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Dental materials science curriculum in Malaysia: Time for transformation

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Abstract

Introduction: Dental materials science is one of the core courses for Malaysian undergraduate dental programmes, which has been primarily taught through a series of didactic lectures during the preclinical phase. In accordance with the newly revised national competency statement, Malaysian dental education is moving toward competency-based education, hence a reformation of the dental materials science curriculum is warranted.

Methods: Curriculum design including common teaching, learning and assessments methods for the Malaysian dental materials science were described and analysed. The common practices were reviewed and compared with latest national guidelines and literature.

Results: There is yet an initiative to establish a national curriculum for dental materials science. The use of traditional teaching strategies for this course also needs to be revamped from a teacher-centred to a student-centred approach. Furthermore, faculty members are facing significant challenges because the revamp requires them to explore cutting-edge pedagogical methods and develop appropriate learning opportunities, environments, resources, and assessments. Several recommendations are proposed, such as mapping the existing dental materials science curriculum to identify gaps, incorporating more hands-on sessions, implementing an integrated curriculum, introducing various formative and summative assessments, as well as recruiting faculty members with different areas of educational expertise.

Conclusion: It is hoped that this article offers a clearer pathway for Malaysian dental educators to pioneer new insight and transform the existing dental materials science curriculum.

Practice Highlights

- In 2021, a revised national dental competencies statement is established in Malaysia.
- Malaysia is moving toward competency-based dental education.
- Curriculum mapping is essential to identify gaps in existing curriculum.
- Traditional didactic lectures need to be revamped to apply a student-centred approach.
- Dental educators need to introduce various pedagogical methods and assessments.

I. INTRODUCTION

Malaysian dental curriculum is historically underpinned by the primary goal in nurturing clinically competent dentists to provide safe and high-quality oral healthcare treatment to the public. Although the curriculum has witnessed an array of revisions over the years, little has been done for dental materials science courses. In the present article, the authors outline an overview of the dental curriculum in Malaysia and describe how dental

materials science courses are currently delivered. Subsequently, challenges and compelling needs are highlighted to envision the future curriculum.

II. OVERVIEW OF DENTAL CURRICULUM IN MALAYSIA

In May 1972, the Universiti Malaya established the country's first dental school to offer a Bachelor of Dental Surgery (BDS) programme. Nowadays, dentistry has

become one of the popular university programmes for high school leavers in Malaysia and the number of applicants has increased significantly over the past decades. Thirteen dental schools have been established of which six are public institutions and the remaining seven are private institutions. All dental schools in Malaysia operate independently as siloed institutions; there is no national standardised curriculum or licensing examination. Currently, each of these dental schools offers a five-year undergraduate dental programme leading to the conferment of BDS or Doctor of Dental Surgery (DDS), and all programmes are required to be accredited by the Malaysian Dental Council (MDC).

In general, undergraduate dental programmes in Malaysia are divided into two phases: preclinical and clinical phases. The preclinical phase encompasses the first two years of the undergraduate programmes. Undergraduate dental students are taught fundamental dental and medical concepts along with operative practical and laboratory skills through simulation exercises on mannequins or dummy heads. In the subsequent three years of the clinical phase, students are given the opportunities to manage and provide treatments to patients. At the end of the five-year programmes, dental students are expected to be clinically competent and practise evidence-based dentistry with ethics and professionalism.

III. DENTAL MATERIALS SCIENCE CURRICULUM IN MALAYSIA

A. Curriculum Content

Undergraduate dental programmes in Malaysia offer dental materials science courses as one of the core disciplines in the second year of preclinical phase. Dental materials science is a course that integrates underlying principles of chemical engineering and materials science into the practice of contemporary dentistry (Qazi et al., 2019). Typically, dental materials science is introduced as a stand-alone course distributed across several modules over the preclinical dental phase. The course usually starts with an introduction to dental materials and the properties of commonly used dental materials. In some dental schools, the course is divided into discipline-based such as dental materials used in conservative dentistry, prosthodontics, paediatric dentistry, orthodontics, or periodontics; whereas some schools divide the course into clinical-based and laboratory-based dental materials. Among the course content covered in clinical-based dental materials include amalgam, dental composite resin, glass ionomer cement and impression materials. On the other hand, denture-based polymers, dental ceramics, metal alloys, gypsum products as well as casting and investment materials are covered under laboratory-based dental

materials. Additionally, most dental schools in Malaysia design and develop their dental materials science courses based on Bloom's and Simpson's taxonomies, with the bulk of the curriculum content lying within cognitive C1 (Remember) to C3 (Apply) and psychomotor P2 (Set) to P4 (Mechanism) levels.

B. Teaching, Learning and Assessment Methods

Dental materials science courses are usually delivered through a series of didactic lectures. Students are also exposed to practical hands-on sessions to examine the properties of commonly used dental materials and manipulate various dental materials. For instance, some dental schools in Malaysia introduce hands-on practical to evaluate the mechanical and viscoelastic properties of various dental materials as well as to mix clinical and laboratory-based dental materials, such as dental gypsum products, dental polymers, dental cement, and dental impression materials.

Nevertheless, since each dental school utilises a distinct set of course learning outcomes, it is infeasible to make a direct comparison between them. Moreover, students are required to meet the desired course learning outcomes upon completion of the courses. Most dental schools use either formative, summative, or a combination of both assessments to evaluate their students, though solely evaluating students based on formative assessment is rare. Students also might be evaluated through quizzes, presentation seminars, assignments, written assessments, and practical assessments such as objective-structured practical examinations (OSPE). Examples of written assessments include multiple-choice questions (MCQ) and short-answer questions (SAQ).

IV. CHALLENGES AND THE TURNING POINT

In June 2021, the Malaysian Dental Dean Council organised a workshop and proposed a revised national competency statement for future graduates in Malaysia, which was later endorsed by the Malaysian Dental Council in July 2021 (Malaysian Dental Council [MDC], 2021). The national competency statement was revised to align with the Malaysian Qualifications Framework version 2.0 competency-based education. Specifically, for dental materials science, the cognitive and psychomotor-related clusters have stated that future dental graduates should be able to justify the selection of dental materials based on the science and applications and related environmental issues (Cognitive: C4 Analyse) and to manipulate commonly used dental materials (Psychomotor: P5 Complex or overt response). Subsequently, Malaysian dental schools are prompted to revise their existing dental materials science curriculum

to attain the intended learning outcomes. It is necessary to reform the dental materials science curriculum that is going to lead the attainment of cognitive and psychomotor competencies. Yet, there is no standardised national curriculum for dental materials science courses in Malaysia, despite there were a few attempts by faculty members from several dental schools.

Furthermore, pedagogical methods require improvement as dental materials science courses are often delivered via didactic lectures, whereby students claimed as a 'dry' subject (Soni et al., 2021). Implementation of traditional pedagogical methods does not only result in a lack of applications of pertinent knowledge, but these methods also reduce students' interest and learning efficacies for the courses. Hence, the traditional pedagogical methods used to deliver dental materials science must be revamped to shift from teacher-centred approach to student-centred approach. There is a need to adopt diverse pedagogical methods in encouraging active students' engagement during learning activities. This shift has posed a significant challenge to faculty members because not only do they need to explore innovative pedagogical methods that promote active learning, but they need to devise appropriate learning opportunities, learning locations, learning resources, and alternative assessments for students.

Different educational backgrounds of faculty members who teach dental materials courses are also a topic of discussion. Some Malaysian dental schools recruit experts with postgraduate degrees either in dental materials, conservative dentistry, prosthodontics, or restorative dentistry, while some schools might employ experts with a background in chemistry or material sciences. Students may miss the fundamental knowledge (if taught by BDS qualified) or fail to relate the clinical applications (if taught by scientists). At the present, teaching qualifications are encouraged but not mandatory for faculty members.

V. RECOMMENDATIONS FOR TOMORROW'S DENTAL MATERIALS SCIENCE CURRICULUM

The revised national competencies statement represents national advocacy for transformation in the dental curriculum. Hence, curriculum mapping is an initial step in transforming tomorrow's dental materials science curriculum. Following curriculum mapping, dental educators can identify the gaps in the existing curriculum, suggest components to be maintained, revised, or removed with the purpose to achieve the desired cognitive and psychomotor competencies as listed in the national statement. Consequently, it also symbolises the significance to spur the call for the

establishment of a designated dental education department in designing and developing comprehensive dental programmes in Malaysia. In hindsight, one may say that this notion served as the impetus for Malaysia to accomplish competency-based dental education in the 21st century.

Didactic lectures place a focus on the transmission of knowledge passively from lecturers to students. Students may find it difficult to understand the basic premises and practical applications of materials science and engineering due to its interdisciplinary nature in the field of dentistry. As students are required to comprehend and justify the selection of various dental materials, hands-on experience in their pre-clinical education is of utmost importance. For instance, practical sessions on manipulating different materials may be arranged following theoretical lectures. Thus, the ability to actively apply the theories of materials science to clinical content is what constitutes mastery in dental materials science courses, which goes beyond how well a student can recall and repeat factual information. In addition, to incorporate more hands-on sessions, the dental materials science curriculum should consider diverse pedagogical methods including but not limited to concept mapping, flipped classroom, micro-teaching, jigsaw, small-group discussions, and team-based learning. Although these methods are experimented in the literature, there is limited published evidence in Malaysia (Bhat et al., 2021).

The current discipline-based curriculum in Malaysian dental education consists of a stack of separate courses with their compartmentalised scopes and syllabus. Students may find it difficult to correlate theoretical knowledge and clinical application due to the lack of integration between preclinical and clinical courses. An integrated competency-based curriculum could overcome this dilemma by incorporating dental materials science into the list of courses that demand vertical and horizontal integration. Integrated curriculum as a visionary change could be regarded as one of the first instances in Malaysian dental education, where dental materials science is no longer viewed as a stand-alone course or under the aegis of a particular dental speciality. In fact, it will be divided into several subtopics that are integrated into several dental specialities across the preclinical and clinical phases. For instance, topics like amalgam and dental composite resin can be incorporated in conservative dentistry courses, whilst removable prosthodontics courses can cover dental materials like resin polymer and gypsum. As students are transitioning into clinical years, dental ceramics can be integrated into fixed prosthodontics courses.

A well-designed dental materials science curriculum must take assessments into consideration since it reflects how the documented curriculum is related to the outcomes (e.g., the student's learning experiences, course learning outcomes and learning opportunities). If the dental materials science curriculum is to be revised to accommodate horizontal and vertical integrations, then a myriad of assessments should be utilised. Interdisciplinary care and evidence-based treatments with sound analytical and communication skills, are necessary for the successful and efficient delivery of tomorrow's dental education. This justifies the need for assessment systems to be thorough and concrete enough to evaluate every stage of students' progression. Although dental schools in Malaysia have been utilising written assessments (e.g., multiple choices questions, short answer questions) as the main assessment tool in dental materials science courses, alternative assessments such as modified Direct Observation of Procedural Skills (DOPS), peer- and self-assessments could be introduced in accordance with an integrated curriculum (Ferris & O'Flynn, 2015). These alternative assessments are valid and reliable in determining competencies and offering exceptional chances to combine summative and formative assessments. It is expected that students would be capable of recognising knowledge and skills, and they would value opportunities for improvement in their learning (i.e., self-reflection).

Moreover, Malaysian dental schools should consider recruiting faculty members with different areas of educational expertise in teaching dental materials science courses. Diversity of teaching staff will enhance and enrich the learning experiences of students. Experts with backgrounds in chemistry and materials science could involve in the teaching of fundamental principles of dental materials, while those with dental degrees may involve in translating the knowledge into practical applications. It is also worth noting that no single faculty member is recommended to cover the whole teaching and learning syllabus. Last, teaching qualifications are highly recommended for faculty members to apply and keep abreast with the latest instructional design. Nevertheless, the movement toward competency-based education (and moving away from traditional discipline-based or requirement-based education) would require more education research and academic discussions in Malaysia to rationalise and select appropriate teaching, learning and assessment methods as well as intellectual vibrancy, academic support, research, scholarship, and educational management in dental materials science courses.

VI. CONCLUSION

Malaysia is on the verge of advancing towards competency-based dental education along with the introduction of a diversity of teaching, learning and assessment methods. The path to change is not without obstacles and ambiguity. Thus, comprehensive education research and academic discussions among dental educators in Malaysia involved in the teaching of dental materials science are warranted to pioneer new insight to transform the existing dental materials science curriculum.

Notes on Contributors

GSSL and CCF was involved in conception and design of the study. GSSL and YSN reviewed the literature, collected the data, and wrote the original draft. CCF edited the original draft. All authors have read and approved the final manuscript.

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Declaration of Interest

All authors have no conflicts of interest.

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