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A Comprehensive Template for Inclusion of Research in the Undergraduate Dental Curriculum

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Abstract

Purpose: Evidence exists that undergraduate students in the health professions benefit from an early introduction to research skills. However, many undergraduate health programs internationally have a minimal inclusion of research methods in their curricula. Most dental curricula focus most of their time and energy on clinical dental training. Increased emphasis on research in dentistry has led many schools to include research in their undergraduate curriculum. This commentary describes the structured inclusion of a constructively aligned research module in the undergraduate curriculum in all Malaysian dental universities.
Method: This commentary reports the structured inclusion of research at one of the private dental universities in Malaysia. Students in a cohort were formed into groups. The dean appoints academic staff members as supervisors to each of the groups in their research work from the selection of the research topic to the presentation of the research work in an external conference. The student scientific conferences provide students with a platform to showcase their research.
Results: All the research groups presented their research in an external conference, and two groups could convert their research reports to articles in international peer-reviewed journals. Feedback provided by the students identified many positives and highlighted a few barriers in conducting student research projects.
Conclusion: The approach taken by the Malaysian dental academic fraternity over the past decade to build and strengthen research in the undergraduate dental curriculum provides a template which other nations can follow.

Keywords: Constructive alignment; Hidden curriculum; Peer teaching; Undergraduate research; Dental curriculum

1. Problem

Increasingly undergraduate dental curricula cover research, although to a limited extent. Inclusion of research in the undergraduate dental curriculum has multiple advantages. Students/"budding dentists" may become better consumers of science and be updated on current knowledge and developments in dentistry.[1] It would guide students towards developing critical thinking and identifying resources to gain sound

Abbreviations: ASEAN, Association of Southeast Asian Nations; BDS, Bachelor of Dental Surgery; IADR, International Association of Dental Research; IRB, Institutional Review Board; NDSSC, National Dental Student Scientific Conference; SCATE, Scientific Convention and Trade Exhibition.

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scientific knowledge.[1] An updated and informed student can apply the principles of evidence-based dentistry while making clinical decisions.[2,3] Being part of conferences through research would provide an opportunity to gain an initial insight into the aspects of industry and profession in dentistry. Insights into the dental industry are of paramount importance as new dental materials and products are launched regularly. Research inclusion in the undergraduate dental curricula may develop an interest in research at a young age and offer them an overall view of the nature of the profession.[1,4]

Some countries have mandated the inclusion of research experience before students graduate and become health professionals.[5,6] Ping reported 62% of undergraduate dental students took part in research at a high-ranking dental school in China[7] and suggested systematic reforms in dental education to make the curriculum more research inclusive.[7] A questionnaire-based study from Pakistan reported improved awareness and participation in research by undergraduate medical and dental students.[8] However, the study identified a lack of funds and academic overload as the main barriers in student research.[8] Since 2007, undergraduate research projects are part of the dental curricula in the four Swedish dental schools.[9,10] There are few reports of research being included as a minor portion in the undergraduate dental curriculum.[11,12] However, there is a lack of literature for research being included as a structured module in the undergraduate dental curriculum.

Despite the desire to build research capacity, majority of the curricula are still limited to producing health professionals with adequate clinical training as the end product.[7] Though the aim of many dental schools is to produce "safe beginners" with adequate skills and knowledge to ensure patient safety, including research in the undergraduate dental curriculum is an issue that needs addressing. For example, compulsory research skills for European and the United Kingdom dental schools are not seen as a priority and appear neither in the blueprint for European dental students[13] nor in the documents of the General Dental Council, United Kingdom.[14] This article describes the structured inclusion of research in the undergraduate dental curriculum in Malaysia, which has existed for the past 10 years and could serve as a template for other countries.

2. Approach

2.1. Course

The Bachelor of Dental Surgery (BDS) program in Malaysia is a five-year course. The following sections describe the research module in the BDS program at one of the Malaysian dental universities. Inclusion of research in the undergraduate dental curriculum in Malaysia occurs in the 2nd semester of the 4th year and the 1st semester of the 5th year of the BDS program, although, there could be minor differences among different dental schools in Malaysia over its exact manner and implementation. Exposing students to research during the BDS program was a decision taken by the Dental Deans Caucus of Malaysia.[15] It hoped that exposure of the students to research during the BDS program would generate interest in research among the students. Knowledge about research and conducting a research project would be of valuable experience in case students pursue a research higher degree program.[15]

The aim of the research module is to introduce students to the various research designs and processes involved in research, including the selection of a research project, writing a research protocol, ethics in research; conducting a research project; and dissemination of the research findings. Lectures, tutorials, assessments and student research projects are the teaching strategies used. Academic staff members conduct formative assessments of these topics during year 4 of the BDS program. Formative assessment includes theory-based exams (modified essay questions, short-answer questions, and multiple-choice questions) and objective structured clinical examinations. The research module in the undergraduate dental curriculum in Malaysia encompassing of the teaching and learning activities, assessment and the student research projects are constructively aligned with the learning outcomes.

The Malaysian Dental Council in its document "Competencies of New Dental Graduates, Malaysia" has listed out eight program objectives, which are mapped to the learning outcomes.[16] In addition to knowledge and clinical skills, the Malaysian Dental Council expects its graduates to gain critical thinking & scientific skills, value the importance of teamwork, ethics and to communicate effectively with peers in the dental community. Critical thinking and scientific skills are mapped to the learning outcomes of applying an evidence-based approach in the practice of dentistry. The program objectives also hope to engage the "budding dentists" in continuing professional development and make them a lifelong learner, which are mapped to learning outcomes of recognizing the resources of lifelong learning and demonstrating the ability to gain knowledge and scientific evidence.[16] The research module directly or indirectly helps the

student to gain critical thinking, scientific skills, value teamwork, effectively communicate, engage in continuing professional development and become a lifelong learner. Constructive alignment of the learning outcomes in the research module with the program objectives of the dentistry program is an added advantage.

The student research project forms the main component of the research module. Dental schools have a research coordinator to coordinate and implement the student research projects in their faculties. The research coordinator divides the cohort into groups of two to four students (In the first batch of Faculty of Dentistry, SEGi University, 24 students were divided into 6 groups of 4 students each). The dean appoints one academic staff member as a research supervisor to assist and mentor each of the groups. Coordinators of year 4 and 5 provide a 2-h slot (research slot) on the weekly timetable (2nd semester of year 4 and 1st semester of year 5) for the student research projects. Students use the initial research slots for meeting their research supervisors and discussing/selecting the topic for the research projects. The student groups in agreement with their supervisors finalize topics for their research projects. The projects varied from retrospective studies, questionnaire studies, lab based in-vitro studies and clinical studies with minimal follow-up. Student projects were mostly independent, while few supervisors carved out student projects from their own projects. Students complete the University's ethics form along with the research protocol and submit them to their research supervisors. After addressing inputs from the supervisor, these documents are submitted to the Dean and later to the Institutional Review Board (IRB) for final approval. The entire process of ethics approval takes around one-two months.

Following IRB approval, students start their research projects with guidance from their supervisors. Student groups meet weekly with their supervisors to update progress of their research and to discuss solutions to challenges faced in their projects. In circumstances, wherein students found difficulty in completing their projects, mentors helped such groups. Upon completing the research project, students submit a research report of up to 3000 words and an oral presentation. Students in their class, research supervisors, and the Dean attend the oral presentations. Scores for oral presentation and research reports contribute to the formative assessment in the 1st semester of year 5. Student groups are required to present their research findings at an undergraduate student research conference as either a scientific poster or oral presentation. Students are also encouraged to publish their findings in a suitable scientific journal. Fig. 1 summarizes the research module in the undergraduate curriculum at the Faculty of Dentistry, SEGi University, Malaysia, one of the Malaysian dental universities.

2.2. Platform for presenting student research projects

There are 13 dental schools in Malaysia including public (six) and private (seven) universities.[17] Every year, one of the 13 universities offering the BDS program hosts the National Dental Student Scientific Conference (NDSSC) that serves as a platform for undergraduate dental students to present their research.[18] The Malaysian section of the International Association of Dental Research (IADR) conference and Malaysian Dental Association's Scientific Convention and Trade Exhibition (SCATE) are the other two smaller conferences wherein students have the opportunity to present their research. Dental Universities in Malaysia have a tradition of conducting an internal conference of their student research projects and putting forward their best research project (from the internal conference) to the yearly NDSSC. Student research groups compete for best oral presentation and scientific posters, judged by a panel of experts and senior academicians in Dentistry. The organizing committee of the conference awards prizes and monetary incentives to the best research presentations. Some organizing committees have arranged for international travel awards (industry sponsored) for the best research presentation to encourage quality research among undergraduate students.[19] Fig. 2 outlines the importance and structured inclusion of research in the undergraduate dental curriculum in Malaysia at the national level.

Even though conferences are essentially a platform for students to present their research findings, there are many other added benefits. Students professionally interact with other students from different universities. There are booths/stalls of dental companies that display and sell their latest dental products/dental materials, giving them an initial insight into the functioning of the dental industry. Exploring newly introduced products and dental materials helps students to stay connected with recent advances in the dental arena. Students also critiqued company presentations and promotions. Students could discuss their questions/doubts on the authenticity of products/promotions of the dental companies with their supervisors who had accompanied them to the conferences. Some conferences have student mentorship programs wherein a

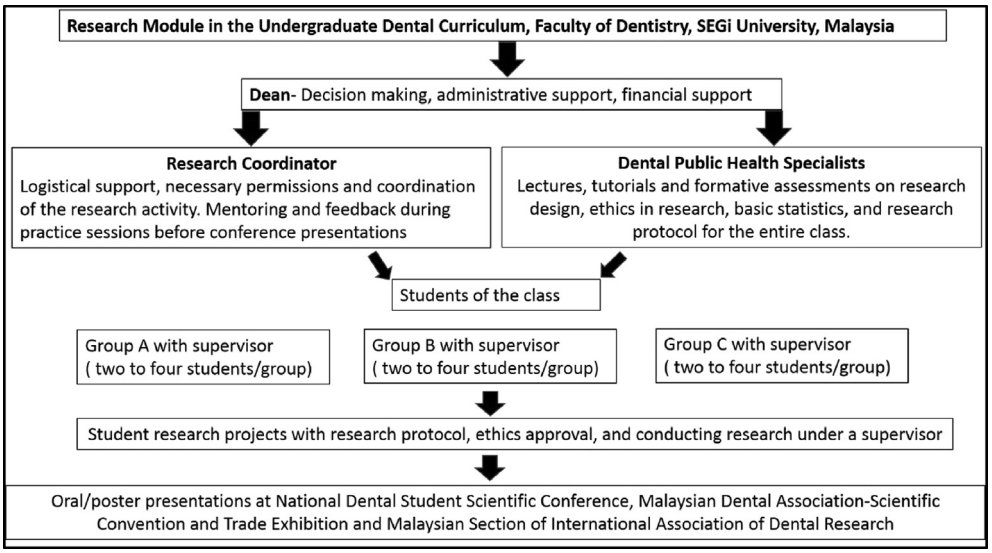

Fig. 1. The figure highlights the roles played by the Dean, research coordinator, dental public health specialists and research supervisors in the research module. The platforms for undergraduate students to present their research are also listed.

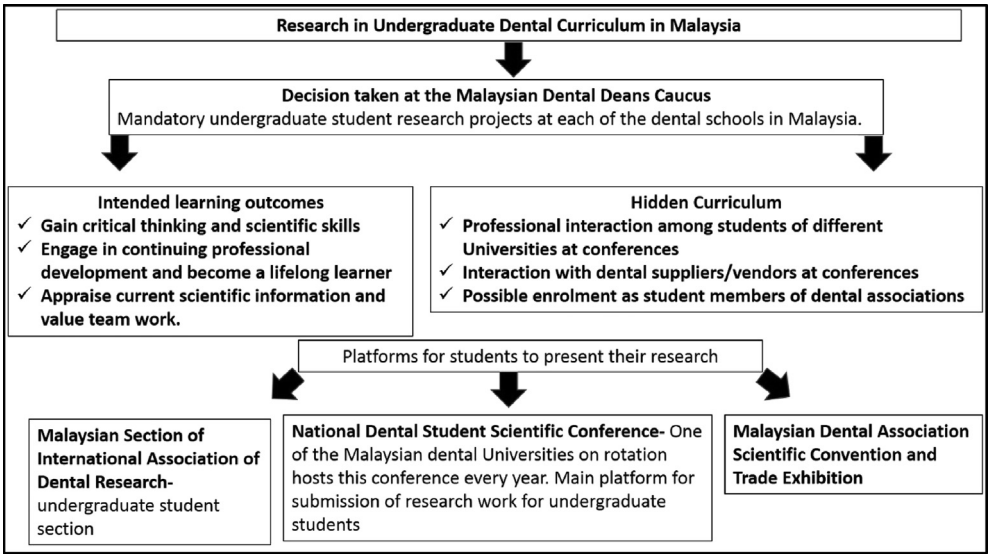

Fig. 2. Outlining the impetus on research in dental undergraduate curriculum in Malaysia, the intended learning outcomes, and benefits to the students from the "hidden curriculum."

senior member of the dental fraternity involves students in their workshop/hands-on program as volunteers. Students can gain immensely from these mentorship programs. Students also benefit from updating their knowledge by listening to guest lectures/keynote lectures. Professional organizations including the Malaysian Dental Association have booths in conferences wherein students can register as associate members and avail their associated benefits. Attending conferences provides the students with a feeling of "having arrived" into the real world of dentistry, a world different from their routine lectures and student clinics. This experience would be similar to the "sense of belonging to the scientific community" noticed among undergraduate students.[20]

3. Outcomes

3.1. Evaluation

Constant evaluation of the educational activities improves the teaching and learning experience. All six

student groups presented at one of the external conferences (three student groups at the Malaysian Dental Association's SCATE and three student groups at the NDSSC). One of the student research groups bagged a prize at the Malaysian Dental Association's SCATE. Out of the six research groups, two research groups could convert their research reports to articles in international peer-reviewed journals. Additionally, two students published case reports in scientific journals, although not related to research projects (influence of publishing may have brushed on these students from their peers). Publication of research in a recognized peer-reviewed scientific journal is considered to be the conclusion of research.[21] Publishing in international peer-reviewed journals could be a tall ask for undergraduate students. Encouraging students to publish their findings in their University's journal is a solution. Scientific publications in dentistry, a measure of outcomes of scientific research has been low in the Association of Southeast Asian Nations (ASEAN) countries.[21] Following the completion of the BDS program, a dental industry related company hired one student as a scientific expert, before being absorbed into the Oral Health Clinics, Ministry of Malaysia (a probable benefit of interactions with the dental industry).

Feedback collected from students in the form of interviews at the end of the 1st semester of year 5 showed that students were excited about research projects. Opportunity to present their research work on a platform, increased interest in research, awareness about scientific journals in dentistry, interaction with students & faculties of different Universities and opportunity to interact with vendors of dental companies were the few positives highlighted by the students. A focussed survey on the perceptions of student research projects from various dental universities is a future research plan. Scientific literature has previously reported such data and provides vital inputs to further refine the teaching and learning activity.[22]

Some limitations pointed out by students were insufficient time and the infrastructure for research. Public universities offer postgraduate research programs and have a better research culture compared to private universities in Malaysia.[15,23] In addition, the number of academic staff are more in public universities, so the time devoted to guiding research by supervisors could be more in public universities compared to private universities. The Malaysian Government has awarded the status of "Research Universities" to four public universities in Malaysia.[15] This status may ensure a substantial amount of funding from the Government of Malaysia to "Research Universities." Therefore, better research infrastructure could be available in public universities compared to private universities.[15] Distribution of scientific resources influences scientific production.[7] Establishing a research unit catering to the Faculties of Health Sciences (Medicine, Dentistry, Optometry and Pharmacy) and investing in additional research infrastructure may be the solutions.

4. Next steps

4.1. Lessons learned from implementing the research module

Biggs defines constructive alignment as the 'constructive' aspect refers to what the learner does, which is to construct meaning through relevant learning activities.[24] The 'alignment' aspect refers to what the teacher does, which is to set up a learning environment that supports the learning activities appropriate for achieving the desired learning outcomes. Alignment of the teaching methods and assessment tasks to the intended learning outcomes is an important requirement. The learner is 'trapped', and cannot escape without learning what is intended."[24] Including learning outcomes and assessment of cognitive and psychomotor domains are straightforward in most curricula concerning health professions.[25]However, learning outcomes and especially assessing the affective domain fall into the grey area in many documents. Quantifying and measuring the learning outcomes of the affective domain or learnt "soft skills" is difficult.[26] Constructively aligning the learning outcomes, assessments and practical tasks in the research module would help the students to achieve such learning outcomes.[25]

Some narrative reviews and commentaries have stressed positive aspects of the "hidden curriculum" in dental education.[27,28] Students benefit enormously from attending scientific conferences.[20,29] Undergraduate students attending or presenting at biomedical research conferences had increased belief in their capabilities to become scientists. In addition, they are more confident in applying their scientific skills and they have a sense of belonging to the scientific community.[20] Intentions to pursue a research higher degree (either a master's degree or a graduate degree) was more evident in undergraduate students who had attended or presented at scientific conferences.[20] Dagher et al. highlighted an innovative medical research volunteer program among undergraduate

medical students at the American University of Beirut, Lebanon.[29] Apart from an active research experience to the students, the program granted the staff members a chance to motivate and influence future generations in research.[29] Jaberansari et al. report the successful conduction of the 2nd British undergraduate dental research conference to raise awareness of students towards dental research.[30] The dental academic fraternity in Malaysia has been regularly organizing the NDSSC since 2009.

Small group learning/peer learning is an effective way to engage students in group work. The advantages include the facilitation of deep, active and collaborative learning.[31,32] For the student research project, some universities have two students/group, while others have four students/group. The project also brings together students with different personalities and experiences to work towards a common goal resulting in challenges. To overcome these challenges, students search for problem-solving strategies and this encourages teamwork.

4.2. Limitations and possible solutions

Universities expect academic staff to multi-task in their job roles.[15,23] Apart from teaching responsibilities, staff may be involved in clinical supervision of the students and in treating patients at the Faculty clinics. Staff will also be engaged in their own research projects in the role of principal or associate investigators. Some staff have additional responsibilities of year coordination or module coordination. Therefore, providing quality time for supervision of student research projects in the midst of all the above-mentioned work responsibilities might be challenging to some academic staff. Presently, the dental undergraduate curriculum is already crowded and stressful for the students.[33,34] While working on the research project, students may lose focus on their core business of clinical work and attending routine lectures. Therefore, the challenge among academics and dental educators is to provide adequate knowledge, effective skills, and the right attitude toward research in the undergraduate course without hampering routine teaching and clinical work.[35]

4.3. Conclusion

Student research projects included as part of the dental curriculum in Malaysian universities provide an initial insight into research to the undergraduate student. The enormous time spent by students, research supervisors, coordinators and hosts of dental undergraduate conferences every year may provide significant initial exposure to research for the undergraduate student. This may act as a good foundation for students in their future and help in improving the standard of dental education in Malaysia. The research template followed by the Malaysian dental universities could be a template for other countries to follow.

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