Experiences

A quick survey at the end of one of my 10.008 Engineering for the Physical World classes showed that 90% of students have no preference over Zoom or Microsoft Teams (Figure 3). Most agree that the delivery of the lesson is more important than the platform that was used. This finding aligns with the recommendations by SUTD's Learning Sciences Lab that the choice of technology tools for teaching and learning depends on the tool's "Fitness of purpose" [10]. However, based on the survey and students' comments, there seems to be a slight preference over Microsoft Teams because unlike Zoom, there is no need for email link to join the meeting.

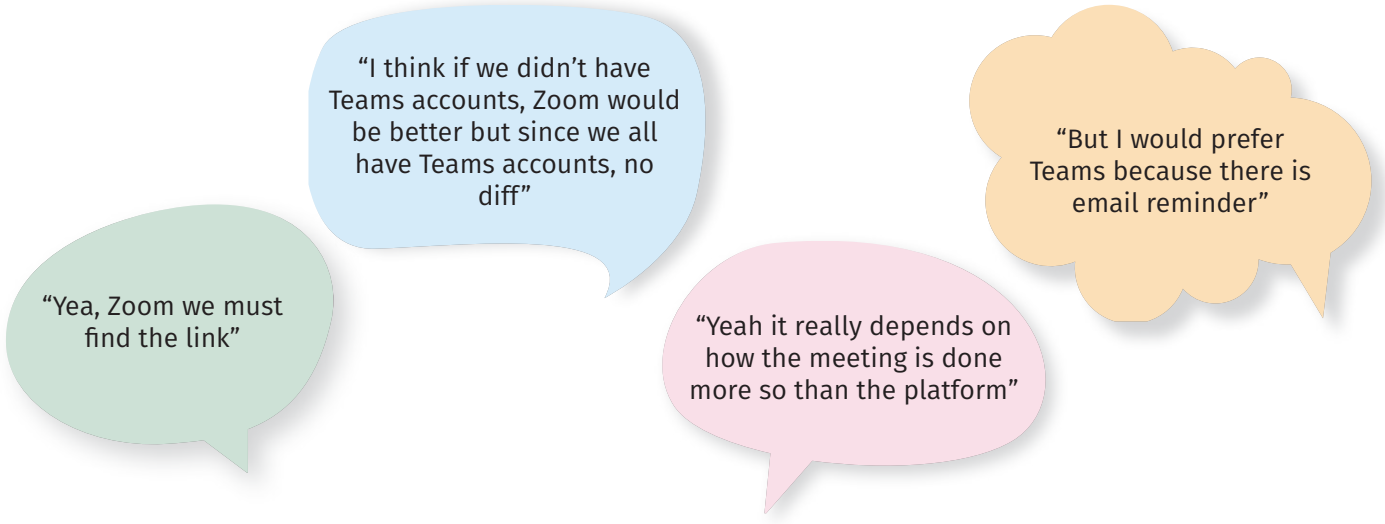

Figure 3. Students' comments on their preference between Zoom and Microsoft Teams

Conclusion

Zoom and Microsoft Teams provided the basic requirements for online lessons. These included video conferencing, screen sharing, chats and polls. The biggest difference between the two is that Zoom is purely a web conferencing tool, whereas Microsoft Teams is a collaboration tool that has functions comparable to an LMS. There are other video conferencing platforms such as Google Meet and Skype. However, I did not have the chance to use them for teaching in the Spring term. As we continue to explore online teaching and planning for the digital future, it would be good to make a well-informed decision on the suitable online platforms to adopt for your own course when teaching, so that students can have a better learning experience. More technology resources for online learning can be found at the SUTD's Emergency Preparedness for Teaching and Learning (EPTL) website [11].

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Redesigning Cohort-Based, Hands-on Learning to Effective Remote Learning in Teaching Physical World

Li Ling Apple Koh (SMT), Mei Xuan Tan (SMT), Gim-Yang Maggie Pee (SMT), Lee Chee Huei (SMT), Massimiliano Colla (SMT) and Wei Lek Kwan (SMT)

Context

10.008 Engineering in the Physical World is a Term 3 Freshmore course, which was conducted from January to April 2020. This subject introduced the concepts and laws of the physical world to understand the fundamental principles and limitations in the design of thermomechanical, thermoelectric and photovoltaic energy systems (Figure 1). Each week, there were two 2.5-hour cohort classroom lessons, where two faculty members facilitate the session in each cohort.

Throughout the course, there were problem sets, hands-on activities (HoA) and 1D and 2D projects described in SUTD's Big D framework [1, 2] for students to reinforce concepts learnt. In addition to these assignments, the second cohort lesson of each week required students to complete a worksheet that reinforces the concepts learnt during the week in groups of 2 to 3. Exams were scheduled for Weeks 6 and 14.

As the COVID-19 situation evolved, there was a transition from in-person, cohort classroom lesson format in Weeks 1 to 9 to a hybrid (partial remote) learning approach in Week 10 and finally full remote learning from Week 11 onwards, as shown in Figure 2. For remote learning, YouTube was our chosen video sharing platform while cohort lessons were held on Microsoft Teams. This article is dedicated to sharing our personal efforts and experiences in the implementation of full remote learning.

Asynchronous Delivery of Lesson Content

The Physical World (PW) team of instructors exercised some flexibility and decided to pre-record and upload videos on lesson content such that students could watch anytime. These videos were created during the full remote learning and home-based learning (HBL) period. Asynchronous delivery was chosen over livestream because of the potential non-ideal internet access and home environment that some of our students experienced. In addition, YouTube was chosen as the streaming platform for the videos as the system was deemed more robust. The video was unlisted so that only people with the link could view the video. An example video can be found here: https://youtu.be/1cwxkR-xkPo.

At the end of every week, a 2-hour cohort session was scheduled for students to clarify doubts and go through solutions to the case problems. The session was optional in Week 10 to keep the number of students below 39 per cohort classroom with safe distancing. In Weeks 11 to 13, the sessions were converted to online, synchronous sessions on Microsoft Teams. Instructors engaged students through the 'Polls' and 'Chat' function. These sessions were also recorded and uploaded to Teams. In addition, the team implemented daily 1 hour online office hours for students.

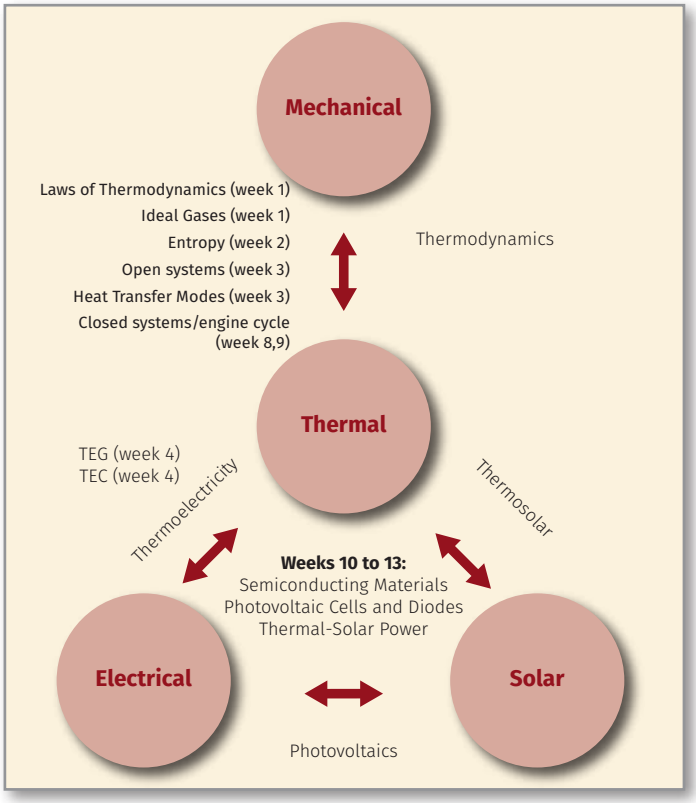

Figure 1. An overview of content in 10.008 Engineering in the Physical World

There were a total of six videos on lesson content. The length of these videos varied from 7 to 34 mins, with three videos that were longer than 20 mins. Based on the average view duration data provided by YouTube for the videos, the team concluded that the attention span of our students was less than 10 mins and approximately 25% of the students did not watch any videos. Assignment submission deadlines and quizzes were the main motivation for students to watch the videos as the view count for all videos surged the day before deadlines and quizzes.

Online Hands-On Activities (HoA)

In total, there were three HoA that were meant to be conducted during cohort classroom lessons. These HoA were designed to help students understand and apply concepts learnt in class. The original HoA required students in groups of 3 to 4 to conduct experiments, collect and analyze data, and complete a group worksheet. Each HoA also had an individual component consisting of a timed MCQ quiz on eDimension, SUTD's learning management system (LMS).

In Week 2 of the term, as the COVID-19 situation began to worsen, we started converting two out of three HoA to be online and delivered asynchronously. Pre-recorded HoA videos

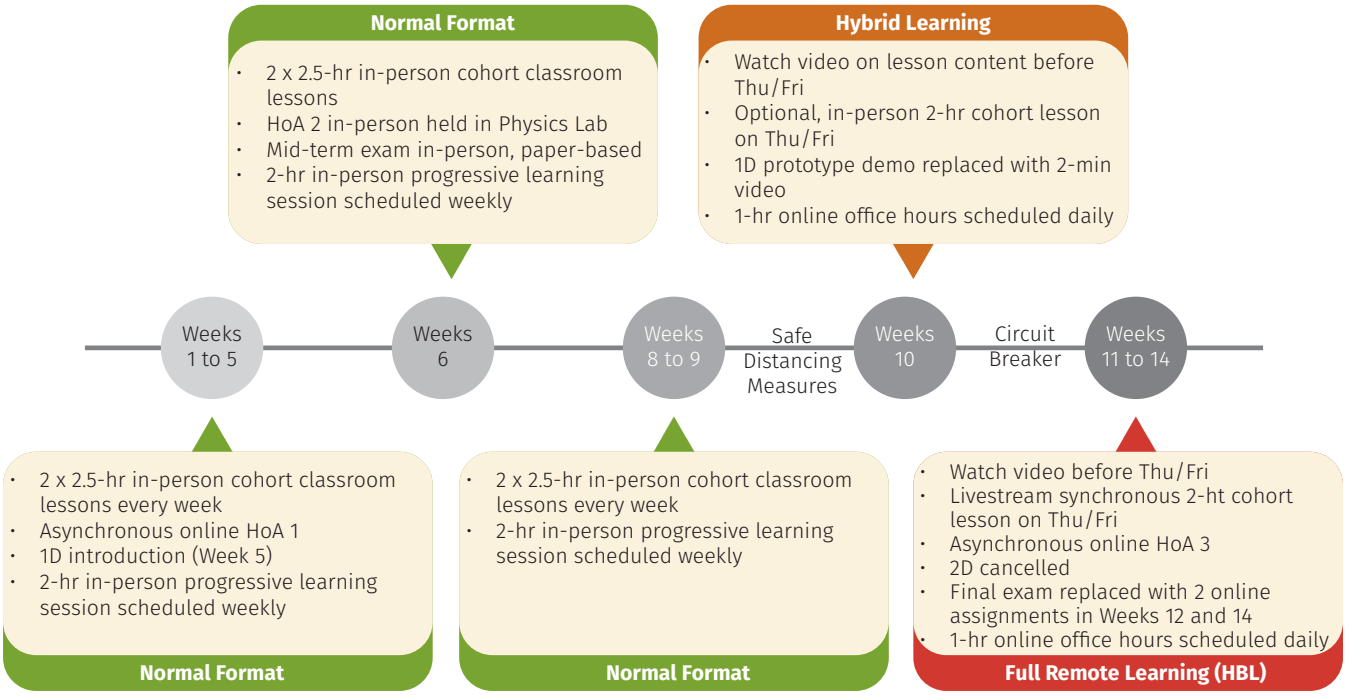

Figure 2. Course transition during the term from in-person cohort lessons to full remote learning

on experiment procedure and data collection were made in preparation for the cancellation of on-campus classes. These preparations proved to be useful as the school moved to minimize contact in class.

After understanding the experimental procedure and data collection via the video, students then analyzed the experimental data to complete the worksheet. To reduce copying and to ensure that students attempted the data analysis, there were ten unique sets of data such that a maximum of two groups shared the same data set in every class. The group size was kept at 3, with a few groups of 4 students, to reduce the likelihood of student(s) not participating in the group activity. Students were given three weeks to watch the videos and complete the worksheet.

1D and 2D Activities

The 1D project development was largely unaffected as it was prior to the circuit breaker and HBL. Students worked in teams, over a period of four weeks, to demonstrate their understanding in the concepts learnt in this course by delivering a working prototype of their solution in making a conducive classroom environment. However, the 1D demonstration by students was planned for Cohort Lesson 1 of Week 10 and was impacted by the transition to remote learning in Week 10. The team of instructors were not able to see the students' physical 1D prototypes in action; instead, instructors watched 2-min long video demonstrations of the working prototypes which explained how it worked. This was disappointing for the students who spent a lot of time and effort on the prototypes.

To ease students' workload, the team chose to cancel 2D so that more time was dedicated on learning the remaining material at a manageable pace and helping students adjust to the new learning platforms and tools. The one-week long 2D project was originally scheduled for Week 11. Students were required to integrate and apply concepts from this course and 10.009 The Digital World to write a program that uses machine learning and statistical analysis to predict the actual temperature of a water bath accurately within the shortest time possible.

Online Assignments and Grading

Previous runs of this subject had one mid-term and one final exam in Weeks 6 and 14, respectively. Both exams were originally meant to be closed book and paper-based. In 2020, the final exam in Week 14 was replaced with two online, synchronous individual assignments conducted on eDimension LMS in Weeks 12 and 14. These individual assignments were open book, however, discussion with peers was prohibited. The mid-term exam in Week 6 was not affected as it was conducted before the switch to HBL.

Control measures in the form of timed grading, optional bonus questions and a big collection of questions were put in place to minimize academic dishonesty. In timed grading, students' work was graded based on correctness and time taken to complete the question. This time score decreased linearly in 10 min time blocks. In addition, students were informed on many occasions that the instructors may randomly select students after the completion of the assignment for oral verification of their answers.

To reduce students' anxiety, the PW team released information and instructions two weeks prior. A dedicated post titled 'Frequently Asked Questions (FAQ)' was created on Piazza for students to seek clarification on the assignment.

A big collection of calculation questions was especially challenging for instructors to finish grading within a very tight timeframe. This was compounded by the circuit-breaker situation, with the added stress of working from home under various difficult situations. However, the team had numerous selfless instructors who went the extra mile to help each other.

Figure 3. Students' responses to our edition of 'This or That' and 'Bingo' created by the instructors

Effective Communication

Instructors regularly spent time talking to students about coping and staying positive and healthy at home; we also attempted to provide some light-hearted entertainment to the students by creating our version of 'This or That' and 'Bingo'. Santhanam [3] used activities such as 'This or That' to promote student engagement in online classes, attributing such fun activities as a form of teletherapy. 'This or That' and 'Bingo' were two Instagram trends during the social distancing period. 'This or That' allows the user to choose between two different choices on the one that best applies, while 'Bingo' allows the user to pick as many choices in the table. These two Instagram activities were fun, relaxing, quick to complete and interactive, serving as good conversational points to relate to each other during this challenging period. In the Physical World edition, the options were focused on the lesson content or the mode of remote learning. Figure 3 shows the responses from two students.

Students' Experience

83% of the student population indicated anonymously in the course survey that they watched the online videos and attended the Teams cohort lessons. Those who did not watch the videos or attend the Teams cohort lessons were asked to comment on their reason. Some students commented that the PowerPoint slides were self-explanatory and sufficient in explaining the concepts; they only watched some videos to clarify misconceptions. A few also commented that they watched the videos but did not attend the Teams cohort lessons as they felt that the cohort lessons were unnecessary and would rather post their questions on other platforms to seek clarification.

A few students indicated preference on the synchronous mode of learning over asynchronous mode which we both implemented. They attributed this to the lack in motivation in a home environment and that having live lessons would help them stick to the class schedule better.

Time management was commonly cited as a downside to electronic exams as student respondents commented that the questions were difficult and long to read [4]. This was also observed in our online assignments, where some students commented on the strict duration of the MCQ section. Although we did not ask for formal feedback on the online assignment in the course survey, students generally understood the rationale behind timed grading and commented positively about this format, noting that it discouraged academic dishonesty.

Lessons Learnt

At the start of the term, we observed that students were upbeat when on campus. However, as the term progressed, students were stressed, anxious and tired over the numerous changes, especially on the change in on-campus exams to assignments. As the situation was constantly evolving, many decisions concerning students had to be made fast. The team understood that the workload for these students had to be reduced without compromising on the learning objectives and assessments. Communication with the students was important. The team is thus glad that the students felt that the course was well-paced with manageable workload and the communication on the transition to remote learning was well-received.

Figure 4. Behind the scenes of recording of videos by instructors Lee Chee Huei and Tan Mei Xuan

There was a steep learning curve with recording and editing of HoA and lesson content videos. Figure 4 shows a behind-the-scenes snapshot during recording of a HoA. A well-rehearsed script was necessary to minimize the time spent in video production. In addition, the video content needs to be unique as there are many high-quality videos on physics and math content that are easily available online, for example, Khan Academy.

Similar to the students', the work from home environment was challenging for many instructors as we converted and digitized lesson materials, activities and assignments. The instructors took on the challenge to convert hands-on activity to online assignments and created fair online assessments to replace physical exams. These are useful experiences that we can implement in the future to better prepare for digital learning. There are also challenges of eye strain and lack of ergonomic workspaces at home. While conducting lessons at home, some instructors also have young children who need supervision for their own home-based learning during this period. Overall, this experience had allowed us to embrace different solutions and become more innovative in delivering our lessons and content.

Afterword

This is the last run of 10.008 Engineering in the Physical World as a new Freshmore curriculum, with a mix of new and revamped courses, is implemented from AY2020 onwards. We always had a great team and would like to thank all who had contributed to this course and supported the team in the online assignment. We are in the unprecedented times and many people are badly affected by the COVID-19 situation. We wish everyone well and hope to see everyone back on campus soon!

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The SUTD Physics team

Remote Learning for Integrated Learning Program in Chemistry in the times of COVID-19

Franklin Anariba (SMT), Chandrima Chatterjee (SMT) and Eng Ying Bong (SMT)

Integrated Learning Program in Chemistry (ILP2 Chemistry) is a bridging program offered at the Singapore University of Technology and Design (SUTD) that aims to equip pre-university students with fundamental chemistry concepts to smoothen their transition into the SUTD Freshmore curriculum. This course is catered to a class of about 45-50 students with diverse academic backgrounds with majority of them being scholars from China under the Senior Middle School Scholarship (SM2) Programme offered by the Ministry of Education (MOE), Singapore. The rest comprise local students from Singapore who are enrolled in Polytechnics or Junior Colleges and require a refresher course. There are usually four instructors conducting this course, each one teaching for approximately 2-3 weeks.

This module is offered from January all the way to April with a two-week break over the Chinese New Year period. The SM2 students usually travel back to their homes during this time and return to Singapore, just before the lessons resume. The ILP2 classes are conducted in a typical cohort-style format and embedded with active learning components including worksheets, quizzes on Kahoot, and hand-on activities as shown in Figure 1. This arrangement was interrupted this year owing to the unprecedented outbreak of the COVID-19 pandemic (Figure 1).

Figure 1. Typical cohort classroom set up for ILP2 program

In an effort to curb the spread of this virus in Singapore, Ministry of Education (MOE) had issued some directives in early February for students entering the country from overseas. Moreover, the Ministry of Health (MOH) had simultaneously raised the Disease Outbreak Response System Condition (DORSCON) level to orange, whereby it was recommended to postpone or cancel large scale gatherings. To align with these precautionary measures, SUTD implemented mandatory leave of absence (LOA) for a period of 14 days for students returning from certain countries such as China, which our SM2 students were required to follow. With their movements restricted, they were unable to attend the ILP2 classes physically during LOA, which disrupted their regular learning process. Consequently, instructors involved in teaching ILP2 Chemistry had to implement an alternative approach, which was remote learning. While classes were still conducted physically for a handful of local students, the SM2 students were doing online learning during this period.

This article illustrates and reflects on the different modes of online delivery of lessons as well as assessments that were employed by the three ILP2 Chemistry instructors.

A. Flipped Classroom Lessons by Dr. Chandrima

Owing to the mandatory LOA that the SM2 students needed to comply with, Flipped Classroom was implemented for a period of five days, commencing from February 10th to February 14th to facilitate the process of remote learning for 37 SM2 students. Classes continued to be conducted physically for a handful of local students, with standard social distancing measures in place.

The Flipped Classroom model [1-3] had two components; one where SM2 students were required to watch online video lessons before the classes resumed physically. Once they were able to physically attend the classes, the second component was implemented whereby students had to do an in-class worksheet with numerical problems encompassing all the topics presented in the video lessons. There were two sets of video lessons uploaded covering fundamental topics in ideal gases and thermodynamics. For each topic, there were about 5-6 mini video recordings, with each video of approximately 10-20 minutes duration. These videos were created and recorded using Microsoft PowerPoint and Wacom tablet. While some of these videos introduced and explained important concepts, others were focused on problem solving and application of these concepts (Figure 2). These lessons were previously developed as a part of MOE initiative to facilitate learning for Singaporean students serving National Service and those in the final years of the polytechnics. Even though primarily targeted for different stakeholder, these videos proved extremely useful for Flipped Classroom model adopted for the SM2 students amidst the COVID-19 crisis.

To further enhance the student learning experience for Flipped Classroom, a lesson plan for each major topic was prepared highlighting the sequence in which these videos were recommended to be watched. The video lessons were uploaded on the SUTD portal called eDimension, and corresponding web links created on the Learning Management System (LMS) platform of SUTD to make them accessible to the students. To assist students encountering technical issues, pdf versions of the PowerPoint lessons were provided as well. These lessons were supplemented with guided worksheets that the students

were required to solve at their own pace. Detailed solutions to the worksheets were uploaded later in the week to enable them to check their answers and self-assess their understanding of a specific concept. This was well-aligned with SUTD's directive for student-directed learning.

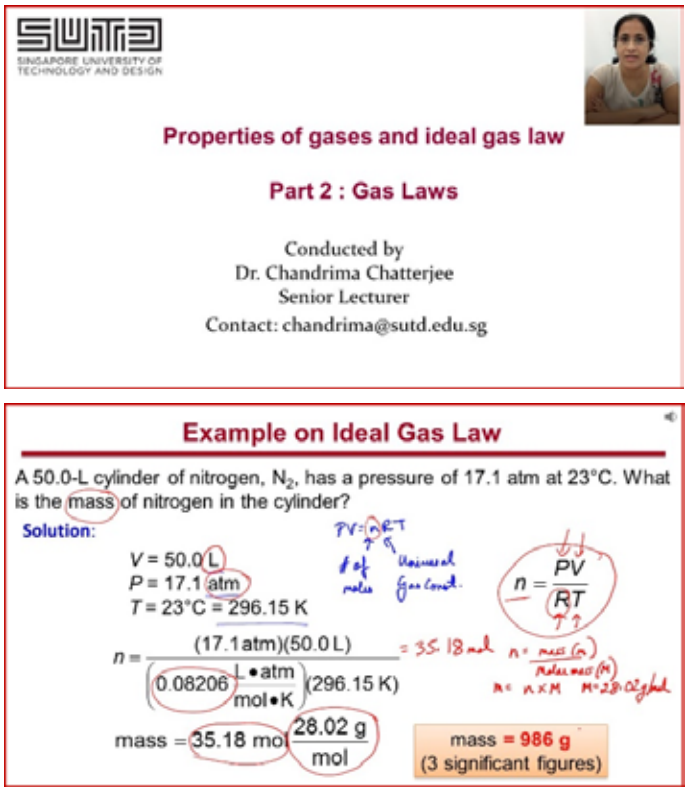

Figure 2. Snapshots of online video lessons showing annotations to explain

The SM2 students had the opportunity to communicate with the instructors via emails if they had any doubts relating to any topic. However, this was not always a smooth experience. Despite the best efforts made by me to address the concerns via email, some students were not satisfied with the explanations given and had difficulties. This is a known challenge with online learning. However, having some lessons flipped provided the students with the unique opportunity to rewind and revisit any topic multiple times thereby enabling them to clarify any misconceptions on their own. Once the classes resumed physically, I was able to address the individual concerns and provide numerical questions to the students to ensure proper understanding of concepts delivered using the Flipped Classroom model. In my opinion, classrooms always provide a conducive environment to learning but flipped classroom lessons allow the students to effectively learn at their own pace [1]. In fact, in the course evaluation for ILP2 Chemistry, the students mentioned they liked "e-learning", the clarity of the PowerPoint slides and clear explanation of the solutions to the worksheets.

B. Remote Learning via Zoom by Dr. Franklin

Due to the COVID-19 pandemic, ILP2 lessons for SM2 students (37 students) were transferred to remote learning. Without prior experience but with the assistance of EduTech and Office of Undergraduate Studies, I was equipped with an educational Zoom license and a Wacom tablet to conduct lessons remotely. A key aspect of the Wacom tablet is its digital pen to annotate on the Microsoft PowerPoint slides. The devised strategy consisted of two steps: uploading the lesson materials for a particular day onto the LMS [1-3]. These materials included pdf versions of the Microsoft PowerPoint slides and in-class worksheets. Conducting the lesson via the Zoom Meetings platform [2].

The online class started at the same time (10:30 AM) as previously scheduled and the duration of the lesson was also maintained (2 hours). For the first half an hour, the lesson consisted of covering new concepts and definitions, which were dramatically enhanced through the use of annotations on the PowerPoint presentation shared with the students through a "shared screen" feature in the Zoom meeting room (Figure 3). After every 10 minutes or so, I would ask students if there were any questions following which students would ask questions using their microphones. There were usually 2-3 questions per 10 minutes interval. However, I soon realized that some students preferred asking me questions through a "chat" feature on Zoom, either publicly (so that all students could see it) or privately. Hence, it became a necessity to keep imparting the lesson via "shared screen", while at the same time monitoring the "chat" exchange. The next 20 minutes were dedicated to work on a few examples together step by step, and this was followed by a 10 minutes break. The final hour was used for the students to work on problems on a worksheet at their own pace. During this time, students were able to ask questions about the worksheet or any other topic when necessary. In general, I felt that the lesson material content covered via Zoom required more time than if it were imparted in a physical classroom.

Figure 3. Representative Zoom interaction with students

Students preferred immediate answers and explanations to their inquiries as seen by their desire to communicate their questions through the "chat" channel. This is highly characteristic of the new generation of students. Those students who were both vocal and interactive continued to be so. In addition, the home environment allowed students to modify their immediate surroundings. For instance, a couple of students had the Sentosa beach as their virtual background! Others were seen at their desks or relaxed on a couch. Generally, 5-10 students did voice their questions directly, however, the "chat" feature did observe a higher degree of interaction, whereby student answered each other's inquiries.

C. Take-home Assignment Submission via LMS by Dr. Eng Ying

The main assessment for ILP2 Chemistry was a summative, closed-book exam (Exams 1 and 2 with equal weightage) that were originally intended to be conducted physically. Exam 1 was conducted physically as planned before lessons were transferred to remote learning. In light of the COVID-19 pandemic, the assessment grade distribution for Exam 2 had to be revised.

The weightage on exam component was removed and replaced with continuous assessments (CAs) such as take-home synchronous assignments and homework. According to SUTD Assessment Type Guideline, CAs were to be administered throughout the term to provide real-time feedback on student learning. Students were required to complete their take-home assignments or homework within the stipulated time and submitted it via LMS (Figure 4). On LMS, students attached their work on the "specify assignment" tools created by me or other instructors-in-charge. The majority of the students attached pictures of their hand-written work and only a couple of students worked on word documents. I found accessing and grading student's submitted assignments using on LMS simple and effective. I could review their submissions online in the Grade Center without downloading the files and could assign grades immediately. I was also able to provide grades and comments directly into the grade center cells so that students were updated with their progress instantly.

In my opinion, replacing exam with take-home assignments was not the best way to evaluate student's knowledge on the subject. Like normal homework given in the course, it can be done in the comfort of one's home with full access to lecture notes, books or any online resources. In addition, there was no way of preventing students from asking another student for pointers. Hence, it was recommended to create question pools to give students a different question on the same topic. It was also recommended to design open-ended questions, which was an effective strategy to challenge and encourage critical-thinking skills. Take-home synchronous exams were much closer to standard open-book exams. However, it was exceptionally challenging to implement logistically as it required a communication software to monitor student's progress throughout the exam.

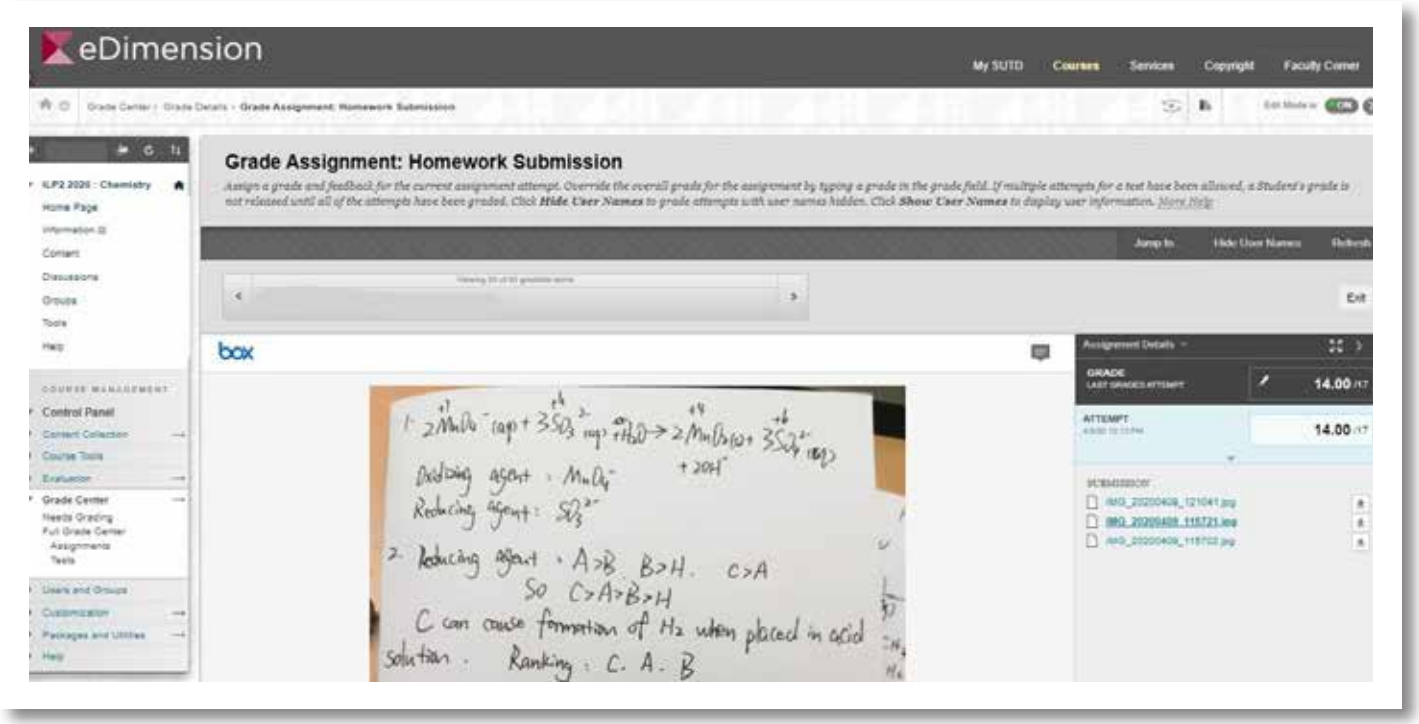

Figure 4: Submission of online assignments by students on the university's LMS

Conclusion

The Chemistry ILP2 Instructor team has explored and implemented different modes of remote learning, including flipped classroom lessons as well as live lessons via Zoom platform. In addition, instructors designed take-home assignments that could be submitted as well as evaluated online via the LMS. Digital learning proved to be very beneficial amidst the COVID-19 crisis and can be facilitated with the contemporary technologies available. However, all three instructors concurred that while e-learning may offer advantages but there are certain drawbacks when compared to learning physically in a cohort classroom set up.

One of the challenges of students learning remotely is the lack of engagement with their peers. They are deprived from the opportunity of team-based learning that are usually provided in a cohort class setting. Besides, from a student's perspective, it may seem a little impersonal not to be able to physically and socially interact with their instructors. From the instructor's perspective, we found it easier to facilitate a lesson in the cohort classroom as compared to conducting it online. In addition, a classroom setting allows instructors to have a better gauge of students' learning, thereby giving them the opportunity to reach out to those requiring additional help. Since the interaction between learners and instructors establish a conducive environment to learning, we feel that students benefit much more by physically attending classes than learning remotely. Likewise, take home assignments may not necessarily provide an accurate assessment of student's understanding of the subject matter if not executed appropriately. Nonetheless, it is crucial for instructors to be aware of emerging digital technologies available that can help them to enhance both teaching and learning for the students, particularly in times of crisis.

Acknowledgment

We acknowledge the Education Technology personnel from the Office of Undergraduate Studies for providing us with the necessary equipment and software for recording and teaching purposes. We would also like to thank them for conducting training workshops for the faculty to facilitate digital teaching and online assessment.

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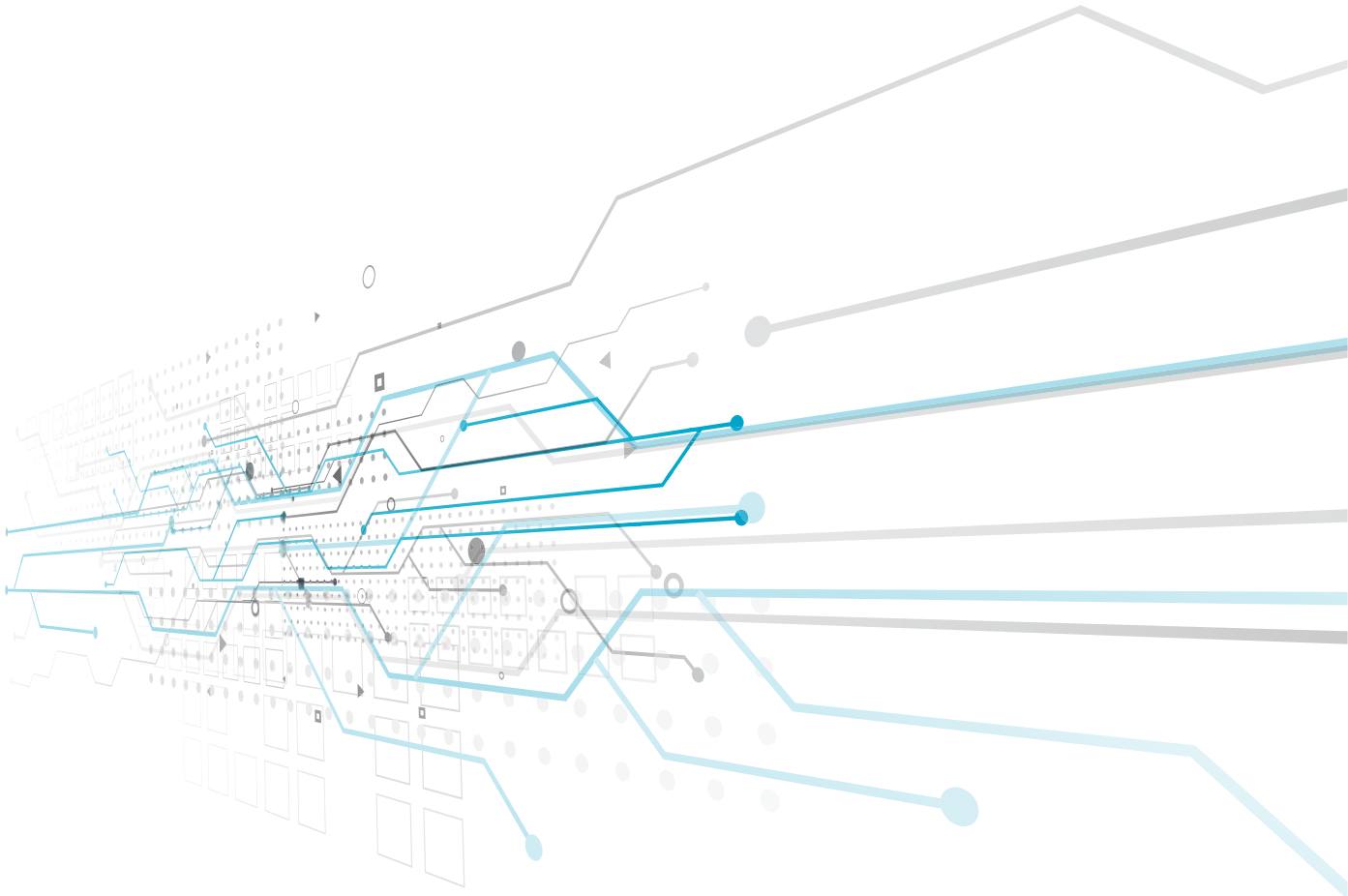

Visualizing Partial Derivatives in Advanced Mathematics II using Virtual Reality

Keegan Kang (ESD) and Sergey Kushnarev (ESD)

In the 2019 run of SUTD's Advanced Mathematics II, the teaching team wanted to explore if it was possible to use Virtual Reality to assist students in learning about partial derivatives. This would allow students to learn at their own pace. How did this idea come about, and what takeaways did the SUTD Math team get from this?

SUTD students have a passion for engineering. However, we have students of varying levels of mathematics abilities in a typical cohort class. Some students may have weak mathematical foundations and require additional study while other students could be extremely strong in mathematics. In such a cohort class, the students who are weak in mathematics run the risk of not being able to catch up with the material, and fall further and further behind, as the cohort lesson is usually catered at the level where most of the students are.

This becomes even more critical in a Term II course such as Advanced Mathematics II.

For example, we teach multivariable functions in Advanced Mathematics II, which involves visualizing objects in three dimensions (or more). This can be a large step up from what students are used to, and hence they may face difficulties which affects their conceptual understanding of the material.

Hence, the math team started to explore possibilities of using technology tools to allow students to learn at their own pace with a deeper understanding. The team explored various technology tools including AI tools, and we finally decided on Virtual Reality (VR) since this is also well explored in the literature [1, 2], to help students visualize multivariable functions and surfaces.

Dr. Sergey Kushnarev first conceptualized the idea of using VR to help students with multivariable calculus in early 2019, and together with Dr. Omar Ortiz, Dr. Wong Wei Pin, Dr. Keegan Kang, and PhD student Jacob Chen Shihang, refined and created SUTD's first VR application for multivariable calculus.

The VR application was developed in Unreal Engine 4 (UE4), which is an open-source 3D game engine by Mr. Jacob Chen Shihang from IDiA lab, SUTD. The main core of the application involved a method in UE4 to generate a 3D surface based on any mathematical formula. The application uses the Oculus Rift, which is a consumer VR headset with motion controllers that has six degrees of freedom tracking. All the equipment has been funded by the university and purchased by UGS for the IDiA lab.

The process was one of iteration - for every week in Summer 2019, Jacob Chen Shihang would show the current state of the application, and Dr. Sergey Kushnarev, Dr. Omar Ortiz, Dr. Wong Wei Pin, Dr. Keegan Kang would trial out the features, and give comments on what could be done. At key intervals, members of the Advanced Mathematics II teaching team (Dr. Ali Godjali, Dr. Cai Kui, Dr. Cheong Kang Hao, Dr. Chin Chee Leong, Dr. Colin Tan Weiyu, Dr. Liu Xiaogang) would also come to give their feedback.

The VR application evolved from a simple prototype that generated a 3D surface, to one which allowed students a variety of options: zooming in and out, rotating the surface, to visualizing partial derivatives and their slope. More features were also built into the application, allowing the user to go through a tutorial

Figure 1. Main page of the VR application

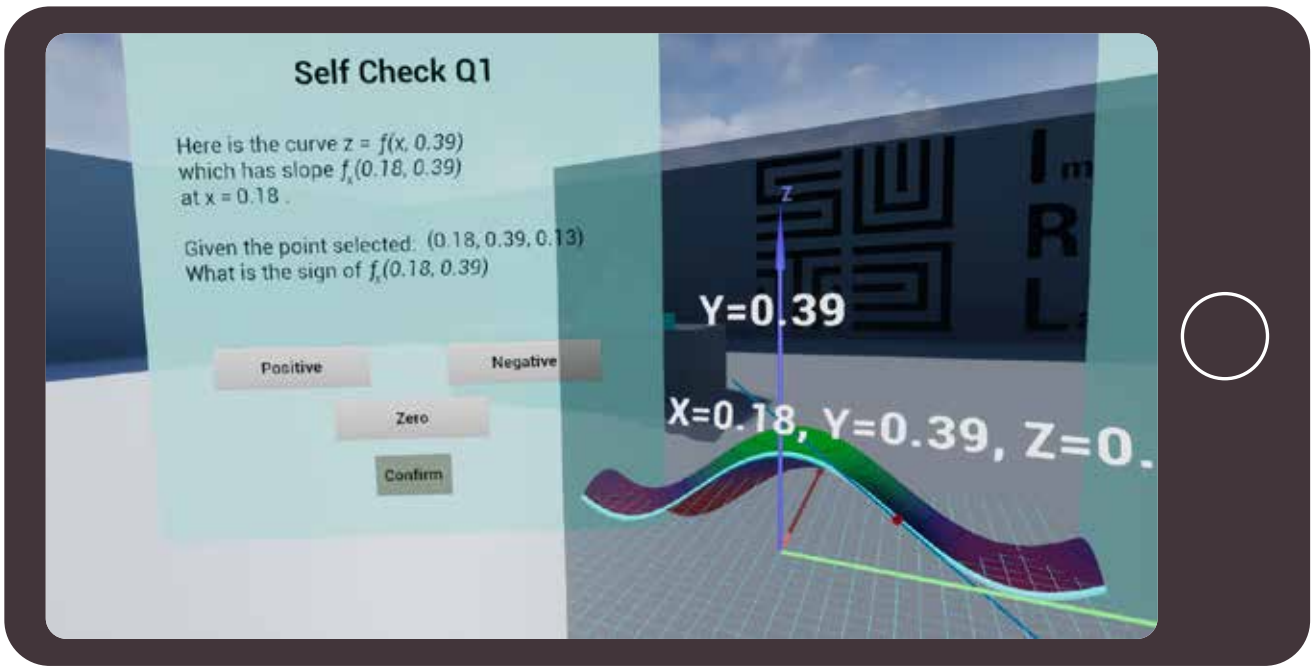

Figure 2. The VR environment showing a surface that students can interact with a self-check question

explaining concepts on partial derivatives, as well as self-check exercises and a quiz to evaluate how much a student has learnt (Figure 2). The VR app was a desktop app (PC or Mac), students had to use the Oculus Rift VR set. IDIA lab has purchased more than 20 Oculus Rift VR headsets, which they use in a variety of pedagogical and industry projects.

During the 2019 Advanced Mathematics II run, the students in each cohort were split into two groups - one group would have the usual face-to-face lesson on partial derivatives conducted by an instructor (187 students), and the other group would take a lesson by themselves using the VR application (125 students), where instructors were monitoring any technical issues students might face. At the end of the lesson both groups did an (ungraded) test, as well as a survey on their experience.

The students who were in the VR lesson had the option of taking the test when they felt they knew enough about Partial Derivatives, whereas the students in the usual lesson would have to go through the entire lesson. The evaluation was done during the third week of the semester. All students had the option to use the VR application freely after the test. The intention for splitting the students into two groups was to evaluate if part of the in-class teaching could be done via VR, in order to best allocate faculty time to students.

The analysis of the tests and surveys which both groups took led to some surprising results. We received extremely positive feedback from the surveys (as well as the end of course feedback) demonstrating that students preferred the VR experience rather than traditional teaching. However, when we looked at the actual quiz results, we found that the group of students who did the usual lesson had a mean score of 8.90/10, while the group of students who did the VR lesson had a mean score of 7.81/10, almost one point lower. We applied a two-sided, two-sample t-test to the two groups of scores with the null hypothesis being that both mean scores were the same. The test was significant with $p < 0.001$, which suggested that there was a significant difference in the performance of the two different groups of students.

We did not expect that the students who experienced VR would end up doing worse, and that led us to examine our results. Figure 2 shows the density plots of the time students took in learning about partial derivatives in the VR app before taking the quiz, as well as the time taken for them to do the quiz. Most of the students spent somewhere about six minutes (360 seconds) learning about partial derivatives in the VR application, and about five minutes (300 seconds) doing the quiz. In contrast, for the usual cohort-based lessons, each instructor took 15 minutes (900 seconds) to go through the concepts, and every student had 10 minutes (600 seconds) to do the quiz.

We hence came up with a hypothesis why the students who did the VR lesson performed worse. Although we had a step-by-step process in the VR application that also contained self-check segments for students to test their understanding, it seemed that most (if not all) of the students spent less than 15 minutes (900 seconds) on this segment (see Figure 3). On the other hand, in the cohort classroom, the students would have had to undergo the same lesson, without any chance of skipping the lesson.

We believe that students may not be self-aware of what they know and do not know, and hence with an option to skip forward to the quiz, end up learning less than a traditional lesson. Hence while VR technology may be seen as desirable and useful, this must also come together with some form of faculty intervention to ensure that students are not short-changing themselves. In fact, VR alone may not always suitable as a replacement to lectures and classroom learning, but we can aim at using this technology to complement regular lessons for students who have difficulty visualizing surfaces.

Future development of the app will include wider range of examples, improved visualizations and instructors making sure students do not skip the self-check quizzes.

Publications about this research can be found on SUTD official Facebook page [3] and in IEEE Access journal [4]. We would like to thank the staff of the IDIA lab, Cherish Chan Xiao Si and Song Youngbin for helping out in the course of the project.

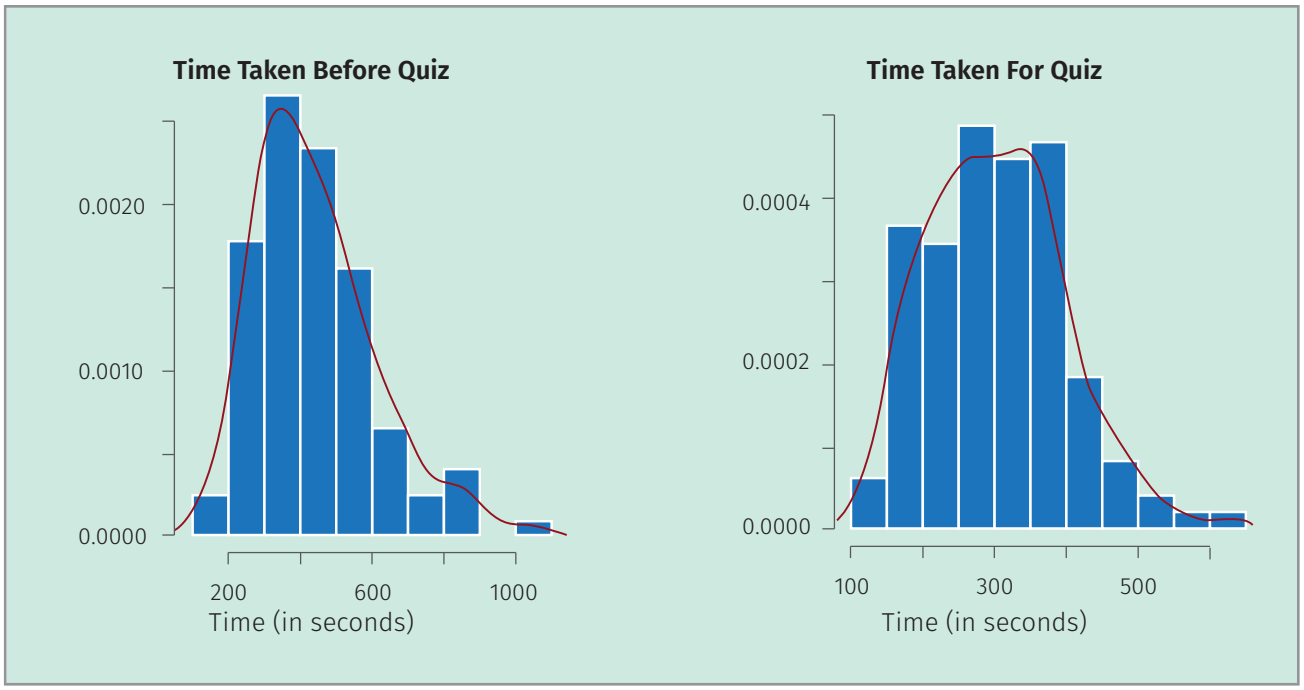

Figure 3. Density plots of learning time taken by students before the quiz and time taken to complete the quiz in Group 1 using the VR application

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Assessing Programming Knowledge and Ability with an Online Oral Exam

Norman Lee (ISTD), Kenny Choo (ISTD) and Oka Kurniawan (ISTD)

Introduction

Typically, university courses are designed and run with the premise that students and instructors can meet physically on campus, such that lessons, projects, and assessments can be conducted face-to-face. However, as the threat of COVID-19 pandemic emerged in January 2020, one consequence of the resulting physical distancing measures to ensure public health was a disruption to the usual way of teaching in SUTD.

Under normal circumstances, the final exam for our first-year programming course, The Digital World, is a practical programming exam that is conducted on campus with students' own laptops. Cheating is deterred using a solution that involves using a lockdown browser, appropriate exam policies and taking human factors into account [1]. This exam would have been administered in early May 2020.

However, as the pandemic situation worsened in Singapore, lessons began to be conducted online during the final week of March 2020. The "circuit-breaker" measures then began on 7 April 2020, closing most workplaces and schools, and thus requiring a large part of the population to remain at home, making it impossible to carry out any activities on campus. Although lessons could continue to be conducted using video-conferencing tools, we had to think of an alternative final summative assessment to replace a planned final exam.

In this article, we describe how we transformed our on-campus final exam to an open-ended game making programming assignment together with an online oral exam. We reflect on our experience in designing and administering this method of assessment and describe both student and faculty perspectives.

Context

"The Digital World" is a programming course in SUTD that introduces students to basic programming using Python programming language and exposes them to its applications to areas such as GUI programming, machine learning and internet-of-things. It is conducted in the third term of the Freshmore year. Classes are conducted in cohorts of fifty students each, with two instructors assigned to each class.

Students are assessed individually via two in-class quizzes, a mid-term exam and a final exam, all held on campus in the usual manner in previous years. Students take the exams in classrooms with their laptop. In the exam, apart from programming problem-solving questions, there are also conceptual questions to assess their understanding.

When the term began in late January 2020, some students who had just returned from affected countries were placed on compulsory leave of absence and told to remain in their residences. To assist these students in keeping up with their coursework, instructors were asked to record their lesson. After a period when instructors used different video-conferencing tools, we introduced Microsoft Teams (MS Teams) in Week 4 of the course as a common communication platform for the course. This was because all students and faculty were already automatically registered in MS Teams. From then on, instructors used MS Teams to stream and record their lessons using its video call feature and to answer students' queries via its chat feature.

Without further measures, the mid-term exam in Week 8 of the course was conducted on-campus in the usual manner.

However, when it became apparent that the pandemic situation would worsen, we then had to think of alternatives to the final exam to prepare for a possible closing of the campus.

Problem

As such, we faced the problem of having to design an alternative assessment to replace the usual on-campus supervised programming exam. The alternative assessment would have to fulfill the following requirements:

- It had to be able to assess the learning objectives in the course.
- With students at home, it had to be designed to minimize the possibility of cheating.
- A means of verifying the students' identity also needs to be established, in a similar way to on-campus exams.

An initial plan to implement an at-home online exam was discarded, due to the logistical difficulties involved. The at-home exam would have been conducted using Respondus Monitor, a software that is used to conduct at-home online exams and requires a webcam on the students' laptop to record the students' activity during the test to deter cheating. When we conducted a mock test with the students, several students reported that their webcams were not functional. As the closure of workplaces, schools and retail outlets mandated by the government had already taken place, and due to the spike in demand for work-from-home setups, it was difficult for these affected students to purchase the necessary equipment.

Related Work

From a search of the education research literature, it seemed that an oral exam could be one viable replacement for a written exam. Ohmann describes how an oral exam was used to replace the final written exam in an introductory computing course [2]. Each student in a class of 53 was allocated a 30-minute time slot to be interviewed by the sole instructor teaching the course. A set of questions and their associated rubrics were developed by the instructor prior to the exam and used to grade the students. It was reported that students had positive feedback about this assessment and reported that it was equal in difficulty or easier than a prior written exam.

Another alternative assessment that could be used is a programming assignment. It has also been reported that using games as programming assignments improves students' motivation. In an object-oriented programming course, Sindre et al. (2003) required students to complete one group-based game programming project that was graded as pass/fail. Minimal constraints were placed on the project scope, and students were free to design the game however they wished. Upon completion of the assignment, students were evaluated through a demonstration. The authors mentioned that this resulted in an increased motivation in students, as they could decide the scope of their own project, and reduced plagiarism greatly as it would be easier to detect.

Figure 1. A code for a guess-the-number game used in lessons

Solution

Our solution was to replace the final exam with an individual open-ended game-making programming assignment, where the grade was to be assigned by means of an oral exam. In the programming assignment, students were tasked to write a computer game using Python. They were free to design the game as they wished. No restrictions were placed on the genre, format or the type of user interface (text-based or graphical) of the game. Students were told to use only the standard Python libraries, so that the grader would not have the burden of installing and understanding additional libraries to evaluate the students' games.

We felt that writing a game is a good way to test students' programming skills, and as it will make them use most of the concepts taught in the course. Even a simple computer game like guess-the-number will require students to synthesize many concepts, such as loops and branching (Figure 1). By increasing the complexity e.g., the "hangman game" where the player must guess a word, the student would need to bring in data types such as lists, dictionaries and possibly employ file processing as well. In many cases, there is also a choice of procedural programming or object-oriented design when writing the program. Writing a game also makes the assessment authentic; one job of a computer programmer in real-life is to design and create software.

Implementation

We wrote an assignment brief describing the requirements of this final assessment and released it to the students. We specified clearly that students would primarily be assessed using an oral exam. Questions in this oral exam would be based on the code that each student submitted and will test students' understanding of programming concepts.

Included in the brief was a set of rubrics (Figure 2). The rubrics communicated the fact that to obtain maximum points, on top of a well-designed game with sufficient complexity, students would have to demonstrate their programming skills and knowledge by being able to answer all the questions in the oral exam. In addition, concepts such as Kivy, a library for programming a graphical user interface, and state machines were taught in the second half of the term. We awarded one extra point if the students used and applied these concepts correctly in their game. This was to encourage students to apply these concepts, and at the same time, retain the open-ended nature of the assignment.

As students are working from home, there is nothing to prevent them from plagiarizing from other sources of code on the internet, or from seeking unreasonable external help, such as engaging in contract cheating [3], to complete their assignment. Our solution thus contains two aspects to minimize any incentives for students to do so. The first aspect is the open scope of the project, which as Sindre [4] has mentioned, makes

Points	0	1	2	3
Programming skills	Students have no idea on the code. Very weak programming skills. Unable to answer questions.	Students have minimal idea of the code. Weak programming skills Able to answer few questions.	Students have good idea of the code. Good programming skills. Able to answer all questions.	Students know the code very well. Very strong programming skills. Able to answer all quetions clearly.
Game Complexity	Game is the same as the template or very similar.	Game is simple with minimal modifications from some online code.	Game is moderately complex.	Game is designed well, has sufficient complexity.
You will get an extra of 1 pt if you make use of SM class from libdw package AND/OR your game is GUI-based using Kivy. This only applies if you either obtain 2 or 3 from the rubrics above.				

Figure 2. Rubrics given in the assignment

plagiarism easier to detect as every assignment submission is meant to be unique. The second is making the oral exam the primary means of assessment. Hence, a student cannot score well with just submitting a well-designed Python program but needs to demonstrate his/her understanding of the programming concepts in the oral exam.

We required all student queries on this assignment to be posted on the course forum. This helped to address any doubts that students had. Students were not prevented from contacting their instructors for guidance; however, the instructors were mindful to keep any help provided to a minimum. Students were encouraged to create a game that best reflects their programming knowledge and ability.

For the oral exam, each faculty teaching was assigned to one cohort of fifty students. To reduce the bias that comes from familiarity, faculty were assigned to a cohort that they did not teach. One day was reserved for this. Students were given interview slots of five minutes each, starting from 9.00 am in the morning. With breaks in the schedule, typically, the final student would be interviewed at around 3.30 p.m.

Prior to the exam, instructors looked at students' submissions and planned the questions that each student would be asked. Looking back at our records, most of the questions were those that required higher order thinking and the synthesis of several concepts, such as:

- How would you improve this section of the code?
- How would you implement this section of the code using a different concept?

Other questions tested students' familiarity with their program and their knowledge of important programming concepts, such as:

- Explain what this line of code does for the program

As such, each student had questions that were uniquely based on their assignment submissions.

The instructor contacted the student via the video call feature of MS Teams. Students had to first login to MS Teams using their university credentials. Each student was required to turn on the webcam and show his/her student ID at the start of the interview. Students who had problems with their webcam would be contacted subsequently via Zoom through their mobile phone. We did not encounter any student who could not meet these requirements.

Reflections

Students were positive about the final assignment. In the end-of-course survey, many remarks cited the final game as a response to the question "best three things about this course". One typical remark was:

> ***"Our final assignment is now a game!! yayyy, they should do this every year and make it a group effort if possible"***

Faculty spent approximately the same amount of time administering the oral exam as compared to preparing for an on-campus exam. Reflections from some members of the teaching team reported that they required between 8 to 20 hours of work to read students' code and decide what questions each student was to be asked. Conducting the interviews required another 6 to 7 hours. This time spent is similar to the work necessary for an on-campus exam - the setting and checking of exam questions, testing the online systems, invigilating the exam and finally marking students' submissions.

Faculty reported that the oral exam was effective in assessing students' programming knowledge, as they could distinguish the students' level of programming knowledge and ability through the questions. The best students showed that they had a strong grasp of programming by being able to answer all the questions posed, even with questions that required the synthesis of several concepts. The weakest students could not even answer questions that tested basic knowledge. As this was a summative assessment, and due to the short time of five minutes allocated per student, no feedback was given at the end of the interview.

With each student having a relatively unique set of questions, one faculty remarked that, "students who were waiting down the line realized that they could not share the questions that they had been asked before, since they were custom to each of them."

The games show the diverse academic ability of our student population. The simplest games used basic programming concepts employing loops, selection and basic data structures like lists. The code in the best assignments showed a good understanding of object-oriented programming and used the Kivy GUI and state machine concept effectively. Some of them are showcased at this website: https://acad.sutd.edu.sg/10-009/showcase/.

Another key aspect was maintaining communication channels with students, given that we could not meet them face-to-

face anymore. The online forum was helpful in addressing queries and pointing students to queries that had already been answered. Many queries were about instructors' expectations of the game and clarifying the nature of the online interview. MS Teams was helpful in allowing instructors to provide individual consultation sessions via the video call feature.

At the time of writing, it is likely that the physical distancing measures to manage the COVID-19 pandemic will persist for some time, thus making it necessary to adjust the delivery of teaching and learning in SUTD. Also, future disruptions to teaching and learning ought to be planned for [5]. Our positive experience with this final assignment shows that it is a feasible way of assessing students' programming knowledge and can be executed whenever we are prevented from conducting on-campus exams.

Conclusions

In this article, we have described how we replaced an on-campus final exam when the SUTD campus was required to close. Each student was given an assignment to program a game using Python programming and was then individually assessed using an oral exam that was conducted online. Our experience has shown that such an arrangement is feasible to execute, and that the students' ability and understanding can be assessed. Such an assignment can be part of plans in managing the risk of future disruptions to teaching and learning.

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Re-imagining COVID-19 through Digital Learning and Innovation by Design

William Siew Jing Wen, Graduate Student (EPD), Evan Sidhi Peradijaya, Undergraduate Student (ESD), Bina Rai (SMT) and Xiaojuan Khoo (SMT)

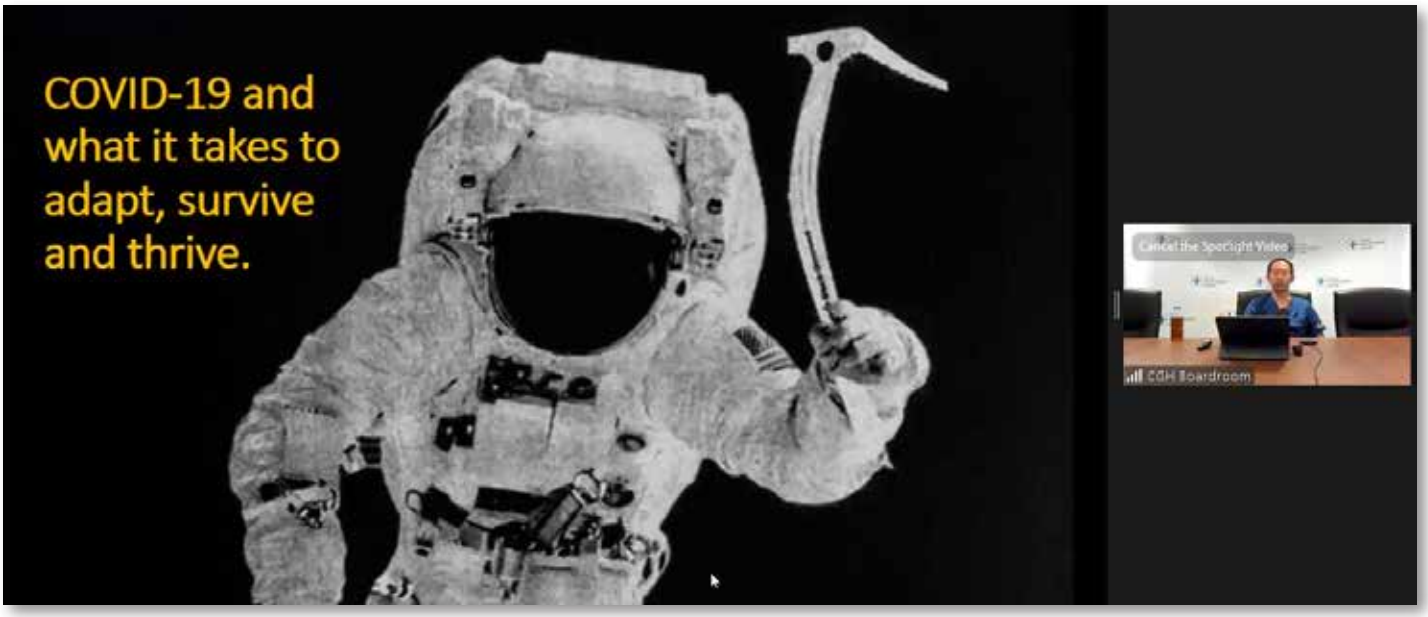

Figure 1. Sharing by Dr Jimmy Goh on clinician leader perspective on the management of COVID-19

On 27th and 28th June 2020, Healthcare Education & Research Talks (HEART), presented the inaugural SUTD-CGH Virtual Ideation Challenge centred around the theme of "Re-imagining Healthcare in the Time of COVID-19". Jointly organised by the Singapore University of Technology and Design (SUTD) and Changi General Hospital (CGH), the programme challenged student participants to ideate innovative and timely solutions to key healthcare challenges that emerged from the pandemic through the use of design methodology and tools.

The key objectives of the initiative were as follows:

1. To engage frontline CGH clinician leaders to share their experience and perspectives on the COVID-19 crisis and its associated healthcare challenges.

2. To promote SUTD's culture of design and co-creation to current and future students.

3. To introduce student participants to useful design methodology and tools.

4. To provide an opportunity for collaborative team-based learning and networking.

In view of COVID-19 restrictions, we adapted our planning strategy, turning to digital learning and communication tools to establish common virtual spaces, coordinate discussions, and remotely engage participants. While such events have been traditionally in-person, the use of a virtual platform offered unique opportunities, which we elaborate on below. We ultimately delivered the opening and closing sessions via Zoom Webinars, ran clinical mentors' consultations and team discussion sessions via Zoom breakout rooms, and broadcasted announcements and updates via a private Telegram channel.

A Virtual Ideation Challenge in a Digital Age

The opening session saw 100 seminar participants coming together via a Zoom online webinar to learn about specific COVID-19 healthcare challenges during pre-, ongoing-, and post-pandemic phases. An esteemed panel of speakers from CGH, including A/Prof How Choon How, ACEO A/Prof Selina Seah, and Dr Jimmy Goh, shared their perspectives in managing the COVID-19 situation through the lens of the regional health services, hospital and clinician leader, respectively (Figure 1). This series of talks were supplemented by a virtual 360° immersive tour of the CGH emergency department and a foreign worker dormitory, which provided a rare insider view of the COVID-19 frontline, and contextual knowledge prior to the ideation process (Figure 2).

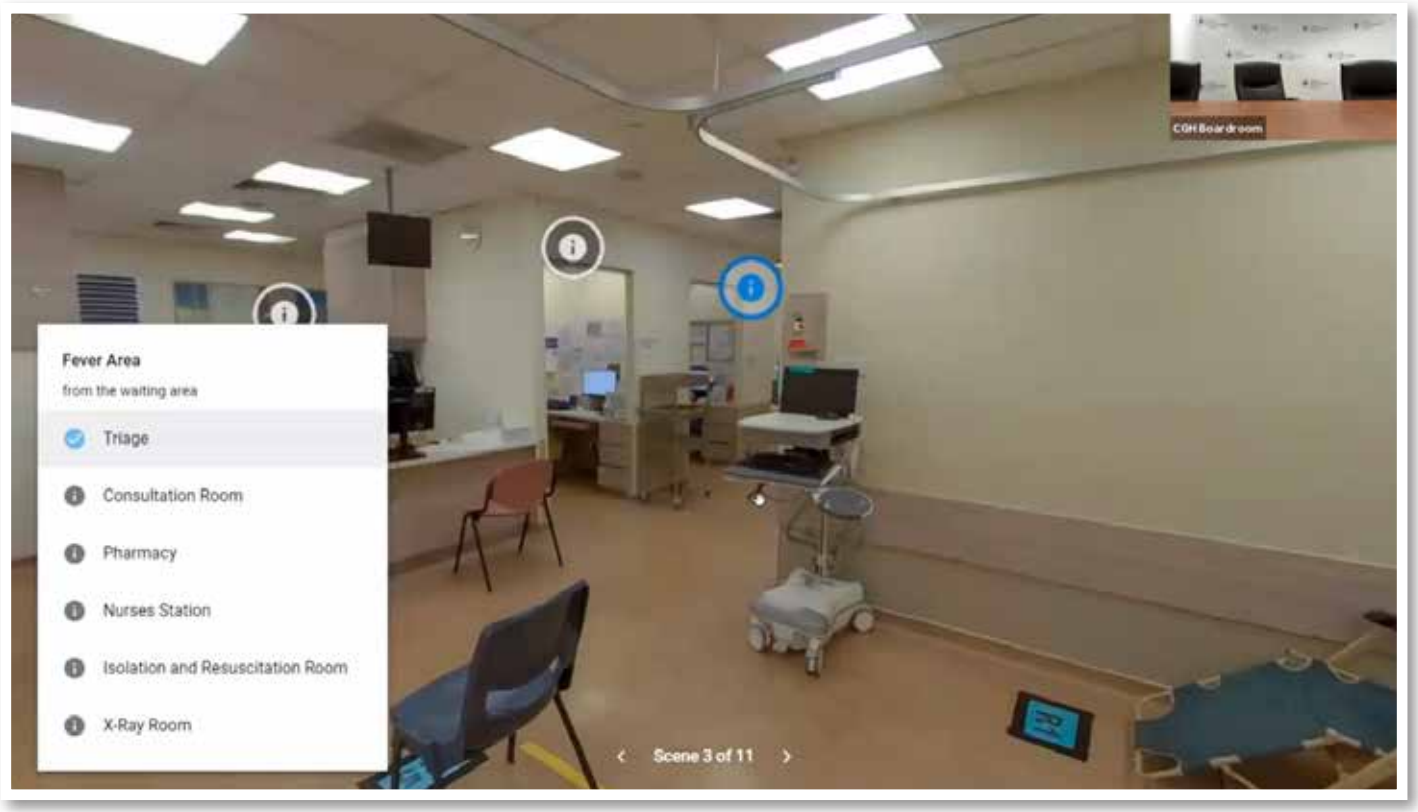

Figure 2. Virtual 360° immersive tour of the CGH emergency department

Following the large-group webinar session, 58 ideation challenge participants, who attended the seminar, regrouped in a separate Zoom meeting room designated as the virtual "Main Room" for the rest of the 2-day programme. Participants were invited to join a private Telegram channel set up for this event. This instant messaging platform served as the main mode of communication between event facilitators and participants, by allowing for prompt broadcasting of reminders, announcements, and links. Students could also reach out to facilitators for assistance at any point during the program via this same platform.

To better prepare them for the ideation challenge, student participants were taken through a 40-minute "crash course" on design thinking and innovation delivered by SUTD Associate Professor Arlindo Silva (Figure 3). They were introduced to the specific design methodology and tools (e.g. C-Sketch, user journey maps, etc.,) which they were to apply in their ideation process.

The student participants were grouped into 14 teams to identify the design gaps and opportunities through their interactions with clinician leaders and graduate mentors, each tackling one of 14 COVID-19 case scenarios and problem statements. The graduate mentors roamed around every breakout room throughout the two days to support participants in their application of the design methods and fill in their knowledge gaps. Participants were assigned to a separate breakout room via Zoom based on the selection of case scenarios. Each team was given a shared folder in Google Drive, providing access to their case scenarios, slides of the 40-minute "crash course", design method cards [1-3], programme itineraries and templates for the deliverables.

At the end of the ideation challenge, all 14 teams successfully delivered their pitch to a mixed panel of esteemed SUTD and CGH judges, comprising Prof Teo Eng Kiong, Chairman of Medical Board, CGH, Adj A/Prof Siau Chuin, Chairman of Medical Board

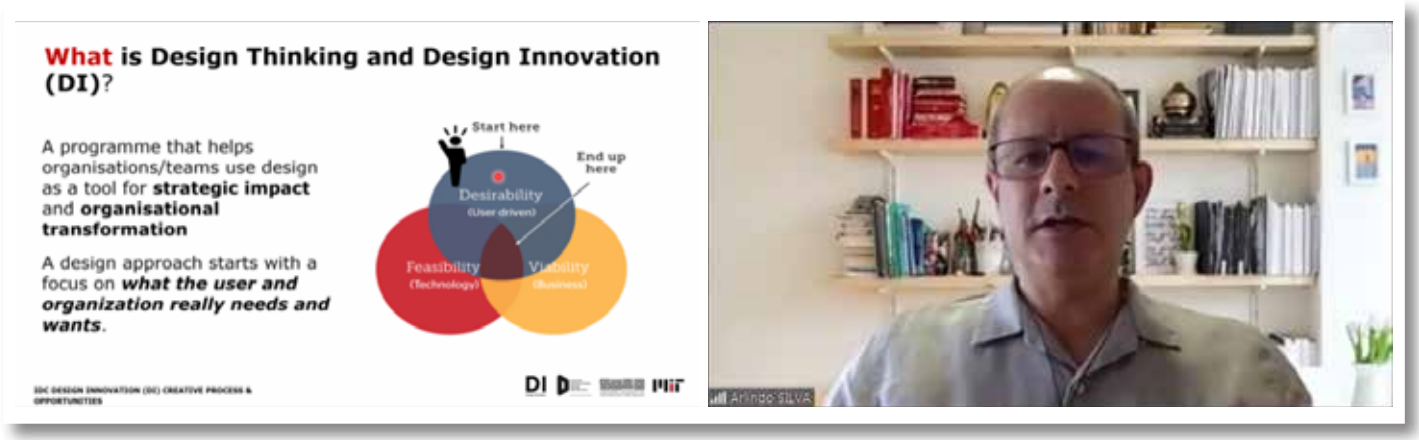

Figure 3. The 40-minute "crash course" on design methods by associate professor Arlindo Silva

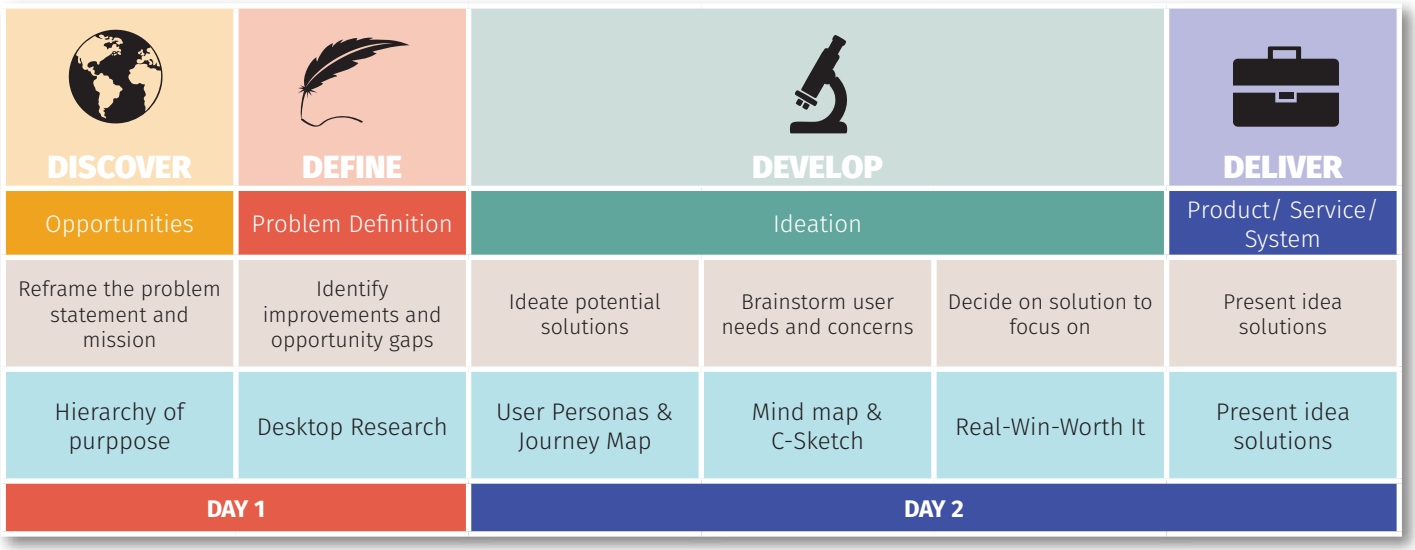

Figure 4. The key steps and deliverables for participants in the 2-day ideation challenge

(Designate), CGH, Prof Chua Chee Kai, Head of Pillar (Engineering Product Development), SUTD, Dr Wong Woon Kwong, Director, Office of Research and Industry Collaborations, SUTD, and Ms Lydia Tan Wan Har, Director, Office of Innovation, CGH. This session was run as a Zoom webinar to reach out to a wider SUTD and CGH audience beyond just the student participants. The judges were very impressed at how well the students were guided throughout the journey of reframing the problem statements, understanding user needs and coming up with novel solutions under the time constraint of 2 days.

Eventually, one winning team and two runner-up teams were selected. The winning team chose to tackle the problem of disposable mask shortage in the pre-pandemic phase of COVID-19, by re-imagining the design of a reusable face mask. The following images highlight the reframed problem statement and the eventual solution, as defined by the winning team (Figure 5).

Student Feedback and Reflections

Despite the pre-existing notion that digital learning quality might be inferior and prone to technical issues, the post-event feedback from students proved otherwise. Students felt that participating in the virtual ideation challenge benefited them as it has "streamlined the event process" with "interactive sessions with the mentors" using technology such as breakout rooms in Zoom. They were able to "think out of the box" and "make friends and brainstorm very challenging projects" through the many virtual discussions. From their ratings, 7 out of 10 participants found the 4D design innovation framework useful, and 9 out of 10 also found

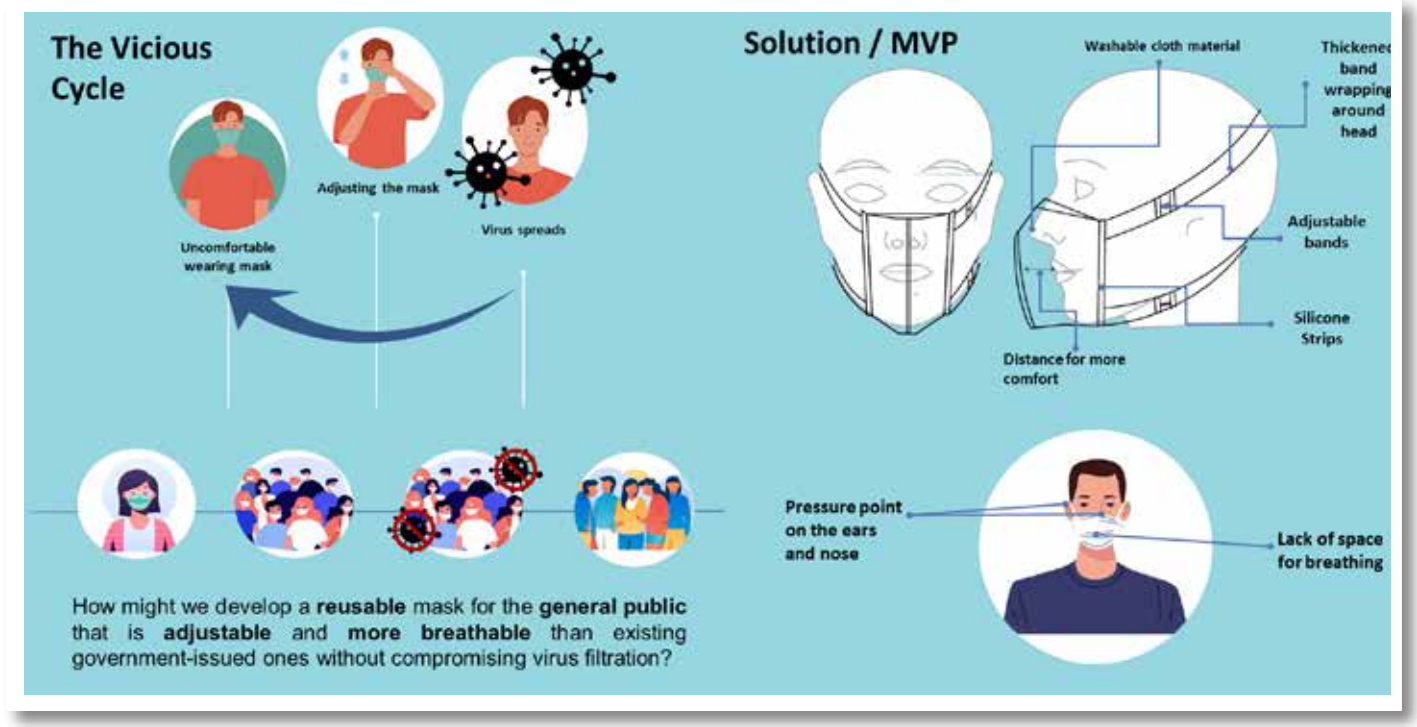

Figure 5. The solution that re-imagines the design of a reusable face mask by winning team

the facilitators/graduate mentors and clinical mentors helpful in guiding their design thinking process.

The key factors to the success of the event, as shared by students, can be summarised by the following:

1. The assigning of students and mentors to each breakout room during the ideation challenge allowed for co-creation to happen.

2. The use of virtual shared folder on Google Drive and Telegram allowed teams to access the information required for their deliverables, facilitated instant messaging reminders and progress updates, and helped them stay on track of their deliverables.

3. Participants were allowed to seek clarifications easily and flexibly in a safe digital learning environment, thus lowering the barriers to entry for students to learn from healthcare leaders by removing the physical distance between them.

Conclusion

Our efforts to establish common spaces for CGH clinician leaders to share their perspectives, to coordinate discussions and collaborations amongst the participants, and to connect with and motivate participants throughout this virtual ideation challenge had created a flexible yet conducive learning environment for students and observed impact through co-creation by design. Students were able to post the fruits of their labour on LinkedIn and shared the valuable exposure they gained through practice in the 2-day ideation challenge.

Acknowledgement

The 2-day programme was SUTD's first virtual ideation challenge with CGH which involved 3 faculty members, 1 senior research assistant, 5 graduate students, 1 undergraduate student and 8 staff from the Office of Undergraduate Studies. Apart from the 3 CGH speakers who planned the sharing for the seminar, there were also 21 CGH clinical mentors who joined in for team consultation sessions during the ideation challenge.

The Organising Committee would like to thank:

- Colleagues from Changi General Hospital, special mention Dr Yuen Heng Wai, Dr Jimmy Goh and clinical mentors under the leadership of Prof Hsu Pon Poh.

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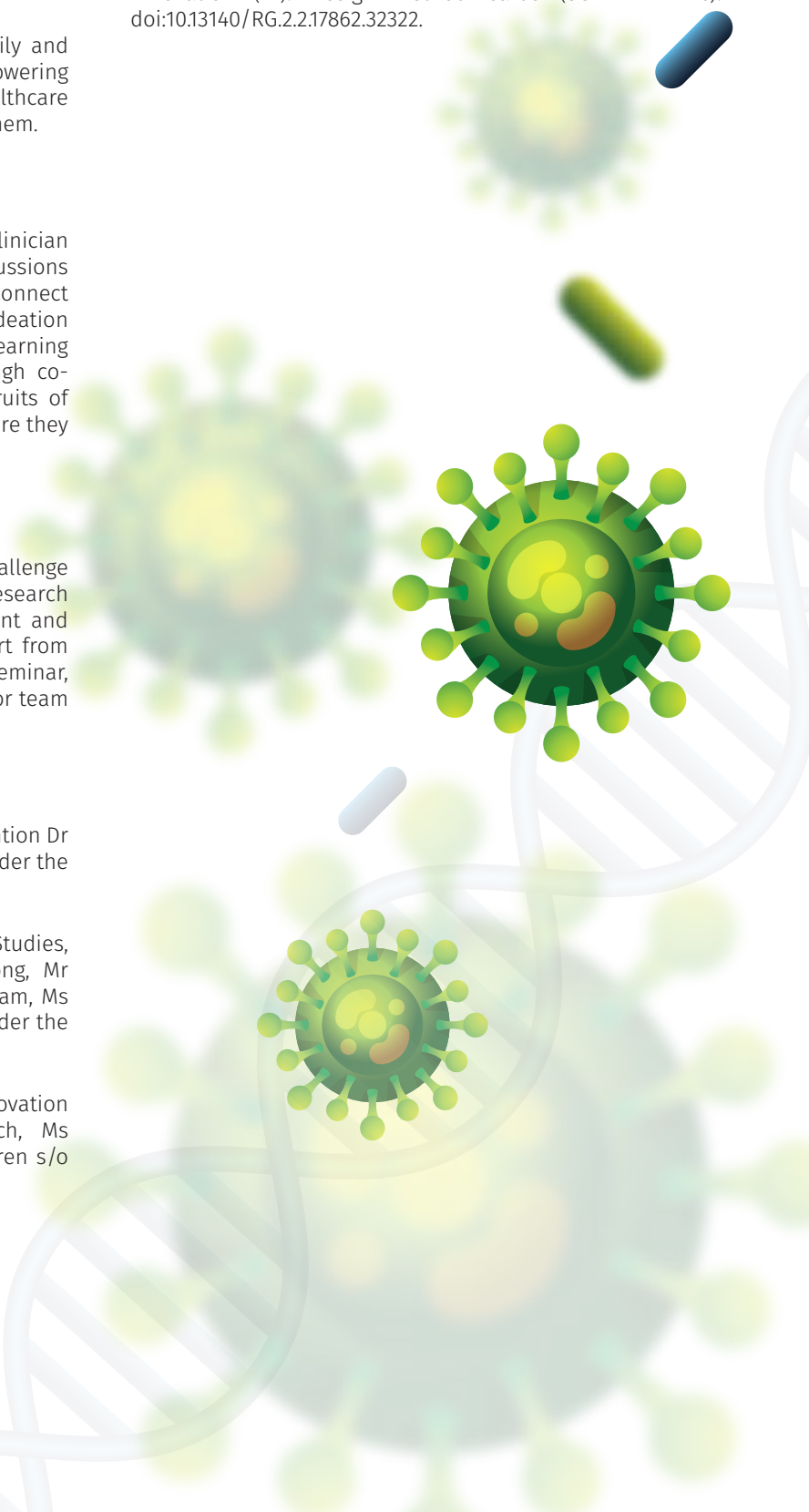

Designing Learning Experiences for Online Teaching and Learning

Nachamma Sockalingam (LSL, UGS) and Liu Jun Hua, Graduate Student (ISTD)

Preparing to Teach at SUTD as Graduate Teaching Assistants

Teaching is about constantly innovating strategies, ways and means to engage diverse students in active and meaningful learning. Each and every lesson is dynamic. Even without the unprecedented situation of COVID-19 and lockdown of educational institutions, we recognize that teaching cannot be just didactic and passive lecturing. While knowledge transfer/ acquisition is necessary, we now understand that our learners need to go beyond and be future-ready so that they are able to solve problems, think critically, work in diverse teams collaboratively, be techno-savvy and be flexible to meet the unforeseen demands of the Volatile, Uncertain, Complex and Ambiguous (VUCA) world.

In line with this, SUTD adopts various student-centric teaching and learning teaching methods and approaches. For instance, SUTD uses team teaching; that is a team of faculty instructors, graduate/undergraduate teaching assistants come together to teach a cohort of 50 students. This ensures that the faculty to student ratio is kept low (from 1:11 to 1: 16 ratio) and makes it possible for students to get individualized attention.

This means that our graduate/undergraduate instructors have to be ready to teach using these student student-centric teaching and learning pedagogies. Even though there is a common belief that only the gifted can teach, we take the perspective that teaching can be learnt by anyone if we try to gain a deeper understanding of what teaching entails. We recognize the need to support our graduate teaching assistants in preparing to teach and run a strategic 18 hour, 6-week course to prepare them to be graduate teaching assistants so that it benefits them as instructors, the faculty instructors they work with and also their students.

In this article, I share my experiences of redesigning this teaching course that is typically conducted face-to-face to a synchronous online course and also invite one of the participant in this course to reflect on his experience as a student.

Pedagogical frameworks/models underpinning the redesign of online course

The "Teaching@SUTD" course is typically conducted face-to-face and embraces various active learning teaching methods [1]. However, we had to conduct this course completely online due to the lockdown situation. This course was run from 18 May 2020 to 22 June 2020 for a batch of 25 students.

Given the limited time and resources and quick turnaround time, I decided to "Augment and modify" the course instead of completely "redefining" the course as per Ruben Putendra's SAMR model which stands for Substitution, Augmentation, Modification and Redefinition (Figure 1). The SAMR model provides a classification of the various types of transformation of face-to-face to blended/online lessons [2].

Typical online teaching and learning lessons that we experience

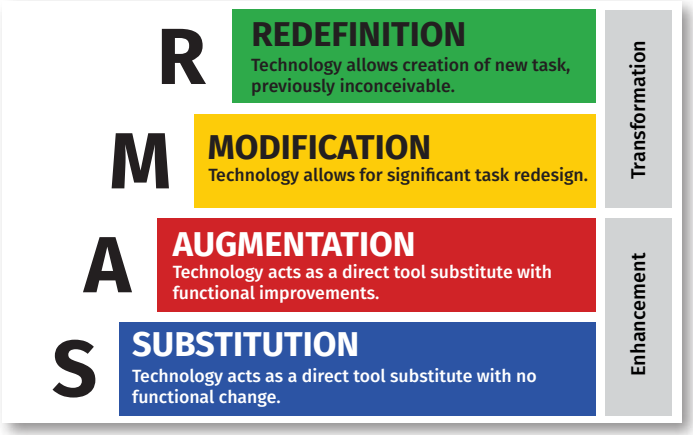

Figure 1. The SAMR model

such as that in corporate trainings, or even Massive Open Online Courses (MOOC) courses refer to provision of structured reading materials, audio and video resources followed by assessments such as quizzes or assignments for independent and self-directed learning. The advantages of such a mode of online teaching and learning are the conveniences of learning anytime, anyplace, anywhere, being able to revisit the learning materials repeatedly, cheaper cost to students and the wider reach to audience.

However, this mode of online teaching and learning is meant for self-directed learning and mainly knowledge acquisition, and may not cover humanistic aspects such as collaboration and communication skills when used solely in an asynchronous/ self-directed learning mode. Hands-on sessions such as lab work or practical work will also be limited. So it important that when we redesign our teaching practices for online learning, we do not simply substitute our mode of delivery to be online, but consider the purposes of our activities and the learning outcomes from each of the activities to "modify" or ideally "redefine" the lessons.

In my case, I needed my students to be able to deliver an online/blended learning that incorporated SUTD's active and interactive learning in groups. So, I decided on " Augmentation and Modification" depending on the activities. While the SAMR model is useful for classifying the transformation type, it does not guide us in what factors we need to consider in the redesign process. The "Fit for purpose" teaching and learning design framework for blended/online teaching and learning [3] I had developed addresses this and helps to plan the technology tools for online teaching.

The "Fit for Purpose" redesigning framework basically breaks the teaching and learning activities into purposeful chunks and proposes that we select technology tools according to the purposes of the teaching and learning activity chunks (Figure 2) . The framework considers various factors like (i) Learning outcomes, (ii) Teaching and learning activities, (iii) Assessment, and (iv) Appropriate technology tools in redesigning our lessons, and it can even help us in considering the sequence of our lessons. It combines various concepts such as Bloom's Taxonomy [4], Constructive Alignment [5], Backward design[6],

TPACK model [7] in one framework. The recommendation is that we use the framework for individual lesson plan and build up to the module plan. This framework is also shared with our teaching faculty in our EPTL website [8] and you will see the examples of implementation in various courses.

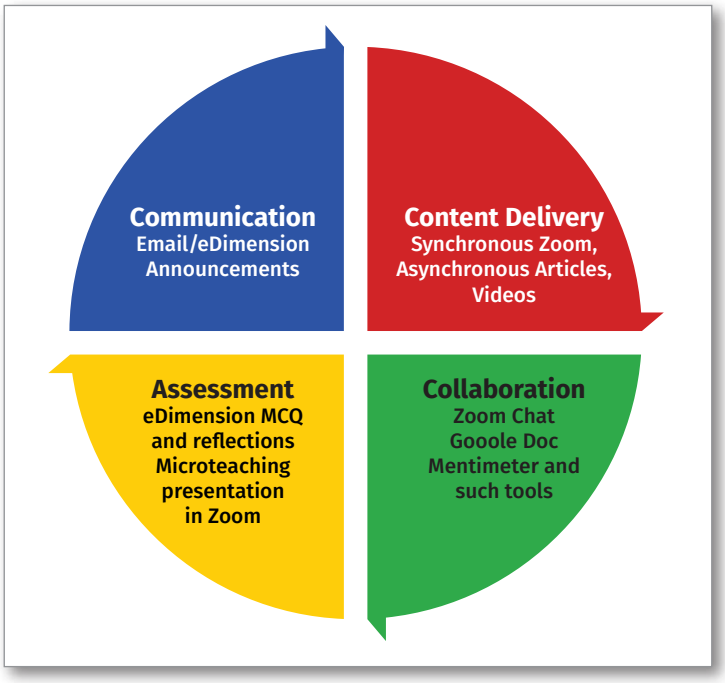

Figure 2. "Fit for purpose" teaching and learning design framework for blended/online teaching

Redesigning the Teaching@SUTD course for online learning

Let us now see how the framework was used. Table 1 gives a quick overview of the Teaching at SUTD course and maps it to the "Fit for purpose" framework.

	Topic	Learning Outcomes	Teaching and Learning Activities	Assessment	Tools
Lesson 1	Getting to know the educational context at SUTD, and understanding self as a teacher	Self-awareness of conceptions of teaching and learning and self	· Discussions · Profiling inventory · Videos · Summary lecture	· Quiz · Reflection	· Google doc · Mentimeter · Zoom · Edimension
Lesson 2	Teaching methods for active learning	Identify suitable teaching methods for active learning and design a microteaching lesson	· Reading resources · Jigsaw activity · Project presentation · Summary lecture	· Reflection	· Zoom · Google doc · Mentimeter · Edimension
Lesson 3	Questioning skills and use of technology tools	Use of open/close ended and socrative questions and providing constructive feedback Identify relevant technology tools	· Video · Small group activities · Presentations · Summary lecture	· Reflection	· Zoom · Google doc · Mentimeter · Edimension
Lesson 4	Assessment and feedback	Design an assessment rubric	· Group activities to design assessment · Summary lecture	· Reflection	· Zoom · Google doc · Mentimeter · Edimension
Lesson 5 and 6	Microteaching	Apply all four lessons in microteaching and provide constructive feedback	· Student presentation · Summary lecture	· Reflection · Quiz	· Zoom and student's choice of tools · Edimension

Table 1. An overview of the online "Teaching at SUTD" course using the "Fit for Purpose" Framework

SUTD's Learning Management System, eDimension, and emails were the primary mode for Classroom Management and Communication. Content Delivery was conducted either synchronously using video conferencing tool Zoom or asynchronously using YouTube videos/reading materials in eDimension. Collaboration and Group Work amongst students were done using video conferencing tool Zoom chat, online word processing tool Google Doc as well online Interactive presentation tool Mentimeter in Zoom sessions. Google Doc was useful as it allowed for collaborative and simultaneous editing and writing. Mentimeter allowed for interactive question and answers for quick polls, quizzes and icebreaking activities. Both formative and summative assessments were conducted using tools such as online synchronous quizzes in eDimension, open-ended reflections in eDimension and student presentations in Zoom with peer and instructor feedback.

While we had used tools such as Google Doc and Mentimeter in previous runs of the face-to-face classes as well, we used these tools more extensively in the online course this time, especially in classroom discussion (Figure 3). Typically, this collaborative activity would have been a role play activity of 3 students where one student plays the role of a teacher, another of a student and the third one serves as the observer. The teacher is to teach a certain concept using socrative questioning method, and after the 15 minute activity of planning and executing, students will reflect on their experiences to discuss how the teaching activity could have been improved. They typically use a vanguard sheet for their script. But this time, the team of students wrote out their socrative questioning in GoogleDoc. I found this useful as I had a concrete script to provide feedback on even after class. It also meant that other student groups could read each other's scripts and feedback to learn from.

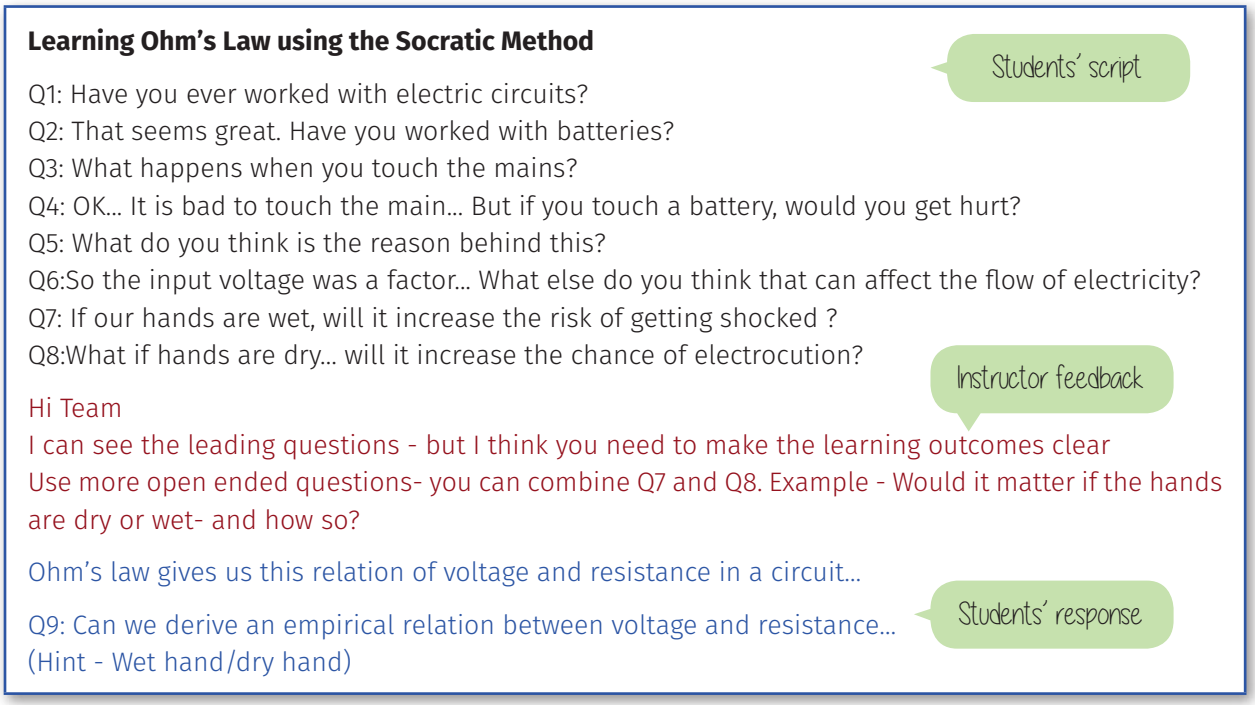

Figure 3. Students' script to teach using socrative questioning method and instructor feedback with student response

The main difference in terms of the technology use this time was the use of Zoom platform to host the synchronous lessons. We used the breakout rooms in Zoom for small group discussion. However, due to the technical limitation of the breakout room, which only allows the instructors/hosts to move from room to room, we could not simulate one of the activities in Lesson 2 effectively.

This was the Jigsaw activity, where group members rotate and go through 6 stations to peer learn 6 teaching methods to construct and formulate their understanding. To adapt this to online format, and since it was not possible for students to move from one station to another, we sorted student names into different breakout rooms and asked students to peer teach. In this case, students did not go from station to station; but students from different stations were sorted into one group. While this is technically the same as moving from station to station, we found that this activity was not as effective as in classroom setting due to various reasons. For example, not all students had read up, some were not speaking up and some others were a little confused with the activity since they were unfamiliar. Generally, the energy and buzz was also not there.

In my views, this activity had worked better in classroom. This is possibly because there would be an expert stationed in one place, and after repeating the explanation 6 times, they would have identified their gaps and would have been able to fill their gaps upon returning to their original station and group. In this way, each group would at least know one teaching method very well and since the others students were learning from experts, they would have picked up the essentials. The advantage was learning in and from groups. But now, everyone had to be an expert and needed everyone's cooperation. As an instructor, I was also not able to monitor the energy level in the various groups simultaneously and move from group to group to energize them by moving around the classroom space as I would have in a physical classroom.

Interestingly, the other online activities that were mostly non-physical and those that focused on cognitive engagement (e.g., designing an assessment) went well.

The assessments were kept as the same format as in face-to-face classes although I modified the questions to suit the context this time. For example, the first reflection questioned on what it means to be an online teacher. The synchronicity of lessons, open-endedness in assignment questions, and focus on the thinking process helped to make the assignments suitable for online assessments so that there is originality and copy-pasting is minimized. I did not see any of these.

The final assessment of microteaching was completely online and this was probably the most challenging for the students in my opinion compared to the previous terms. Senior Lecturer Oka Kurniawan from ISTD also facilitated the microteaching sessions as an assessor. Students had to be creative in designing their online teaching activities and teach within 5 minutes. However we did give additional 5 minutes of buffer time since this was online. The students had to focus more on cognitive activities and minimize on physical activities for their microteaching. In the previous years, many students would include physical activities and demos in their microteaching. I recollect a student teacher asking the class members to imagine themselves to be odd/even numbers and group us according to instructions to illustrate concepts on mathematical clustering. This reminded me of Tactile Mathematics. But such activities would have to be redesigned to be taught online and the graduate students rose up to the occasion.

Lessons Learnt

Overall, while we have the various frameworks and models to redesign the face-to-face to online lessons, this is not a simple process. We have to juggle with the technical and technology limitations and also set new social norms in online teaching and learning. For instance, we had to resort to switching off the online videos to avoid streaming lags but that also meant that we could not keep track of student engagement continuously, and so we substituted with Zoom chats and emoticons. Also, it took a slightly longer time to build the social connection with the students to gain their trust and understanding, and seek the cooperation. Building the social connection is particularly important in group projects.

To get a better perspective, I sought weekly feedback from students. The learners' sentiments of the online class varied. While some liked the online activities, some others found the activities a little monotonous and limited. The discussions and collaborative activities were found to be challenging especially in the early weeks when participants were still warming up but became better over the weeks.

Some noted in their reflections that they still prefer face-to-face learning over completely online learning. Even though blended online learning, that is a blend of synchronous and asynchronous online learning may offer some relief over completely self-directed and independent online learning, students seemed to actually prefer a blend of face-to-face and online learning. There were some rare extremes of students actually preferring completely online (but this misses the importance of learning from peers in collaborative groups). I too agree that the value of personal and social connection in face-to-face meetings is important.

In my personal views, teaching is not all just about just the learning outcomes, skills and values; Many tacit values, habits (e.g., being organized, being positive), mentorship, professional relationships are formed through teacher-student and student-student connections and these are difficult to foster and maintain online.

Overall, the course participants indicated that they felt positive and confident at the end of the course about active teaching and learning in an online environment. All of the graduate students demonstrated active, student centric teaching methods in their online teaching (even though many were not familiar with such methods at the onset) and some were given additional opportunities to refine their work when needed. We continue to improve the course based on student feedback.

Here are some tips for designing online learning experiences based on my experience.

Tips and Strategies for Teaching Online

1. Establish communication channels and connect with students for better understanding and relationships
2. Set expectations on social norms for online learning and communicate effectively on what is expected. E.g., Explain what a Jigsaw activity is
3. Do not just Substitute face-to-face lesson to online mode – Augment, Modify or Redefine (SAMR model) activities in redesigning the lessons as needed. You can redesign gradually instead of one-shot if you have time limitations.
4. Redesign using "Fit for purpose" activities and tools.
5. Minimize physical activities if technology is limiting and redesign activities. For instance, consider virtual tools for labs and reflections to focus on process skills.
6. Blend synchronous and asynchronous activities, and connect the synchronous and asynchronous activities
7. Make assessments open-ended and focus on process skills
8. Use a good mix of formative and summative assessments, and provide prompt feedback, involving the peers and even industrial experts.
9. Give opportunities for students to resubmit work where possible.
10. Get informal feedback from students and continually modify where possible.

This experience of going completely online in such a short time frame was indeed positive and fruitful. I really appreciate and value my students' engagement and learnt from them as well. Their constructive comments on improving the course gave me refreshing ideas. Reflecting through this article also helped me to decide on which activities to keep and modify for the next run.

I end the article with one of the reflections by our graduate student Liu Jun Hua, who is an AI entrepreneur with deep interest in teaching and learning. We both concur that focusing on the learner and connecting with the learner is the most important element for successful teaching - especially in an online context. Do check out his article in the Medium platform (QR code).

My experience and reflections on the course - Liu Jun Hua, Graduate Student

The 6-week GTA course was conducted during the COVID-19 outbreak, where physical classes were not possible. It was the first time that I participated in a class completely online. Fortunately, the online classes went well. I had great joy going through the materials and interacting with the instructor and teachers on Zoom. Most of the students participated in the discussions and class activities actively.

Through the microteaching experience, I realised that it is certainly a challenging task to prepare class materials for online classes that help students achieve learning goals while encouraging active participation. From the entire course and the final microteaching sessions, I observed some patterns or methods that the various presenters had used in engaging the audience and encouraging participatiovn. These are summarized as follows.

Focus on the audience, not the content
Pushing all the prepared content to the audience is perhaps the easiest way to conduct a class, but not necessarily the most effective one. Focusing on the audience is really important, especially for live classes. Be aware of whether majority of the audience are following and being engaged. For instance, are they paying attention? Are they responding to my probing? Are they thinking and taking notes? Learning online can be distracting. Therefore, it is crucial that the instructor keeps in mind students' attention during the class.

Orchestrate the flow of content
Designing a class is like planning for a music performance — we need to anticipate the emotion of the audience though the whole play to create an impact. We can variate the rhythm and intensity of the content to orchestrate the audience's emotion to keep them engaged.

Use of real-world examples
While knowledge is developed constructively, connecting abstract and non-trivial content to real-world examples will tremendously help the audience create connection and see the purpose of learning. Furthermore, making the content light-weighted and fun will certainly help with the engagement — who doesn't like humour?

For more on Jun Hua's microteaching in his article:
https://medium.com/@junhua/orchestrating-an-engaging-online-class-empathy-is-all-you-need-34f2f7b41d59

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There is Something about Games

Bina Rai (SMT)

I informed my seven and ten year-old children that since it was the last weekend before school officially opened after the circuit breaker was implemented from April 7 to May 4, they were allowed to take out the PlayStation and play for as long as their hearts desired. As a result, they sat in front of the television for three hours continuously; completely immersed and engaged as I observed them silently. No toilet, water or snack breaks were needed throughout this period. In sharp contrast, every other morning, there would be at least one toilet break, two snack breaks and multiple water breaks in between lessons and homework sessions. This realization made me reflect on my own teaching experiences. I did not think that I ever had a day in class where my students were utterly mesmerized and engaged during lesson time. If I was lucky, I garnered the full attention of a majority of students for maybe 20 minutes at a time. There is just something about games. What did games have that I was not replicating in my classroom?

To find out the answer to this question, I did what every other millennial would do, Google! Researchers have found evidence that the psychological 'pull' of digital games was largely due to their capacity to stimulate feelings of autonomy, competence and relatedness, and that to the extent they did so they not only motivated further play, but also could be experienced as enhancing physiological wellness [1]. In a research study examining the Self Determination Theory (SDT) and game play, it was revealed that perceived in-game autonomy and competence were associated with game enjoyment, preferences, and changes in well-being as a result of game play. It was also found that competence and autonomy perceptions were related to the intuitive nature of game controls and the sense of immersion participants felt in their game play [1]. The other reason why people seemingly liked playing games was competition. Competition if carried out thoughtfully and in a safe environment is fun! The allure of competition could be illustrated by the students' avid aspiration to become the top three scorers. I observed this personally as my children fought each other fervently (sometimes even with trash talk) to become the ultimate street fighter. For those of us who used Kahoot!, a gamified learning platform, in our classrooms, you will agree that the game's background music alone put the students and you in the right mood.

In Kahoot!, teachers created their own questions adapting them to the level of knowledge and skills of their students (See Figure 1 & 2). It was user-friendly for both parties as well as it contained the basic game elements: points, a leader board, instant feedback and a reward. The desire to fulfil the psychological need for competence drove the students to intrinsically want to achieve as many questions correct as possible. Students would perceive mastery of knowledge as a result and felt good about their performance. Competence promoted the pursuit of challenging and satisfying experiences and is a criterion for psychological growth. The time crunch, clearly visible and deliberate, added to the overall arousal (perhaps manifested as an adrenaline rush and other changes in physiological conditions) and challenge of the games on Kahoot!

But wait, there is more! Kahoot! as an online game used in a classroom created a context in which cooperation as well as autonomy can be observed. Fun and competitiveness add the value to it. In a computer architecture course at the University of Alicante, 88% of students shared that they had fun and learn when they played Kahoot! [2], which was a strong indicator of motivation. In a separate study, it was revealed that Kahoot! enriched the quality of student learning in the classroom, with the highest influence reported on classroom dynamics, engagement, motivation and improved learning experience. Their findings also suggested that the use of educational games in the classroom was likely to minimize distractions, thereby improving the quality of teaching and learning beyond what was provided in conventional classrooms [3].

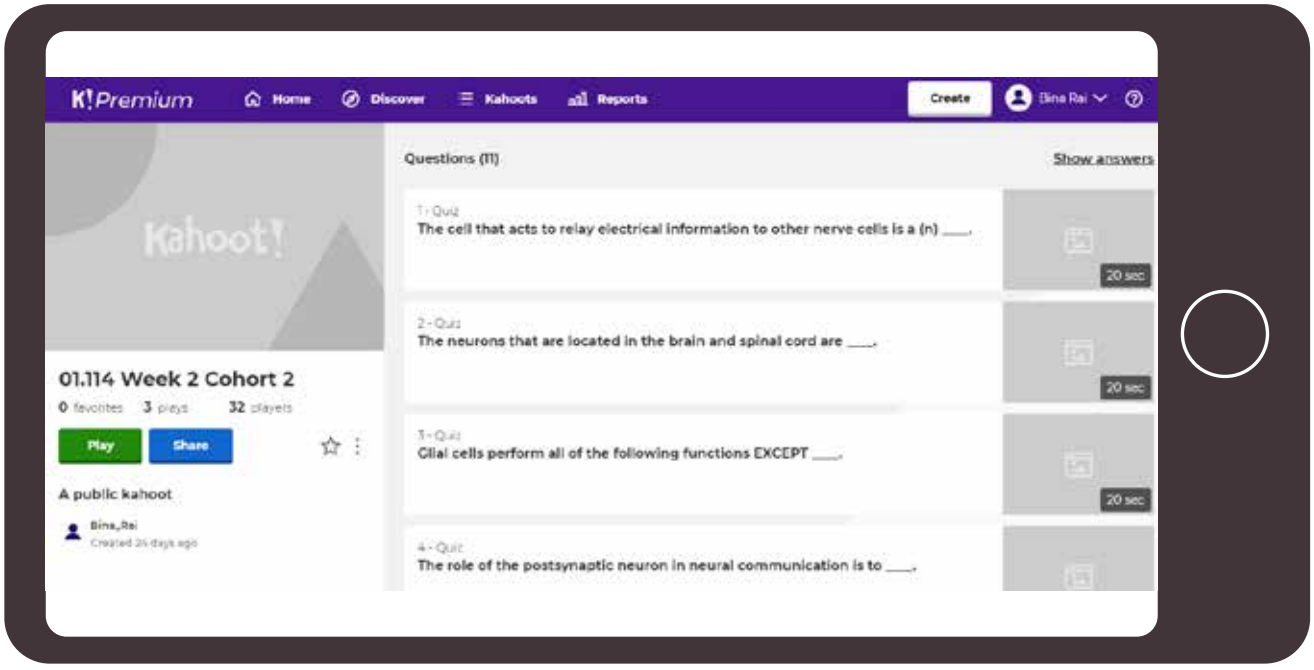

Figure 1. Example of a Kahoot! quiz

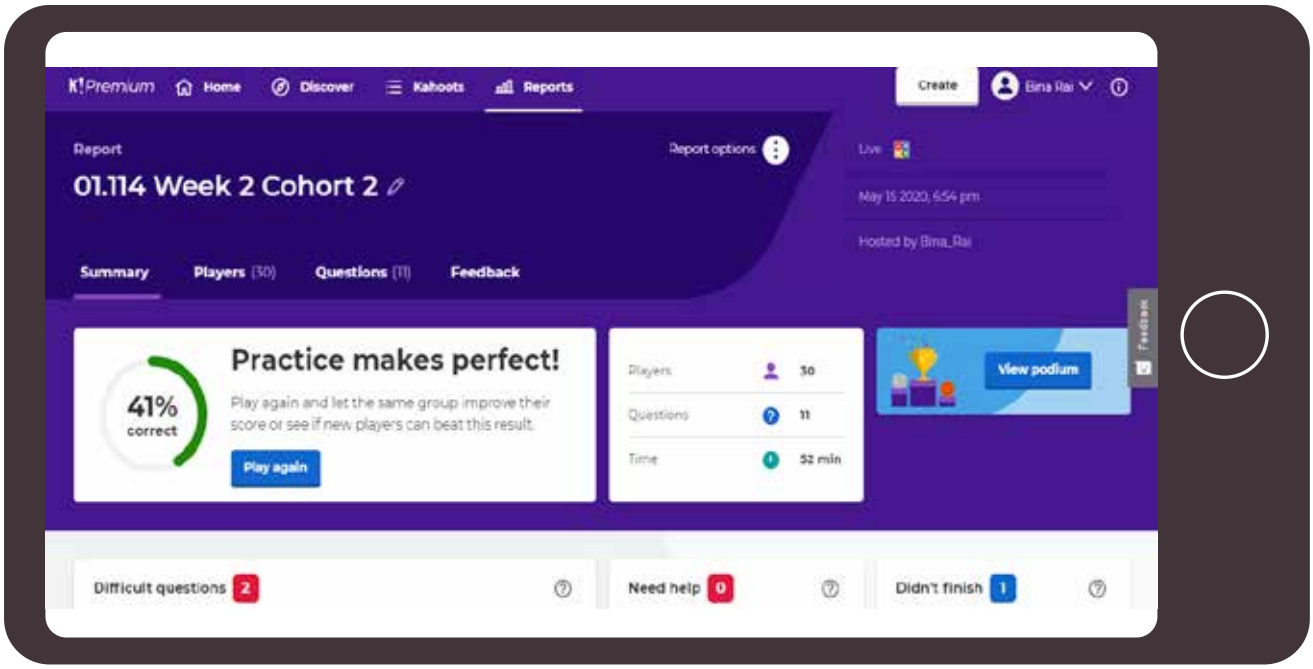

Figure 2. A Kahoot! report generated for instructors

I recently offered a new elective entitled, "Instructional Design of Serious Games for Healthcare" in term 8 this year (https://people.sutd.edu.sg/~bina_rai/). This course starts with an introduction of what serious games are, followed by a close look into the interplay between cellular and molecular storage mechanisms and the cognitive neuroscience of memory and learning. Students then find out why people play and the motivational theories that interpret this behavior. Students are then briefed on game design fundamentals, with a focus on iterative design approach, playtest and the need for assessment. This course takes an evidence-based approach towards information that comprises critical thinking about and critical reading of information to review what research says about the current games, particularly for healthcare applications.

As part of the course, students were asked to critically assess data pertaining the motivations underlying augmented reality games, specifically the case of Pokémon Go [4]. Over 100 million users from 30 countries downloaded Pokémon Go (Figure 3) within a few weeks, and were reported to be playing it for 26 min in an average day [5]. In this game, the user created an avatar and then chose a team to fight with. The game took into consideration the user's geographical location and by moving around in real world surroundings, the player could find and captured "wild" Pokémon. While on the move, the player found other resources that could be useful in developing the captured Pokémon species. The main purpose of the game was to collect all the Pokémon species and improve their abilities.

Figure 3. Characters in Pokemon GO (Credit: Niantic)

The basis of the assessment of motivation was an adapted version of the Motives for Online Gaming Questionnaire (MOGQ-PG) [6], which evaluated ten motivational factors for playing online games. The factors considered were social, escapism, competition, coping, skill development, fantasy, recreation, boredom, nostalgia and outdoor activity. It was observed that the three main motivational factors for playing Pokémon Go was recreation (μ=4.00/5.00), nostalgia (μ=3.57/5.00), and outdoor activity (μ=3.00/5.00). The motivational factors did not differ across demographic factors. Interestingly, male participants spent significantly more time on the game (12.1 h) as compared to their female counterparts (9.07 h) ($p < 0.01$). Men also had significantly higher scores for social and competition ($p < 0.001$). With regards to residence, the motives that stood out were skill development and boredom ($p< 0.05$).

After some deliberation, I may have found some answers to my question posed at the start of this reflection, "What did games have that I was not replicating in my classroom?" Lessons I could draw from digital games was that daily instruction plans need to be crafted with motivational theories such as SDT in mind. Students should feel that they are autonomous and in control of their own actions (student-directed learning), that they experience competence (achieved with appropriate challenges in place) in completing the tasks within the classroom space, and they should feel somehow related to their classmates who are learning together with them at that precise moment. It will take considerable effort but is worth it if restores the fun and magic in my classroom.

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Architectural Design Learning through Data

Verina Cristie, Graduate student (ASD) and Sam Conrad Joyce (ASD)

Virtual design studio has emerged as early as the mid-90s [1] along with the birth of the web in Architecture Studio based learning. Learning and collaboration were the focus in such exercises, such as ETH Zurich's phase(x) [2] where students were to exchange design works in every phase, modifying them creatively in a collective authorship scenario in a common platform. However, such platforms often became proof-of-concept projects without further traction in academia.

Fast forward 20 years later, we adopted this similar idea of digital learning platform in the context of SUTD's Architecture and Sustainable Design computational design approach, with the aim of facilitating student's design learning and at the same time evaluating that learning process. Specifically, we look at parametric design – one of computational design's popular subset. In parametric design, designers are to create their design 'code' visually.

Different design versions are produced by either (i) different code, or (ii) same code, with different sets of parameter values. Numerous design geometries are produced as a result, allowing designers to explore the designs through the different versions created more design versions created early on during the exploration process is usually preferred as it means sufficient exploration is done before committing to a specific design idea to be developed further.

In ASD, parametric design is first taught in 20.211 Introduction to Design Computation Design and subsequently used in 20.202 Architectural Structures and Enclosure Design class in the following term. We introduced our tool, GHShot [3, 4], early in the term during one of the lab sessions of 20.202 course. Students were given an initial parametric truss model, and they were to modify it according to their liking and upload them to the web with GHShot as they were making different design versions. Subsequently, they could continue to modify their design versions, or they could choose to modify their peer's design versions (Figure 1).

The purpose of this design exercise was to prepare the students for the final project of designing and fabricating a parametrically based structural design. Collected design versions exposed the students to different design versions, and the lab review helped students to understand how these design versions performed structurally. For example, when given the same load of 100 kN, different truss structures reacted in different tension value (see Figure 2).

Like how design instructors reviewed students' design journal, the web platform now works as a digital design journal. In it, plenty of data in forms of design versions and information of their authors, creation time, design version connections, and even structural properties were recorded. While the web might not capture the complex cognitive process that happened during designing, the availability of such data provides a learning opportunity as we begin to consider them in the aspects of information, relations, context, processes, views, and interaction [5].

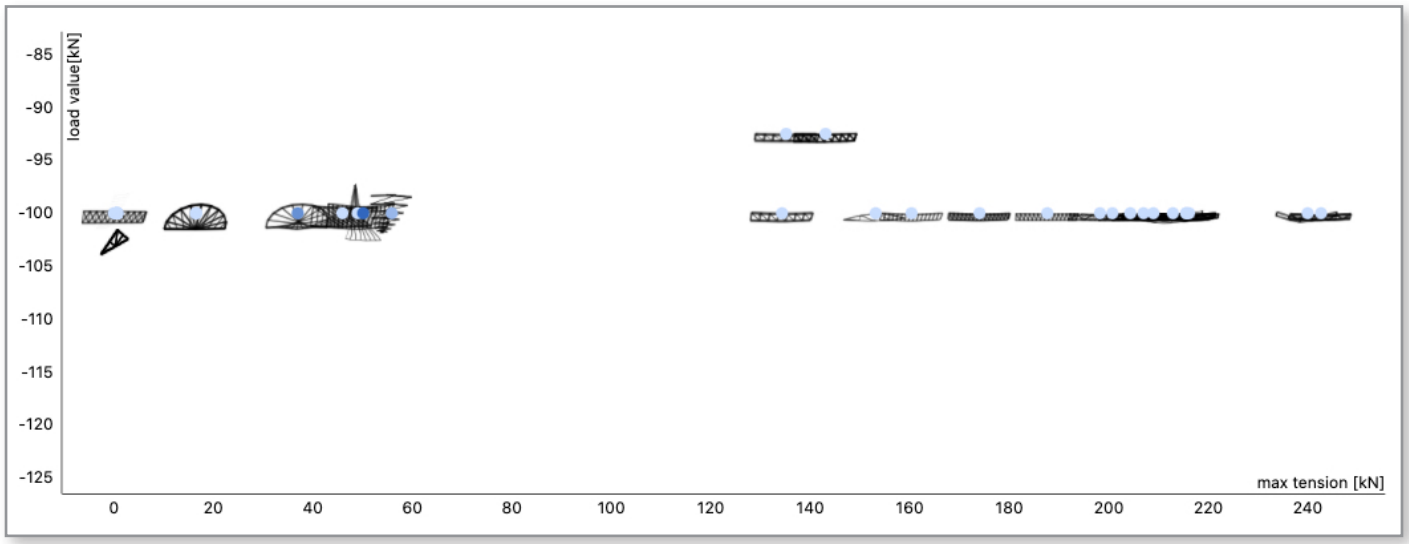

Figure 1. Teaching the structural performance of arch typology (left) by comparing it against standard truss typology (right) from variety of versions designed by students themselves

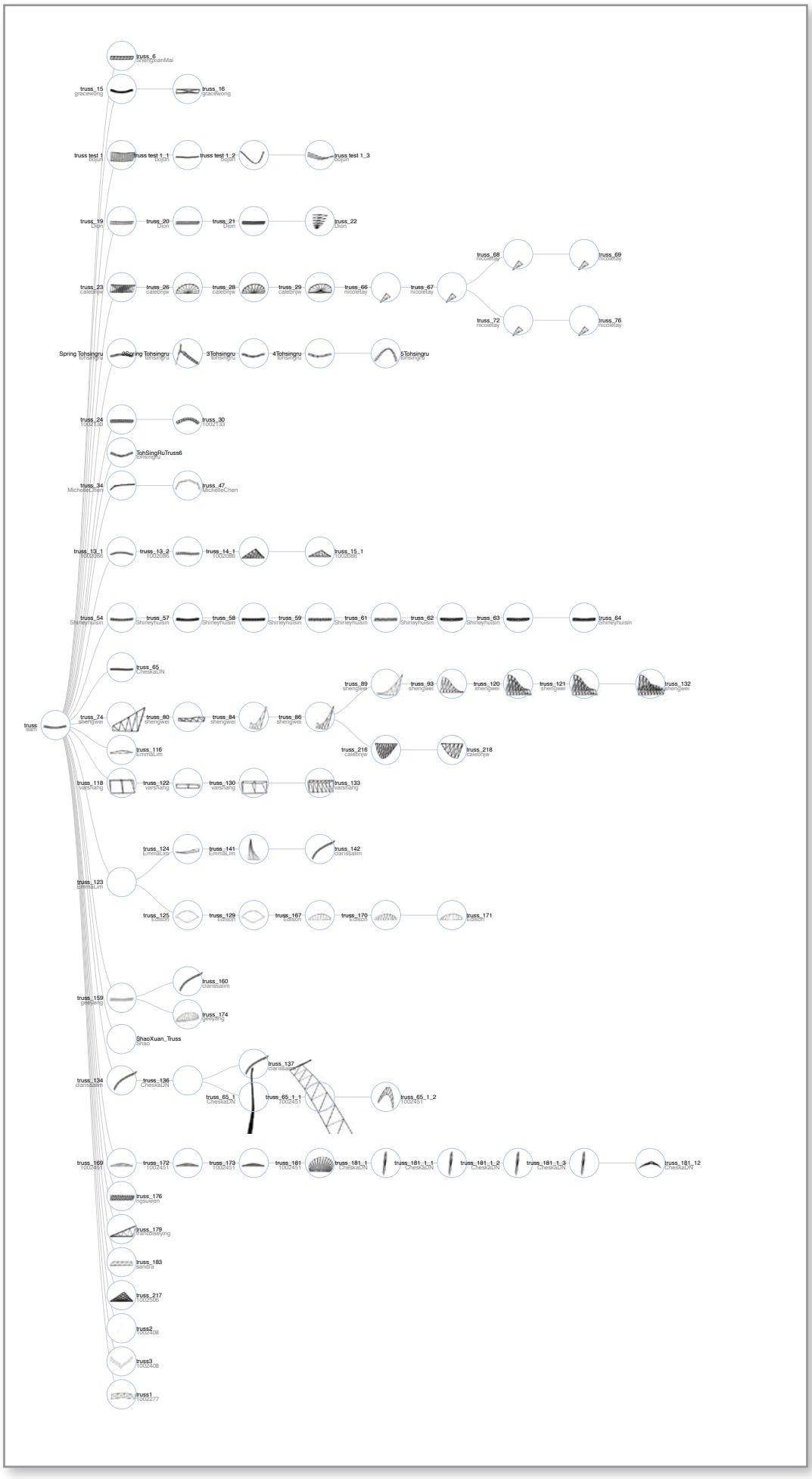

Figure 2. Student's Design Versions Tree from 2018 spring term 20.202 Architectural Structures Design exercise

We used exploratory data analysis (EDA) [6] as the preliminary active data method to recognise patterns and make inferences on the student data. EDA is often started by having summary statistics, followed by visualisation, to further making clusters and detecting anomalies. Following is our initial EDA approach for the data collected from the student projects.

In our study, we grouped the students in Class 20.202 into two groups; Group 1 and 2 and each was assigned a different day to use the computer lab. The students in Group 1 were told that that they could send as many design versions they like, while those in Group 2 were given a minimum of 5 design versions to send. This was done to see how students' design outcome would be if a minimum design number was imposed. The resulting number of design versions produced was counted (see Figure 3).

For Group 1, the minimum number of versions produced was 1 and the maximum was 8. Majority produced about 3-6 designs. This distribution is illustrated through three clusters in Figure 4. Cluster A represents students who only uploaded one design, Cluster B are students who uploaded four designs – this constitutes the majority; and Cluster C refers to students

	Group 1	Group 2
Total number of students	30	26
Total number of design versions	127	128

Figure 3. Summary statistics of participants in our study from 2018 spring term 20.202

who uploaded eight designs. It can be observed that more designs with varying ideas are found in Cluster C. Many of the designs in cluster B seems to be produced by varying the design parameters, with some students attempting to explore different design idea at either the start or end.

On the other hand, it was observed that students in this Group 2 with constrained number of versions actually sent more design versions; there are less students who sent only one or two design versions, with majority of number of design submission now skewed towards 5 or 6 (Figure 4). However, further investigation needs to be performed to see how each version sent is different from one another, to be able to measure how encouraging students to send more design versions affect the overall design outcome.

Figure 4. Comparison of Group 1 and Group 2 design submission

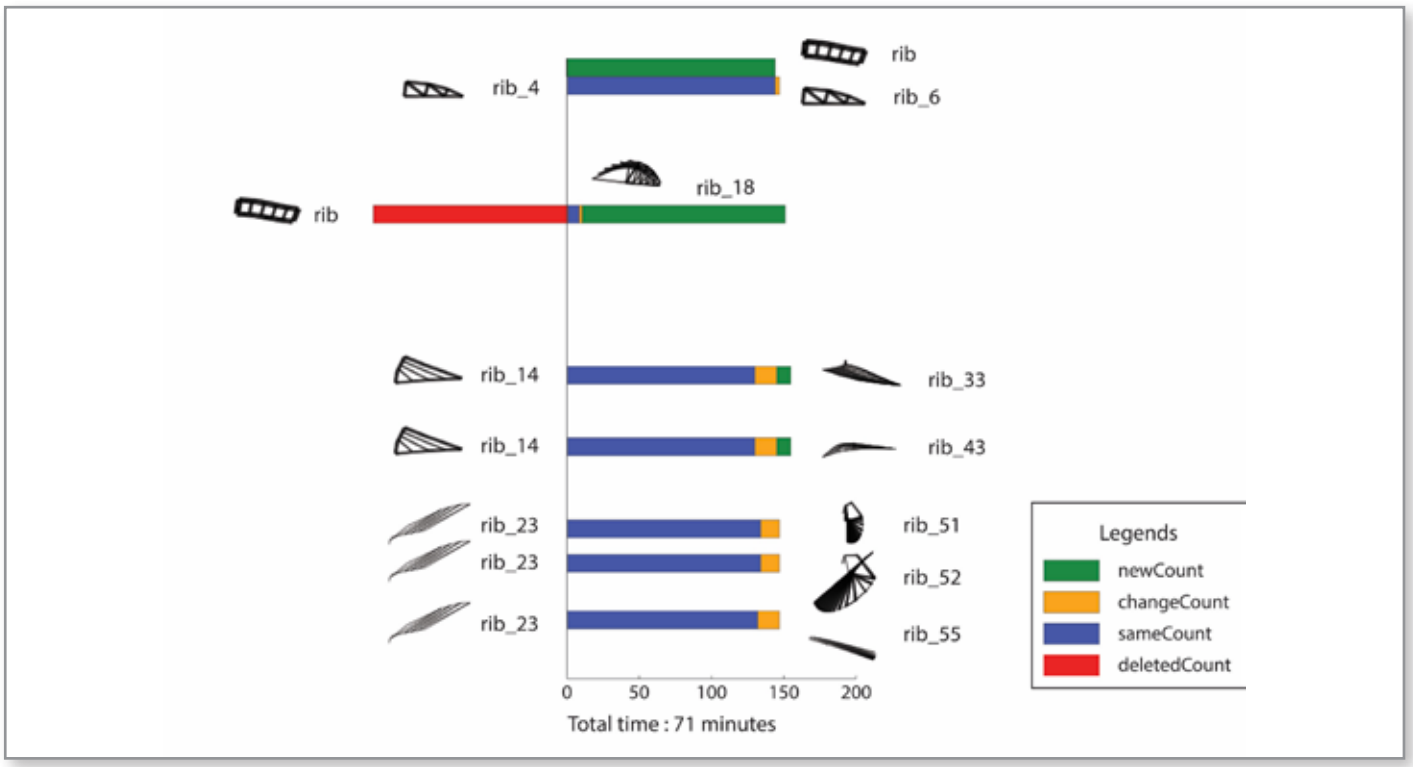

Figure 5. Design journey of a student

For instructors, this versioning web platform provided a real-time, close monitoring of students' progression. The progression could be checked periodically, and it was easy to identify which students who submitted early or last-minute. Instructors could also intervene if students were found to be stuck in their progression. If the student contacted the instructor regarding this, they could discuss better by looking at the student's past progression. Further, the tool also further facilitated a blended learning opportunity. As all designs are collated in the platform, during face to face meeting, instructors can use them as a basis point for teaching and further discussion such as why a certain design is better than the rest.

Further study on quantifying the level of design changes in-between versions is currently ongoing. Doing so will help us to understand better the different type of design exploration and student's design journey. For example, in Figure 5, we are interested to see how a student modified his/her design. Since parametric designing can be likened to writing code, we can count the number of components in the design file that are changed, deleted, added, or remain the same.

By performing EDA, we can learn a little bit more into the group design exploration process that the students go through. However, designing is a complex process, and it is not the purpose of this reflection to find a 'formula' for successful design to be replicated. Instead, it is to provide more understanding of current class' design works for future class' curriculum design, and at the same time to inspire more probing of what can be achieved in the future investigation. For example, GHShot tool could be used in a more extended period of designing, in this manner we can compare if different design pattern could emerge at the start as compared to the end of the design.

Overall, the use of versioning system and web platforms to facilitate design learning and store design progressions should be encouraged, especially in the era of computational design where numerous design versions are continuously produced during design exploration. In our lab sessions with GHShot, the students highlighted that the tool helped them to gain ideas and learn from others' design. Secondly, it also served as an easier documentation method and having versions to go back to, should the current version does not work. Eventually, the data collected provides a repository of designs to build from and also to learn from - to understand more about the design process. Who knows, this learning in the far future could eventually lead us into assisting the design process better.

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New Opportunities Emerging for Heidegger Scholarship in Two HASS Digital Humanities Courses

Paolo Di Leo (HASS)

During the last semester, I had the opportunity to teach two courses, namely The Question of Technology and Being and Time, within the frame of the new Digital Humanities (DH) minor offered by Humanities, Arts and Social Sciences (HASS). Digital Humanities represents a new frontier for the Humanities. New perspectives can be opened on the study of texts in Humanities through the implementation of computers and data analytics. In particular, DH at HASS aims at introducing students to the study of texts, by valuing their skills in informatics. The student projects in these two courses are carried out throughout the semester. In this article, I would like to share some reflections on the students' projects that teaching these courses within the DH minor has allowed us to develop and the potentials these projects have for both didactic and research.

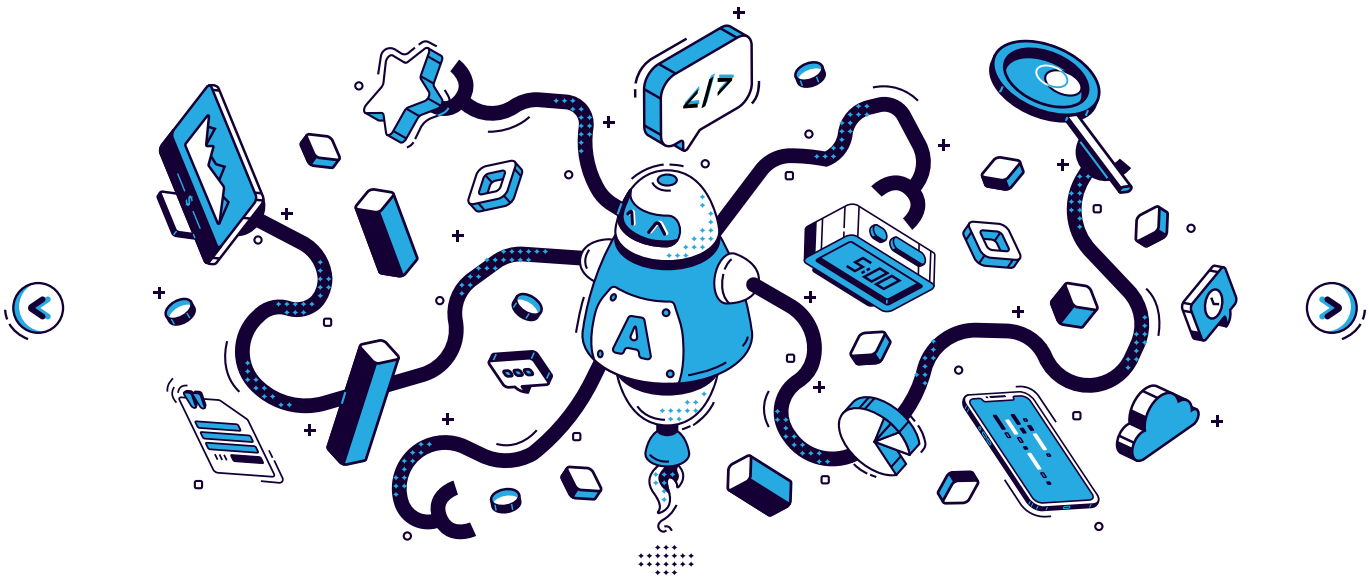
Before describing the projects, a few words about those two courses and their scope. The first course, "The Question of Technology", focuses on a phenomenon that represents in many ways the centre of the latest developments in our civilization: the nature of technology. This phenomenon permeates all aspects of our life, shaping our very understanding of things and of our relation to them.

When thought of naively, technology is deemed just an instrument of human activities, submitted to human will. However, when reflected upon, it appears to be a much more complex and, I dare say, uncanny phenomenon: for, far from being a mere instrument subjected to our will, it determines our very being. Its roots, then, are not to be found simply in the invention and development of new tools and techniques, but rather in precise moments in the history of ideas, in which a certain understanding regarding the human being and its relationship with things emerges. This course, hence, aims at introducing students to those moments, by exposing them to philosophical texts that represents as many milestones in the history of ideas.

We start from ancient Greece, with the Aristotle's Physics II and Plato's Timaeus to then reach Heidegger, whose essay "The Question Concerning Technology" we analyse in connection to the texts previously read. In the past iterations of this course, I had noticed that students appreciated very much studying those texts, albeit their difficulty. They told me that for the first time they gained a new, deeper understanding of themselves and their situation, as they started understanding the nature of the phenomenon that mostly determines their lives and the world they live in. In this sense the course has been a great success since its first iteration and this encouraged me to keep improving it. As I will detail later, teaching it within the frame of the DH minor has offered me new possibilities and avenues of exploration.

Before describing these new possibilities, I would like to say a few things about the other course, "Being and Time". As the title itself makes clear, this course concentrates on Heidegger's 1927 masterpiece, "Being and Time", which since its publication has represented one of the most important contributions to the philosophical debate and the cultural scene at large. Heidegger is deemed by many the greatest philosopher of the 20th century, while by others as a scandalous figure, whose thought is to be fought against: in either case, he is an unavoidable figure for whoever wants to study philosophy and understand the debate that still characterises our contemporary world.

For, Heidegger's thought offers an important reflection not only of the history of philosophy, but much more than that it provides a theoretical frame and a set of speculative tools with which it is possible to gain a deeper understanding of "Modernity" and the world in which we live. Because of this, it is particularly important that students who focus mostly on technology and design read Heidegger's works, as they can find in them what is needed to gain a deeper understanding of what they will do as engineers and designers. However, Heidegger's style does not



make it easy for readers: I know that even the most determined readers have often given up in front of the difficulties posed by his prose. Thus, a considerable effort is made in class to read the book almost line by line, given students ample room to expose their doubts, to voice their uncertainties regarding the correct interpretation and to showcase their hermeneutical abilities.

A text as difficult as this is rarely approached even at the graduate level in philosophy departments, and in Singapore, SUTD is surely the only university where a monographic course on Being and Time is offered. I have to say, not without pride, that most of my students have showed to be able to not only venture through the difficulties of the text, being provided with the right guidance, but have enjoyed it very much, in some cases developing an interest that on the one hand went beyond class hours, on the other allowed them to gain new insights also regarding engineering or design projects they were involved in.

Starting from January 2020, these two courses have been listed in the DH minor offered by HASS. Students who decide to take this minor have the possibility to develop projects, through which they can explore the possible applications of digital tools and instruments to the study and the circulation of texts. As a newly launched course, there are four students enrolled in the course "Question of Technology", and one in the course "Being and Time".

At the beginning of the semester I met all five students to discuss with them on possible projects. Given the fact that working with digital tools applied to texts was something I had never done before, and considering that our students tend to be more familiar with these new instruments –surely more familiar than me, I thought it better not to impose on them my ideas, but to encourage them to come up with their own suggestions. After two meetings, we decided to plant the seed for a rather grand project: the digitalization of Heidegger's texts.

Before proceeding any further, I need to make a small digression, in order to clarify the current situation with Heidegger's enormous production and to expose cases of other authors' works being digitalized. This will make it is easy for the reader to understand the importance of the project, which my students and I have ventured into.

As is known, Heidegger's production is one of the most impressive among the thinkers of both the 20th and the 19th century. Currently the collection of all his writings, the Gesamtausgabe, has reached 102 volumes: they gather all the writings, published and unpublished, as well as the briefings of the university seminars and lectures, which the thinker produced over the course of his career. In its totality this collection appears only in German, and it is divided in thematic areas. Efforts to translate this enormous corpus are currently underway in all major languages, English, French, Italian, Spanish and Japanese representing some of the most accomplished results. However, the problem is that the works that in German appear in a coherent body, published by the same publisher in an orderly fashion, in the various other languages are scattered in a rather disorderly array. This situation makes it rather difficult, and at times even impossible, both for the researcher and the teacher, but for students as well, to find a text originally referred to in German: only finding out whether a certain given work has been translated in any other language, maybe more accessible to the reader than German. This can take a considerable amount of time. To this it must be added the massiveness of the Gesamtausgabe as well as its not negligible monetary cost, well above SGD $5000.

To a certain extent, the works of Nietzsche or those of St. Augustine caused the same type of problems, at least up to very recently. However, a brilliant solution for these two authors has been offered by the digitalisation of all their works. Nowadays any reader can easily consult all the works of St. Augustine in Latin as well as their respective translations in various vernacular languages, by consulting the webpage www.augustinus.it; similarly, one can access from virtually everywhere the works of Nietzsche just by consulting www.nietzschesource.org. Both these webpages offer the possibility to search the texts, to select words and verify their occurrence, and finally to have a basic prospect on the most relevant secondary bibliography. Moreover, each text reproduced in this digital edition provides the reader with a body of footnotes, referencing to other passages in the oeuvres of both thinkers.

When writing my dissertation, I used the digital version of St. Augustine's works very frequently and often wished that something similar existed also for the works of the other author, whose works I was studying, Plotinus. The convenience of having such a tool at one disposal is not only confined to the fact that one has all the works of the author in front of himself, but also and above all by the ease with which these massive works can be perused and researched. Sure, one can still go to a library and use what experts call "concordances", if one lives near one such library, carrying books in Latin and Ancient Greek e.g., and if one has the permission to access one such library, and if this library is actually very well endowed. This is already a lot of "if's". But even assuming that all that were to be at one's disposal, still consulting concordances is not the easiest nor the most pleasant thing to be doing, as it surely entails spending a lot of time and more often than not getting distracted because of the slowness of the process. Having, instead, a text in which each word is easily searchable in the entire corpus is an enormous advantage.

The project I have envisaged with my students is precisely that of offering readers, both researchers and students, with a digitalized version of the entirety of the Gesamtausgabe, linking each German text to an authoritative translation, first of all in English and then in other languages as well. However, we did not plunge into this ambitious project head on, i.e. we decided not to start by digitalizing the German text, but to begin with the English version we were using in our lectures. This decision was due mostly to two considerations: first of all my students, who were the ones to actually digitalize the texts, do not know German, thus encountering serious difficulties when having to even just realign the paragraphs; secondly, we wanted to be able to create something that could be used already in the next iteration of the course by other students both to study the text and to keep improving its digital version. Thus, the four students taking The Question of Technology digitalized the text of the essay The Question Concerning Technology, 35 pages long; while the one student taking Being and Time, started digitalizing the text of Heidegger's masterpiece. Of course, due to the length of the 1927 book, Being and Time, the student was not able to proceed beyond the first chapter, having however digitalised some 60 pages; while the other four students digitalized the entire essay.

The digitalized form of the essay "The Question Concerning Technology" can already be consulted here: https://heidegger.opensutd.org/ (Figure 1). The students have done a remarkably good job, dividing the essay into thematic units, which correspond to those singled through the analysis conducted during class; they also added references, albeit not numerous, to other Heideggerian texts as well as to some of the works of other philosophers we have analysed in class. Each thematic unit is preceded by a succinct summary of its contents as well as by a highlighting of the central point Heidegger develops in it. This is extremely useful, because readers, above all when reading Heidegger's texts for the first time, find it rather difficult to fixate the points he makes while proceeding: having a ready-to-hand reminder of the main points reached in each previous unit helps seeing the argument in its totality and appreciating its logical development.

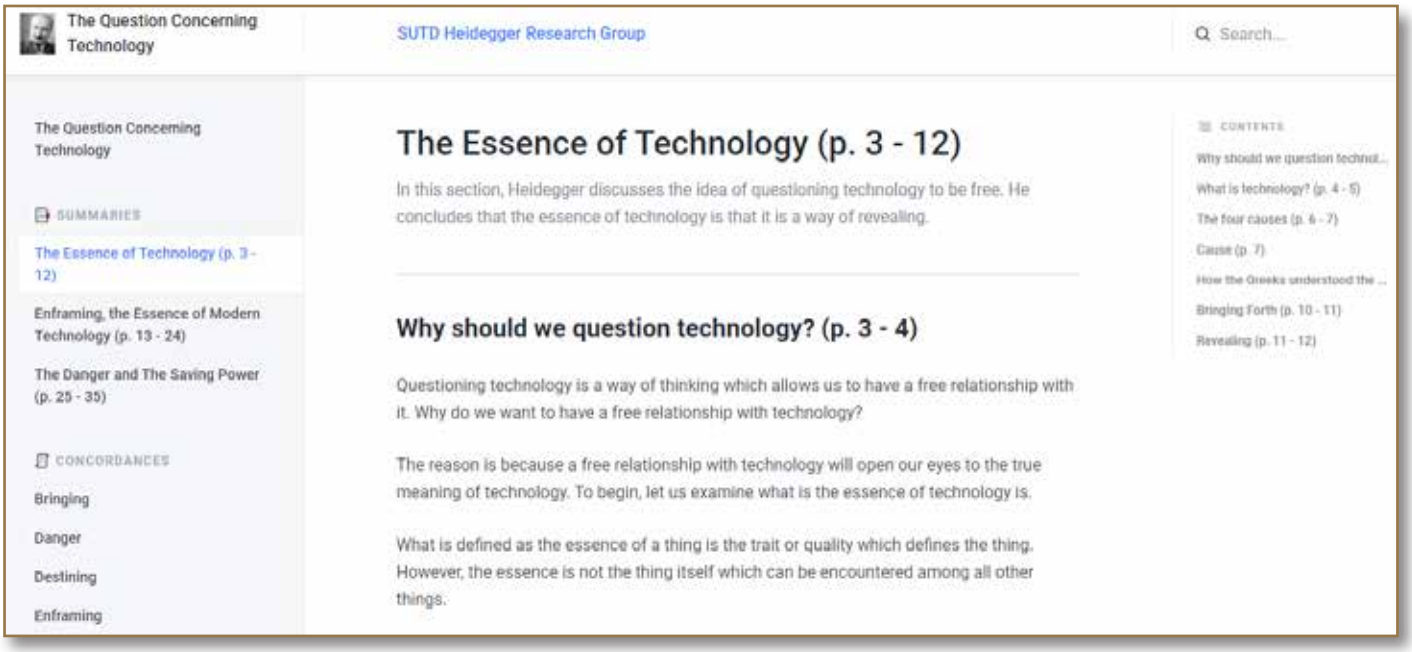
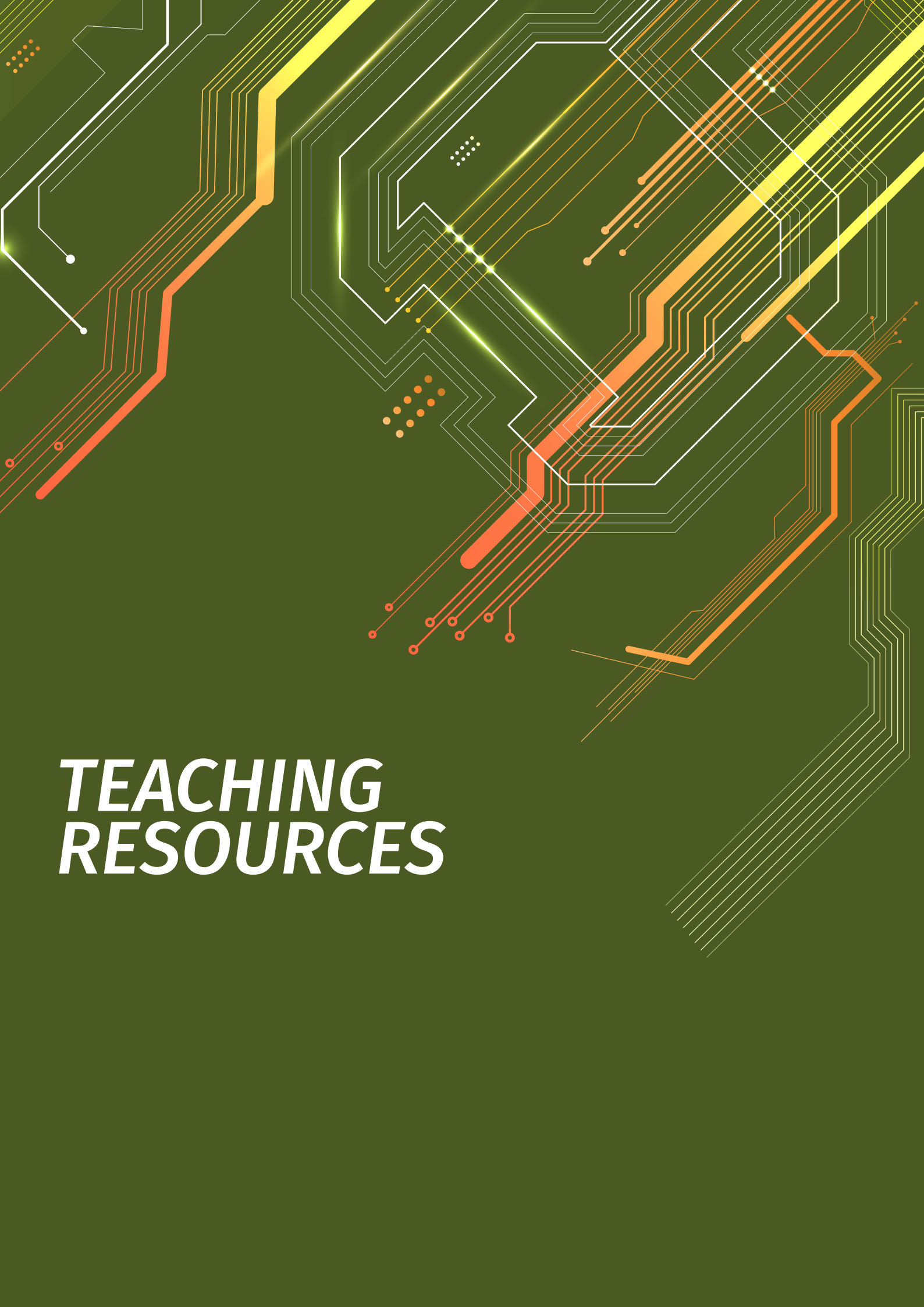


Figure 1. SUTD Heidegger group website

The advantages that a tool like this would offer to researchers do not need to be highlighted again, as they are identical to what I have already stated above regarding the works of St. Augustine. I would like, instead, to say a few words regarding the advantages from the didactic point of view. First of all, a digitalised text like this could offer the opportunity for students to share their uncertainties regarding the meaning of various passages by just writing their comments on them in an open access forum. For example, a digitalised version of the text, on which notes and remarks can be written as marginalia, could be put up on an online platform, such as eDimension or any such thing; students would add their notes on the margins, in which they detail their understanding of the text. This would allow two important things to happen: firstly that the students stay on the text and engage with it, without divagating in random considerations, secondly that the instructor be able to map precisely the progress of students in their reading of the text and be sure that they are indeed following. Moreover, these digital marginalia can facilitate a dialog also among students, since they could comment each other's annotations also outside of class hours. This would allow the dialog that starts in class to keep developing also outside of class. I do not need to underline how a tool such as this would be useful above in a period such as the one, we are going through, in which face-to-face meetings are unfortunately impossible.

My students and I hope that the project we have envisaged and whose first seeds have been planted within the frame of the DH HASS minor can be further developed. The challenges in front of us depend on the one hand on finding the right frame to allow students to keep developing such a project, on the other to get in touch with the main publishers, chiefly with Vittorio Klostermann, to get the permission to use and publish the materials over which they have legal rights. In overcoming both challenges the support and help of SUTD will be crucial. Should we succeed in carrying this project out, SUTD and its community would be at the forefront of both the research on Heidegger and on the innovation on didactical methods.



TEACHING RESOURCES

In Light of COVID-19: SUTD Library's E-Offerings

Due to the COVID-19 situation in Singapore, there was a campus closure from 7 April 2020. While our spaces were closed, SUTD Library continued to provide dedicated library services to all our users remotely through new and existing digital platforms. These include our popular Research Services, Teaching Support and Active Curation of Digital eResources for our SUTD Community to support online teaching and eLearning.

The SUTD Library's Research Services is a value-added service we provide to the SUTD community. While we engage and educate the SUTD community on effective and efficient information

searching techniques, we also help researchers and faculty retrieve resources for various purposes like literature review for grant writing, market research information, research paper bibliographies, annotated bibliographies, presentation research and more!

Soon after the commencement of the circuit breaker, our library team launched a communication campaign to promote our Research Services as well as to assure our faculty members on how they can stay connected with the SUTD Library. Our Research Services includes a research consultation where we attempt to better understand the research background. This session focus on establishing timeframe and building search keywords to establish search strategies together with the requestor. Before the circuit breaker, we conducted such sessions face-to-face. Now, we conduct them via Microsoft Teams or Zoom. Many clarifications on research scope and requirements were shared via screen sharing.

During the campaign period, we successfully completed a total of 27 research requests from the SUTD community. Four requests are from the Office of Undergraduate Studies and they include provision of literature and information on practices for curriculum development, focusing on topics like online assessment, self-directed learning, exam/test/assignment definitions and more. We have also completed 14 research support for grant applications and literature reviews for research paper writing for our faculty and researchers.

Here are some of the positive feedback from our faculty and researchers during this period.

Being a digital first Library, SUTD Library has always provided easy off campus access to our vast collection of digital resources for our SUTD community. During the circuit breaker, we have not only expanded our access capabilities, SUTD Library also played a critical role in securing digital resources to ensure the continuity of lessons during the sudden switch to e-learning. For our HASS lecturers who could no longer screen movies in class with DVDs loaned from the SUTD Library - we provided them with open online streaming alternatives. For our Freshmores who no longer had access to the physical textbooks that we supplied for in-class referencing – we procured e-textbooks to ensure students have ready access to course related content. In addition, we also sourced for open access educational resources to ensure displaced students are not disadvantaged due to a lack of resources.

To support online learning during the COVID-19 outbreak, many resource providers have come on board to offer free and/or unlimited access to their paid resources temporarily for displaced students, researchers, and academics. The SUTD Library curated comprehensive resource lists from authoritative sources. The Education Resources List includes 7 databases that provide extended content access. The COVID-19 eResources List includes free e-resources, enabling students and educators access to resources they need for eLearning as well as research articles relating to COVID-19. These resource lists feature past publications relating to coronaviruses, public health, drug discovery, patient management and more. You can find the full list of resources on the dedicated website called Emergency Preparedness for teaching and learning @SUTD 2020, created by the Learning Science Lab (https://eptlatsutd.weebly.com/library-resources.html).

We have also pushed out an Online Teaching Resource List and a Teaching & Learning Methods Resource List to assist the faculty who had to make a sudden switch to online teaching during the circuit breaker.

To encourage SUTD staff members to upgrade their skills while working from home, the library works with our Human Resource department to disseminate useful courses from Linkedin Learning. Our staff can take the opportunity to enroll and learn while at home.

During the circuit breaker, we held our Capstone trainings virtually via eDimension and M.Arch in-class training via Zoom to ensure the students are equipped with information literacy skills.

We are delighted that our efforts have managed to help ease some of the challenges faced during the circuit breaker and we maintain our stride in the gradual reopening of the SUTD Library after the circuit breaker. For more information on how we can help you, contact us at library@sutd.edu.sg.

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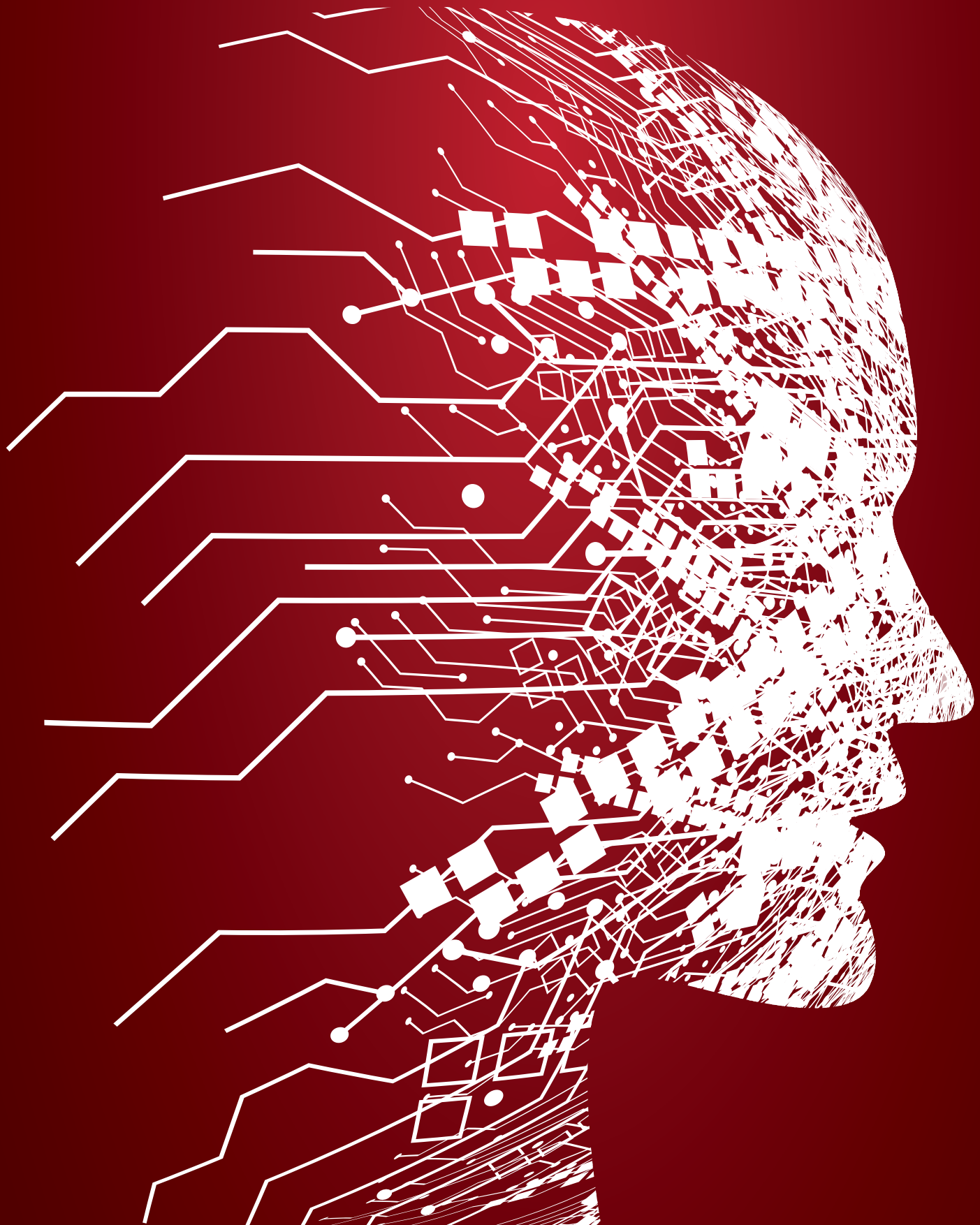

ABOUT LEARNING SCIENCES LAB

Learning Sciences Lab at SUTD was established on 15 July 2016. As part of the Office of Undergraduate Studies, it aims to support faculty and learners in engaged teaching and learning. Learning Sciences Lab is directed by Dr. Nachamma Sockalingam with the support of Mr. Fraser Tan, under the guidance of Associate Provost for Undergraduate Studies, Professor Pey Kin Leong.

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