SUTD, Singapore

Case Study Part B – Institutional context

Undergraduate engineering student intake (1st year cohort 2020/21):	**≈ 450**
Number of engineering faculty:	**≈ 120**
Duration of undergraduate engineering degree (to BEng):	**3.5 years**

1. Defining features of SUTD's engineering education

Established in 2009 in collaboration with MIT, SUTD is a specialist design and technology university, catering to a select intake of around 500 undergraduates per year. A defining feature of the university is its multidisciplinary, active and student-centred educational approach, which is underpinned by team-based problem solving and collaboration. All undergraduates are based on campus to support access to dedicated team working and prototyping spaces, and to advance peer-to-peer learning.

Because SUTD takes a hands-on approach to education, remote learning is not a feature of its current and future educational vision. However, educational technology and the development of cyber-physical systems – as tools to allow students to explore new ideas, deepen their learning and offer individualised learning while on campus – play a major role in the university's educational vision for the future. Drawing on strategic external partnerships in educational technology, SUTD is investing significantly in Artificial Intelligence (AI), data analytics, robotics and AR/VR. Early developments already rolled out in the curriculum include the use of AI[1] and AR/VR[2] in the teaching of mathematics and AR/VR Architecture studio modules[3]. New initiatives in the pipeline to realise the university's vision of cyber-physical systems include the development of: 3D/AR whiteboards (to allow, for example, students to explore, annotate and present 3D models) and a virtual campus (to support virtual tours of SUTD and to showcase students' 3D projects). SUTD is also looking at ways to leverage emerging technologies to develop new learner analytic and 'anti cheating' systems, for application to both online and offline learning. The university points to the willingness of its faculty to embrace a non-traditional and constantly evolving curriculum as a major strength in its capacity to advance innovations in educational technology.

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[1] Example of the use of AI at SUTD: https://player.vimeo.com/video/444750185?dnt=1&app_id=122963

[2] Example of the use of AR/VR at SUTD: https://ieeexplore.ieee.org/document/9045957

[3] The use of AR/VR in SUTD's Architecture studio module 20.317: https://asd.sutd.edu.sg/programme/bachelor-of-science-architecture-and-sustainable-design/courses/20317-augmented-design

2. **SUTD's experience of emergency teaching in engineering**

2.1. Emergency teaching restrictions

During the two-month 'circuit breaker' period of total lockdown across Singapore during April and May 2020, SUTD's programmes moved entirely online.

After more than a month (from April 8th to May 17th 2020) operating in a fully online mode, SUTD moved to a blended model between May 18th and Sep 13th 2020. During this period, many courses were still delivered online, but a limited number of labs, architecture-style studios, hands-on projects and examinations were able to go ahead face-to-face, albeit under stringent social distancing restrictions.

From September 14th 2020, all first year classes were delivered face-to-face on campus provided that the class size was under 50; first year students in larger class sizes and those in other year groups continued to operate under blended learning conditions.

2.2. Managing the transition to emergency teaching

In its immediate response to the COVID-19 restrictions and its shift to online learning in March 2020, the university shipped IT devices to faculty (such as Wacom tablets, iPad Pros, microphones, webcams) to support their capacity to develop and deliver online courses from home. Faculty were also offered training in the use of some of the key applications adopted for this online learning environment, including MS Teams, Hiverlab[4] (for AR/VR activities) and ClassPoint[5] (to integrate student feedback and interactivity into presentations). SUTD currently supports a variety of platforms for synchronous and asynchronous teaching, including:

- **synchronous:** video meeting and collaboration platforms (e.g. Zoom, MS Teams, Blackboard Collaborate); platforms to advance student participation (ClassPoint and Slido);

- **asynchronous:** screen recording (PowerPoint) and content creation (eDimension[6]).

Initial barriers to SUTD's emergency online learning (as reported by students) typically related to internet connectivity and home environments that were unconducive to learning. Despite these early challenges, faculty reported high levels of student engagement in online team-based activities, which was largely attributed to the opportunities for peer-to-peer connection and interaction that these experiences provided.

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[4] Hiverlab: https://www.hiverlab.com

[5] ClassPoint: https://www.classpoint.io

[6] eDimension: https://www.sutd.edu.sg/educational-technology/Learning-Solutions-and-Applications/eDimension

2.3.   Addressing the challenges of emergency teaching

The major challenge faced by SUTD has been in the remote delivery of its hands-on and collaborative project-based activities. This has related particularly to guiding students through the collaborative design process, the development and construction of physical prototypes, and the showcasing of project outputs. Since March 2020, the university has developed and rolled out a number of new online solutions that target these particular areas. Examples include team-based games (such as multi-player logistic simulation games hosted on a remote server[7] and gamified virtual labs to teach cell biology) and e-exhibitions (such as virtual showcases of students' product design solutions, including for Capstone projects[8]). Where on-campus hands-on activities have been possible, smart cameras with facial recognition have been adopted to limit the number of students using prototyping facilities at any given time, with robotics supporting real-time monitoring of safe distancing among the users.

3. **Impact of emergency teaching on SUTD's educational approach**

While SUTD's fundamental emphasis on hands-on collaborative problem-solving and innovation remains unchanged, the COVID-19 restrictions have accelerated the university's plans for the development of cyber-physical systems to support its on-campus learning. In particular, the period of emergency teaching has fast-tracked SUTD's work to develop digital twins and AR/VR content as substitutes for physical systems and prototypes. These advances will also be used to underpin new and immersive modes of collaboration with overseas students and global partners. A second priority is the development of personalised approaches to teaching and learning, be that online (through new advances in learner analytics) or in the classroom (through sensor technologies tracking student behaviour that will allow the university to optimise the physical learning environment).   SUTD's experiences during this period have also underlined the distinctive culture and educational approach of the university and its student community, which is reflected in the ways such technologies are accessed and used. This has galvanised SUTD's ambition to pursue bespoke, rather than off-the-shelf, educational technology solutions in the future.

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[7] ESD Games, SUTD: https://esd.sutd.edu.sg/esd-games/

[8] Virtual Capstone Design Showcase, SUTD: https://capstone.sutd.edu.sg

Source of evidence

The case study for SUTD (including Part A, the review of the Virtual Ideation Challenge, and Part B, this review of the 'institutional context') drew upon one-to-one interviews with 10 individuals: the SUTD Associate Provost; the SUTD Director of Undergraduate Studies; the two co-faculty leads of the Virtual Ideation Challenge from SUTD; two clinician mentors from Changi General Hospital (one of whom was the activity coordinator from Changi General Hospital); the coordinator of the graduate mentors for the VIC; and three SUTD undergraduates.

Further information about the methodology for development of CEEDA case studies is given at the project website[9].

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[9] CEEDA case study structure and approach: https://www.ceeda.org/about#case-studies