

Dental education in Singapore: A journey of 90 years and beyond

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Abstract

In 2019, the Faculty of Dentistry celebrated its 90th anniversary. Since its beginning, the Faculty has grown from strength to strength and its efforts at nurturing generations of oral healthcare professionals have evolved. Such growth and evolution ensure that the Faculty's mission of education remains contemporaneous, effective and relevant to future-proof its graduates to play an instrumental role in helping the population achieve good oral health. This article documents the Faculty's early years; highlights its journey and educational endeavours which have transformed teaching and learning in dentistry. It also sheds light on key drivers of change which will shape the way the Faculty seeks to transform dental education for the future.

Practice Highlights

- Dental education plays a pivotal role in training future generations of oral healthcare professionals.
- Dental education will evolve and transform with time as new pedagogical approaches emerge and shape its delivery.
- The planning and delivery of dental education will also be influenced by a myriad of other factors including demographic shifts such as the increasingly ageing population.
- Critical thinking and problem solving skills are essential skillsets to be cultivated through dental education.
- Technology can be a useful and powerful lever to advance and transform teaching and learning in dentistry.

I. INTRODUCTION

A. The Early Years of Dental Education

In 1922, the Council of King Edward VII College of Medicine mooted the idea of establishing a dental school. The first dental course was introduced in 1926 (Ho, Keng & Tay, 1989). A year later, a Department of Dental Surgery in King Edward VII College of Medicine was formed. The early Dental School, the only one in the British Crown Colonies in the East at that time (Lee, 2006), operated from five small rooms in a disused ward (Norris Block) in the General Hospital, Sepoy Lines. Between 1926 and 1927, seven students enrolled in a four-year Licentiate in Dental Surgery (LDS) course but all dropped out of the course after the first year.

Mr E. K. Tratman from Bristol was appointed Professor of Dental Surgery and Head of the Dental School in

1929. Under his leadership, the LDS was lengthened to five years to align with similar courses offered by British schools and with the eventual intention for it to be recognised by the United Kingdom (UK) General Medical Council. The dental course re-started in April 1929 with three of the pioneer LDS students. A new "Dental School and Clinic" building opened in 1938 in Sepoy Lines to cater for an increased student intake (Ho, Keng & Tay 1989; Lee, 2006).

During the war from 1939 to 1945, the Dental School was closed as the premises were occupied by the Japanese Military. At the end of World War II, the UK General Medical Council recognised the LDS in 1946. In 1949, the University of Malaya was formed and the Dental School became the Dental Department within the Faculty of Medicine. In 1950, Professor Tratman retired.

Professor R J S Tickle took over as Professor of Dental Surgery, University of Malaya. That year, the dentistry course was revised to conform with the UK General Dental Council requirements and the degree of Bachelor of Dental surgery (BDS) replaced the LDS (Ho, Keng, & Tay, 1989).

B. Becoming a Dental Faculty

An extension to the Dental School building in Sepoy Lines was completed in 1955. Facilities and equipment were upgraded. The School, comprising three main clinical units – Conservative Dentistry, Oral Surgery and Prosthetic Dentistry, doubled its enrolment to 124 students (Ho, Keng, & Tay, 1989; Tan & Keng, 2005).

In 1962, the Dental Department became part of the University of Singapore, a separate entity from the University of Malaya (Singapore). The Dental School became a Faculty independent of the Faculty of Medicine in 1966. Professor Edmund Tay Mai Hiong, a graduate from the local Dental School, became the first Dean of the new Faculty of Dentistry. The Faculty continued to develop with newer facilities added to it and was later re-structured into three Departments – Operative Dentistry, Oral Surgery and Prosthetic Dentistry. A new School of Postgraduate Dental Studies was also established (Ho, Keng, & Tay, 1989).

In 1986, the Faculty of Dentistry moved to the Kent Ridge campus (Ho, Keng, & Tay, 1989), occupying three floors in the National University Hospital (NUH) Main Building. In 2010, the Faculty moved to a new location on Kent Ridge where the undergraduate teaching clinics, classrooms, pre-clinical simulation and dental laboratories, the graduate clinic for residency training in Orthodontics and Prosthodontics, the Dean’s office and academic staff offices were housed. Clinical services for the public and residency training for Endodontics, Periodontology as well as Oral and Maxillofacial Surgery remained at the Dental Centre in the NUH Main Building. Research laboratories were housed separately in a neighbouring building.

C. A New Home – the National University Centre for Oral Health, Singapore

On 5 July 2019, the National University Centre for Oral Health, Singapore (NUCOHS) was officially opened. Education, research and administrative functions of the NUS Faculty of Dentistry and the clinical services of the NUH University Dental Cluster came under one roof.

Year	Dean
1986 – 1994	Professor Loh Hong Sai
1995 – 2000	Professor Chew Chong Lin
2001 – 2009	Associate Professor Keson Tan
2010 – 2016	Associate Professor Grace Ong
2016 – Present	Professor Patrick Finbarr Allen

Table 1. Deans of the Faculty of Dentistry at Kent Ridge Campus

II. CELEBRATING THE EVOLUTION OF DENTAL EDUCATION

The fundamental goal of nurturing, educating and training competent oral healthcare professionals to deliver high quality and safe care remains a cornerstone of the Faculty’s mission. While this has not changed, significant changes have emerged in the delivery of dental education.

Such changes stemmed from two factors. The first was a shift from the traditional teacher-centred approach to a more student-centred one. The view that teachers are experts solely responsible for delivering content and student learning is no longer sacrosanct. Instead, students play a significant role in directing their learning while teachers facilitate it. Secondly, the Faculty moved towards a competency-based curriculum driven by clearly defined competencies expected of a newly qualified dentist. This was in line with global best practices in dental education. These changes led to the introduction of various new initiatives between 1990 and 2000.

A. Competency-Based Curriculum

The traditional approach of a requirement-based curriculum where students were deemed competent on completing a fixed number of dental procedures was replaced by a competency-based curriculum. This gave students more flexibility in learning procedures by attaining expected performance standards. It also reduced the attendant stress students faced from the former approach.

B. High-Fidelity Simulation Technology

The first high fidelity pre-clinical simulation training system was introduced in the Operative Dentistry curriculum using real-time augmented reality feedback to inform students and academic staff of the quality of the students’ performance.

C. Problem-Based Learning

Problem-based Learning (PBL) was introduced to help students become more self-directed in their learning. Under the guidance of PBL facilitators, students took the lead to ask questions and find answers related to pertinent oral health conditions presented through case-based discussions.

D. Undergraduate Research Opportunities Programme (UROP)

Introduced in 1996, UROP comprises a compulsory mini-research project which students undertake over 16 to 18 months. Academic and clinical staff guide students to either develop hypothesis-driven projects or conduct literature reviews of key topics. Through UROP, the students' intellectual curiosity is piqued and they are guided to discover answers systematically. The students share their findings at an annual Faculty Research Day with the best teams representing the Faculty at regional and international scientific competitions.

E. Developing 21st Century Skills

Critical thinking and problem solving skills are especially important in a constantly and rapidly evolving clinical dentistry landscape. Towards this end, the BDS curriculum was reviewed in 2015 to reduce content fragmentation and redundancy to allow more opportunity to develop critical thinking and problem solving skills in the students. For instance, the three complementary subjects of *Oral Pathology*, *Oral Medicine* and *Oral Radiology* were integrated to form a new module

spanning Years 2 – 4 of the BDS curriculum. This synergised the learning in these areas to help the students better appreciate the diagnostic and clinical aspects of Oral Pathologies and critically apply the knowledge to address real life clinical issues which often involve Oral Medicine and Oral Radiology too.

F. Harnessing Technology

With the proliferation of technology-enhanced learning (TEL), the Faculty has harnessed the potential of emerging technology to enrich the educational journeys of its students. In light of this, the Faculty has intentionally embraced technology on various fronts.

1) Technology-Infused pre-clinical simulation: Simulation training in the Faculty has advanced further with virtual reality simulators that incorporate haptic force-feedback to complement the conventional simulation training used to teach tooth restorations. Students now have a more authentic experience of these clinical procedures prior to managing their patients. Simulation, which brings together 3D printing and augmented reality technology, has also come to the forefront in teaching students to deliver Inferior Dento-Alveolar Nerve blocks effectively and safely. An iBook has also been developed to help students electronically navigate the theory behind such anaesthetic techniques. Extraction of mandibular first molars of complex root forms and minor surgical removal of wisdom teeth of varying impactions have also leveraged similar 3D-printed simulations in undergraduate teaching.

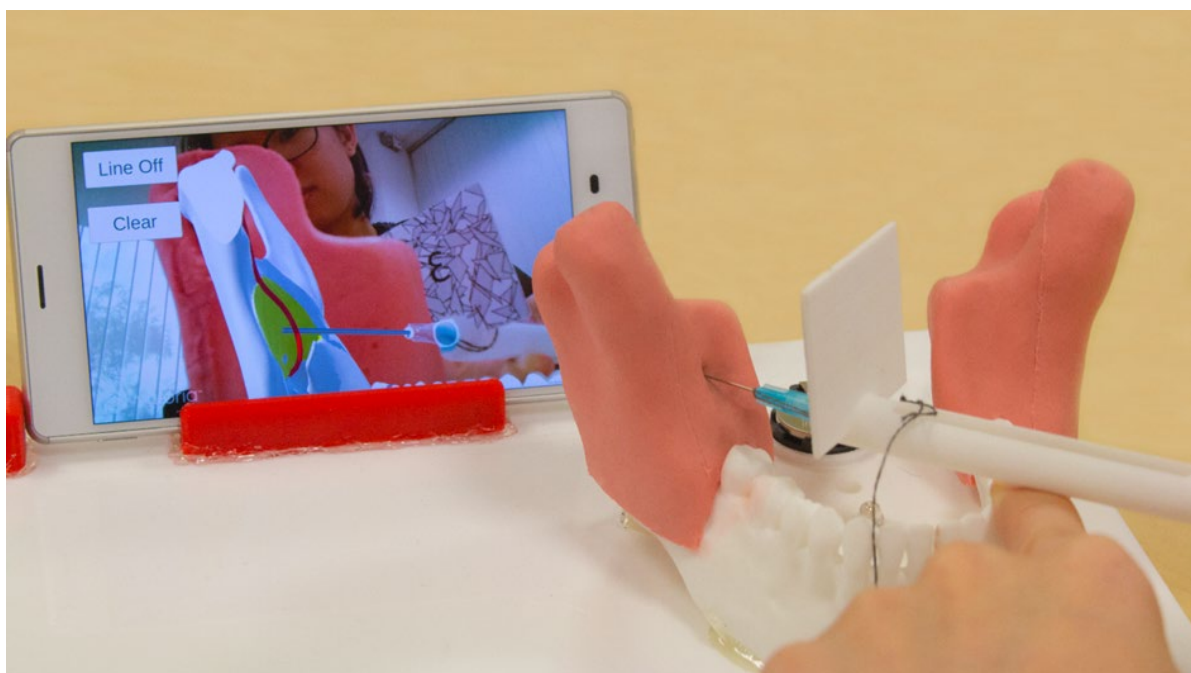


Figure 1. A simulator with augmented reality technology provides real-time visual feedback to students on the placement of the injection needle for Inferior Alveolar Nerve Local Anaesthesia

2) *Eye tracking of X-ray reading*: A more recent TEL development supported by the MOE Tertiary Education Research Fund employed eye tracking technology to understand eye gaze patterns of students when they read X-rays. In so doing, academic staff are able to tailor their teaching to their students' needs and guide them more effectively in interpreting radiographs.

G. Technology in Clinical Education

Beyond pre-clinical training, the Faculty has also used technology in these areas of clinical education:

1) *Visualisation of anatomy with Cone-Beam Computed Tomography (CBCT)*: Diagnostic 3D CBCT technology was introduced in 2009. Dental students, residents and clinical staff use this modality to visualise complex anatomy for diagnosis and to plan treatment of impacted teeth, dental edentulism, and jaw deformity.

2) *Digital impressions and analysis of virtual dental models*: Digital models from digital impressions are generated in PDF file for 360-degree viewing. This facilitates analysis of the dental models by Orthodontics residents.

Given the potential of technology in dental education, the Faculty has introduced a six-stage framework to guide the development, use, and evaluation of technology in teaching and learning. These six stages encourage academic staff to embrace technology in teaching through a systematic approach to:

1. Reflect on teaching practice;
2. Identify learning gap;
3. Design, Develop, and Implement technology solution;
4. Assess learner satisfaction (usability);
5. Assess learner gain (outcomes); and
6. Assess learner impact (behaviours).

With this framework, academic staff can tap on a Faculty-level Technology in Dental Education (TIDE) Fund to champion their technology-enhanced learning (TEL) efforts. In so doing, they will also be able to gather useful data on how their TEL interventions contribute to student learning. Through this fund, academic staff have

since developed innovative teaching platforms such as *iRadiate* and *iRadiate 3D* which use a multi-media platform and augmented reality technology, respectively, to train dental students to accurately position the intra-oral X-ray tube.

In line with a more student-centric approach of learning, the Faculty has leveraged new technology-driven capabilities to longitudinally track students' first piece of work to graduation with the Longitudinal Learning and Coaching Management (LLCM) system. With its full roll-out, students' performance in clinics, laboratories and classrooms can be triangulated to yield patterns of performance for analysis. Through this, students' poor performance can be more expeditiously identified by academic staff for timely remedial interventions.

H. Responding to Continuing Professional Development

The Faculty has also been proactive in responding to the professional development needs of practising dentists. This is supported by the Division of Graduate Dental Studies (DGDS) and Centre for Advanced Dental Education (CADE) which oversee speciality training and continuing professional development programmes. In 2014, a new three-year full time *Master of Dental Surgery Paediatric Dentistry* programme was introduced to address a national need to train more specialists in the management of oral diseases in children. CADE introduced a two-year part-time *Graduate Diploma in Dental Implantology* around 2006 to address the need to train general dentists in dental implantology. A more recent programme in Geriatric Dentistry was introduced to equip dentists with additional skills to manage the oral health needs of the older adults.

III. ADVANCING DENTAL EDUCATION INTO THE FUTURE

As the Faculty sets its sights on its centennial celebrations, it has put in place plans to advance dental education further. One area is continuing professional development of its academic staff. In line with this, the Dental Educators Empowerment Programme (DEEP) has been set up to support, engage, develop the capabilities of its academic staff and empower them to become effective dental educators.

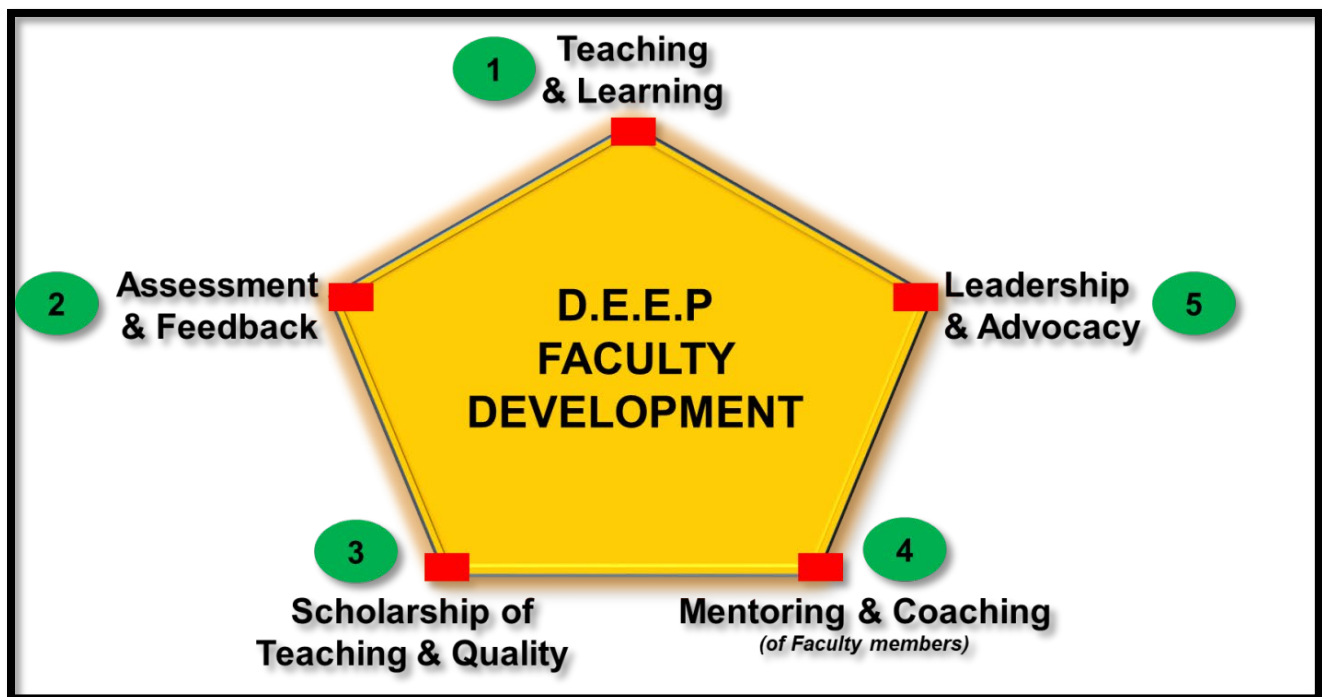


Figure 2. The DEEP framework and the domains of professional development for dental educators to empower themselves to advance dental education into the future

The demographic shifts resulting from an increasingly ageing population will also shape dental education of the future. The curriculum will need to be further enhanced to provide its undergraduates with added exposure in this area to meet the oral health needs of the elderly when they graduate. Increased exposure to the elderly in the community right from the first year of dental school is a possible trajectory for pre-clinical dental education.

Collaborative healthcare practice will also become a critical skillset for our future graduates as oral-systemic relationships become better established. Oral health care should be appreciated in the broader context of healthcare which requires multi-disciplinary and inter-professional engagements. This signals the need for increased opportunities in inter-professional education across the healthcare professions.

IV. CONCLUSION

Dental education is poised for change as it faces a myriad of factors ranging from new evidence-informed educational pedagogies, the advancement of educational technology as well as population changes. The Faculty of Dentistry will continue to embrace change to ensure that its graduates are ready to meet the evolving oral health needs of the population.

Notes on Contributors

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Declaration of Interest

The authors declare no conflict of interest for this paper.

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