REVIEW

Open Access

Current challenges in dental educationa scoping review



Lovely M. Annamma¹, Sudhir Rama Varma^{2,3}, Huda Abuttayem⁴, Prathibha Prasad⁵, Sabrin Ali Azim⁶, Ruba Odeh⁴, Biji Thomas George⁷, Chandrasekharan Nair⁸ and Mohmed Isaqali Karobari^{9,10*}

Abstract

Introduction This scoping review aimed to review the various challenges facing dental education. Dental education faces multiple institutional, student and faculty-based challenges. Institutional challenges include updating infrastructure resources, recruiting qualified faculty, and implementing administrative policies that enhance dental education. Student-based challenges include implementing teaching/learning strategies that will enable students to acquire adequate knowledge, skill, and logical reasoning to identify and execute evidence-based treatment. Faculty-based challenges include regular updating of the dental curriculum, including recent advances in teaching methodology, and adding elective courses that can enhance the readiness of future dentists to address the evolving oral health needs of the public.

Methodology The scoping review was conducted using the PRISMA-ScR, focusing on the current challenges in dental education. Articles were identified via searches of Google Scholar, PubMed, Web of Science and Embase for the period 2019 to 2024. Only English language papers detailing challenges in dental education were included. At the culmination of the search protocol, twelve articles were selected for inclusion in this scoping review.

Results Analysis of these twelve papers identified several themes, which apply to the dental education systems of many, but not all, nations: (1) the correlation between the basic science and clinical phases of the curriculium remains poor; (2) dental students receive inadequate patient care experience to truly develop the competency needed for unsupervised dental practice after graduation; (3) dental students often graduate with inadequate foundational knowledge and clinical experience to provide care for geriatric, specialized pediatric and medically compromised patients, and recieve limited clinical experience in public health settings; (4) dental schools struggle to provide students with training in the technology advancements that are increasingly prevalent in dental practice; (5) difficulties in hiring, training and retaining dentists in faculty positions diminishes the quality of the education experience for students; and (6) an increased number of graduates in some countries struggle to find employment.

Conclusion A variety of studies and advocacy papers over the past 25 years have identified or described similar challenges facing dental education in many nations of the world. The fact that these challenges persist signals the urgent need for curricular and infrastructure reform to better prepare dental students for the realities of dental practice in the 21st century and to provide an environment that will provide an attractive workplace for dentists who desire to participate in the education of the next generation of dentists.

Keywords Dental education, Challenges, Dental curriculum, Patient care, Artificial intelligence

*Correspondence: Mohmed Isaqali Karobari dr.isaq@gmail.com Full list of author information is available at the end of the article



© The Author(s) 2024, corrected publication 2025. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by-nc-nd/4.0/.

Introduction

FDI (Fédération Dentaire Internationale) defines basic dental education as "Teaching and learning of dentists to prevent, diagnose and treat oral diseases and meet the dental needs and demands of individual patients and public" [5]. Dental Institutions provide the knowledge and skills required for dentists to practice competently. The training for dentists varies globally [11] This variation in dental training affects graduates' knowledge and skill levels. Dental education consists of basic sciences, preclinical training and clinical training. The clinical-based training is mandatory, with students doing patient work during their training period on live patients per the requirements set by each dental institution. The dental college bachelor's degree varies from 4 to 6 years [10]. Various authors reported on the challenges faced by graduating dentists [21, 23]. The challenges reported in their survey indicate that the rapidly expanding dental field requires graduates to update their knowledge constantly. The pandemic experienced recently has exacerbated the problems with mental and financial issues, and many dropped out of the course [8]. Financial debts from the study loans burden them to take up immediate employment, but the lack of employment opportunities in some nations makes it challenging. Understanding the various challenges in dental education aids in enhancing the quality of education and addressing the gaps in dental curriculum and clinical training. Issues such as insufficient faculty or lack of a better learning environment can be assessed. Dental education involves theoretical and practical training. Any problems in the training process can impact the student's competence and confidence during clinical practice. The evolving dental education with new technologies such as digital dentistry, artificial intelligence and teledentistry require constant updates in the infrastructure. Understanding challenges in dental education helps with new teaching methods and technologies.

Recognizing the various challenges through literature review and cross-sectional studies enables institutions to promote equity, offering scholarships, hybrid learning and inclusion of underrepresented groups. Knowing the shortages and challenges aids institutional policymakers and educational leaders in better resources and implementing development programs. This ensures that future dental professionals are well-equipped and ready to meet the evolving demands of the healthcare system. This article highlights various challenges faced in dental education and summarizes the challenges into the following categories: institutional, faculty, student, financial and patients.

Methodology

This qualitative review aimed to identify and analyze dental education's various challenges. Understanding the different challenges is crucial for improving the existing educational system to the current practice requirements for better patient satisfaction and safety.

Research design

This study employed a qualitative approach to explore perspectives concerning dental education challenges. Articles that addressed challenges in dental education were searched using Mesh terms Dental Education or Education Dental AND challenges OR Issues OR Problems OR barriers were used to search databases such as Google Scholar, PubMed, Web of Science and Embase for the last five years of 2019 to 2024. The search yielded a total of 2551 documents. The relevancy of the articles was based on triple screening. Six authors screened the title and abstract to eliminate all articles that did not include issues, problems or challenges in dental education. The second screening was done to exclude the articles based on full-text reading. Four independent reviewers reviewed all the selected articles to check if they met the inclusion criteria. A final total of 12 articles, as per inclusion criteria, were confirmed by three reviewers, from which data were extracted. Only studies in the English language that detailed challenges in dental education were included. Grey literature, conference proceedings, editorials and articles in other languages were excluded. A total of 12 articles were selected. (Fig. 1). The inclusion criteria covered dental education and availability of resources, categorised under institutionally based, faculty-based, student-based, financially based and patient-based educational challenges. By evaluating these criteria, one can gain a deeper understanding of the challenges faced in dental education.

Results

The thematic analysis of these twelve articles produced the roster of dental education challenges that are reported in Fig. 2. These challenges were categorized as institutional-based, student-based, faculty-based, and patient and financial-based. As the financial-based category includes all the other groups, such as institutional overhead cost, student fees and expenses, this was not added to the general classification (Table 1).

Institutionally based challenges

The most common institutional challenges many dental colleges face are a lack of updated infrastructure, resources, clinical facilities and the number of patients attending the clinics required for adequate training.



Fig. 1 PRISMA Flow chart

Insufficient faculty resources are a global issue [9]. Inadequate preclinical resources, such as simulator labs and trained faculty, are also common problems at many dental schools. Other institutional challenges include a lack of continuous faculty training through professional development programs that offer workshops and seminars and grant sufficient incentives for research and publications. The majority of institutional-based challenges were inadequacies in resources and training [3, 24].

Faculty-based challenges

Faculty-based challenges include a gap in updating the dental curriculum to the community's existing needs. The topics in basic sciences and preclinical training sessions must be realigned to gain sufficient knowledge and skills for clinical training; hence, the faculty need to update their knowledge in advanced technology to teach the students. If advanced technology such as CAD CAM and intraoral scanners are not taught in dental colleges, dental graduates will require further self-training to update their skills in newer technologies [2, 13].

The institution's curriculum committee must design the curriculum to integrate basic sciences with clinical applications [26]. Challenges related to assessment of student performance were identified. For example, rubrics for measuring student performance during case-based learning and in comprehensive interdisciplinary clinics are rarely implemented. When dedicated research time is not allotted to faculty members, it can hinder academic and professional development. Lack of research time



Fig. 2 Classification based on challenges in dental education

diminishes the overall quality of education and research and impacts the progress in their career (Table 1).

Student based challenges

In many nations, the challenges related to students primarily revolve around insufficient opportunities for the volume and diversity of patient care experiences needed to develop readiness for independent and unsupervised dental practice after graduation. In case of limited clinical training, students and patients can experience trauma later on in practice due to the students's lack of true clinical competence. This often happens when the graduates lack sufficient clinical skills and knowledge of patient ethics, patient safety, practice management, patient diversity and cultural complexities. To address this challenge, several critiques of dental education have recommended expanded community service rotations, internships, rural postings for dental students, and increased use of case-based studies to equip students with diversity and cultural awareness [3, 32]. Improving dental students' readiness for clinical practice can be accomplished by using dental simulations before patient contact [27]. The stress of going through an undergraduate program, learning and skill acquiring can cause anxiety, depression or mild stress in some students [6]. Student counsellors should consider implementing training programmes on how to cope with stress should be implemented on campuses. Among the challenges, the student-related domain was reported to be more stressful than the institutional and co-faculty-related domains [14].

Financially based challenges

The dental institution fees are relatively high, and students face financial burdens in completing the course [40]. Student scholarships, financial aid, and loan forgiveness for graduates from specific categories will ease stress in graduating dental students. Hybrid learning can be a cost-effective solution to reduce educational fees and overhead costs (Table 1).

Patient based challenges

The students must be knowledgeable enough to understand the level of patient expectations, patient fears, and habits. Challenges regarding patients' diverse socioeconomic backgrounds, cultural variations, knowledge of chronic health issues, and adherence to treatment plans require knowledge, emotional intelligence, communication skills, and empathy. Faculty mentorship and support systems as team dynamics are necessary for helping students overcome these obstacles for future clinical practice. Miscommunication due to language barriers can lead to misunderstandings about procedures, cost of

Table 1 An overview of challeng	es in Dental Education			
Institutional based	Faculty based	Student based	Financial based	Patient-based
Insufficient Faculty Resources	Outdated Curriculum	Limited Clinical Experience	High Cost of Dental Education	High level of expectation
Inadequate Technological Integration	Poor Student Feedback	High Student Stress and Burnout	The burden of student loans	Willing to pay less for dental treatment compared to medical
Inadequate clinical and preclinical resources	Lack of training to take on an aca- demic role	Lack of Interdisciplinary Training	Unwarranted expenses dur- ing the course when the infrastruc- ture facility is not good	Dental phobia and non-compliant with instructions from the dentist
Inadequate number of patients in clinics	Lack of research interest	Limited Research Opportunities	Financial burden to get the necessary textbooks and materials	Habits and socioeconomic factors that result in poor oral health
Bad leadership and management	Not integrating recent advancements in teaching and clinical practice	Diversity and Inclusion Issues	Lack of employment opportunities to repay the loans	Compromised patients needing con- sultant care
Blame culture	No rubrics for preclinical and clinical assessment	Inconsistent Assessment Methods	Pressure to repay the loans on gradu- ation	Patient satisfaction is directly linked to success
Toxic work environment	Not participating in conferences and continuing education pro- grammes	Insufficient Exposure to Contempo- rary Practices	Not making sufficient income to sustain	Dental treatments are expensive when not covered by insurance
Excessive working hours (academic, community and research)	Not prioritizing work	Ineffective Communication Skills Training	Lack of advanced equipment for training	Neglecting oral health and substance abuse
Lack of staff retention	Lacking student mentorship/ not rec- ognizing the student's weak points earlier	Burnout due to student pressures, institutional and co-faculty pressure	Lack of funds for advanced training	Patients on medications, geriatric and non-compliant pediatric, and oro- facial pain patients need speciality consultation.
Dissatisfied employee	Not prompt in lecture classes and clin- ics. Student feedback was not delivered within the proper time frame.	Lack of confidence in handling patients alone		Litigation issues
	Lack of research time/ leading to low publication index	Unethical use of A.I. technology to write thesis and projects		

treatment or care instructions. Patients may misinterpret or not fully understand the importance of treatments or hygiene practices. Patients may not fully disclose their medical history, which can lead to complications or contraindications during treatment (Table 1).

Educational challenges

The main focus of educational challenges lies in the lack of stimulatory preclinical training and the acquisition of adequate clinical and community-based training [3]. The majority of colleges lack training in specialized areas such as geriatrics, paediatrics, compromised cases and community-based training (Table 2) [16, 28, 29, 38]. The lack of infrastructure in many colleges could be due to the tremendous financial burden on the institutions. A modified dental curriculum closing all the evidencebased gaps in dental education is required [24]. Another area that the educators recommended was that critical thinking should be added to dental education [35]. Sleep medicine awareness and analysis was also a suggested elective course for dental students, as orthodontists and prosthodontists fabricate various sleep apnoea appliances [30]. A.I. technology ethics should be added to the dental curriculum to create awareness among students for scientific integrity and a stringent peer review process [19]. Present challenges must be tackled at institutional, student and patient levels with modifications in clinical training methods and dental curriculum [33, 36]. Dentistry taught in college differs from what is practised in private clinics regarding the use of the latest technology adopted in the clinics. Fresh graduates are stressed and anxious about applying advanced technology in practice for which they have not been trained.

Discussion

The various challenges faced in dental education differ from one region to another. These challenges vary based on the available healthcare infrastructure, cultural values, and economic and educational resources. Many colleges in the U.K. and USA have these pre counselling sessions. Students select dentistry as their professional choice as they can be self-employed and decide their working hours [39]. Students must be made aware of the prospects in their earlier undergraduate years [20]. Effective career counselling should be included in the undergraduate curriculum to improve the confidence level of the students to face the future [12]. Guidance allows the student to decide on the options they have after graduating. The highly rated career challenge perceived by dentistry students today is to obtain a job either in the government or the private sector. However, it may take quite a long time for new graduates to acquire finances, get approvals from regulatory authorities, and get appropriate buildings and staff. The solutions to many of the challenges, such as lack of knowledge in practice management and lack of expertise in geriatric or diverse patient case management, can be solved by adding the particular component to the curriculum [21, 34]. To manage these challenges, dentists can employ various strategies, such as establishing trust, taking a detailed medical history, behaviour management techniques, treatment planning and decision-making. By recognizing and addressing these patient factors, dentists can better navigate the challenges of providing effective and compassionate care, avoiding litigation issues, and enhancing patient safety [1].

Adding more elective subjects such as practice management, equipment maintenance, geriatric dentistry, orofacial pain, and sleep dentistry have all been suggested by experts for increasing the knowledge of graduates in a rapidly growing dental field [7, 15, 17, 22]. The evidence indicates that community postings can improve rural communities' treatment facilities, reducing unmet needs [4]. The policies on licencing for dental training institutions have shown an accelerating trend towards accepting changes by incorporating new technologies and materials [18]. Most dental institutions globally have not converted from conventional dentistry to adhesive and digital dentistry [37]. When a fresh graduate enters the private practice following digital dentistry, he learns an entirely new concept from what he learned in the dental institution. This lacuna from what was taught to what is practised presently in private centres can cause stress and anxiety in dental graduates [31]. Apart from knowledge, skill, and training, other challenges include the ratio of patients needing treatment to the turnover of graduates per year. In some countries, there are excess dental graduates; in others, there are fewer [25].

Conclusions

The 21st century has brought many advances to the dental profession regarding knowledge, which has doubled daily. Advancements happened in technically supported skills along with computer-aided design and machining. Capabilities have expanded along with increased accessibility. Along with these, challenges also get generated, which the professionals must overcome. This review addresses many of these challenges along with its evolution. The challenges in dental education need a multifaceted approach involving curriculum and faculty development changes, implementing new technologies, and ensuring knowledge, clinical skills, aptitude, and reasoning in clinical decision-making. Community and rural postings also boast the students' cultural competence. Implementing solutions for all the challenges reviewed in the article can enhance undergraduates' dental education

		0			
2	Authors		Type of Study	Outcomes	Challenges
-	Taylor M et al.	A Survey of Current Program Implemen- tation at Australian Dental Schools	Cross-sectional survey	Community-based dental education (CBDE) is important for gaining clinical and patient management skills.	In CBDE, it isn't easy to coordinate external rosters, get funding, supervise students, and ensure diverse types of student exposure.
5	Nitschke S et al.	Undergraduate Dental Education in Gero- dontology in Germany between 2004 and 2019- A case for compulsory teach- ing?	Survey	Knowledge of treating geriatric patients requires specialized training dur- ing the undergraduate dental curriculum.	Many dental universities do not have gerodontology training. It should be mandatory.
ŝ	Hanks S	Current arrangements for training den- tists in the U.K. in primary care dentistry	Review	Traditional undergraduate Dental Education is only within the institu- tion and lacks undergraduate exposure to patient management.	To have undergraduate training in primary health care apart from the dental hospital setup.
4	Mehboob B et al.	Needs analysis for an undergraduate dental curriculum in KPK, Pakistan: Gap identification and general needs assess- ment.	Mixed method study	Thematic analysis identified the following 1. For a five-year BDS program 2. Inclusion of digital dentistry, environ- mental sustainability and artificial intel- ligence applications in dentistry	Changes in the present curriculum to include a patient-centred curriculum and improvement in the educational environment
Ś	Seki N et al.	Critical thinking education for dental schools in Asia: Perceptions of educators.	Online interviews of educators	Critical thinking education is lacking in the present curriculum. More ideas on how this can be incorpo- rated into the curriculum and assessed is required.	Insufficient time, fewer human resources and a lack of information on appropriate teaching and assessment methods
9	Alnafaiy SM et al.	Digital technology implementation in prosthodontics postgraduate programs in Saudi Arabia: a multi-institutional survey of program directors	Survey	Digital technology such as CAD/CAM, intra-oral scanning and 3D printing will be incorporated into preclinical and clini- cal curricula.	Digital technology lacked implementation due to a shortage of resources and equip- ment, a lack of trained faculty, and invest- ment costs.
\sim	Nanji N et al.	Advancing dental care access for patients with disabilities: A global scoping review of predoctoral training.	Scoping review	Dental students lack training in compro- mised patients' special healthcare needs (SHCN).	Dental students lack confidence in provid- ing high-quality care to SHCN, and globally, care disparities exist.
00	Peanchitlertkajorn S et al.	Dental Sleep Medicine Education Amongst Accredited Orthodontic Pro- grammes in Thailand	Structured interview	Dental sleep medicine education should be included in the dental curriculum of Orthodontics.	To increase awareness and competency in the DSME field.
0	Prosser GM et al.	Potential educational and workforce strat- egies to meet the oral health challenges of an increasingly older population: a qualitative study	Structured interview	The topics of discussion included 1. The ageing population (Geriatric) 2. Dental care professional's role 3. Undergraduate dental professional training	The undergraduate dental training is not adequate for both current and future needs.
10	Islam NM et al.	Adopting artificial intelligence in dental education: A model for academic leader- ship and innovation.	Review	Artificial intelligence must be added to the dental curriculum and incorpo- rated into clinical practice, enhancing educational experiences and care delivery.	It is recommended that Bolman and Deal's Reframing Organizations model framework be used for adopting A.I. infrastructure within dental schools.

 Table 2
 Studies included with issues mentioned in dental training

(continued)	
N	
Ð	
Q	
Ta	

N Authors		Type of Study	Outcomes	Challenges
11 Michael Reddy & Sara Hughe	es Dental Education: But Not as We Know It,		To integrate team practices, community clinics, virtual care, Biomedical sciences, population health training, and analytical ability	Predoctoral education and advanced den- tal education, including training at com- munity clinics and mentoring of research faculty.
12 Spielman Al.	Dental education and practice: past, present, and future trends.	Review	Improving dental curriculum by incor- porating specialized care in paediatrics. Gerodontology and advanced technol- ogy. To focus on faculty training and expertise to mentor dental students. Artificial intelligence will drive efficien- cies in diagnosis, treatment, and office management. Individualized competency-based, hybrid, face-to-face, and virtual education will be incorporated into dental training.	A.I. can aid in better analysis of radio- graphic interpretation, differential diag- nosis and treatment planning, complex case assessment, preclinical training and advanced case-based training; A.I. helps in calibration and standardization.

and better prepare them to meet modern dental practice demands.

Acknowledgements

None.

Authors' contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

There are no financial conflicts of interest to disclose.

Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

Adjunct clinical faculty College of Dentistry, Ajman University, Ajman, UAE. ²Department of Clinical Sciences, Ajman University, Ajman, United Arab Emirates. ³Center for Medical and Bio-allied Health Sciences Research, Ajman University, Ajman, United Arab Emirates. ⁴Department of Clinical Sciences, Center of Medical and Bio-Allied Health Sciences Research, College of Dentistry, Ajman University, Ajman, United Arab Emirates. ⁵Department of Basic Dental Sciences, Center of Medical and Bio-Allied Health Sciences Research, College of Dentistry, Ajman University, Ajman, United Arab Emirates. ⁶Department of Diagnostic and Surgical Dental Sciences, Gulf Medical University, Ajman, United Arab Emirates. ⁷RAK College of Medical Sciences (RAKCOMS), RAK Medical & Health Sciences University (RAKMHSU), P.O. Box 11172, Ras Al Khaimah, United Arab Emirates. ⁸Department of Prosthodontics, Sri Sankara Dental College, Akathumuri, Thiruvananthapuram, Kerala, India. ⁹Department of Conservative Dentistry and Endodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu 600077, India. ¹⁰Department of Restorative Dentistry & Endodontics, Faculty of Dentistry, University of Puthisastra, Phnom Penh 12211, Cambodia.

Received: 14 September 2024 Accepted: 16 December 2024 Published: 23 December 2024

References

- Abutayyem H, et al. Significance of Patient Safety and Safety Culture in Dental schools: a systematic review. Open Dentistry J. 2021;15(1):241–9. https://doi.org/10.2174/1874210602115010241.
- Ali K, et al. Blended learning in undergraduate dental education: a global pilot study. Med Educ Online. 2023;28(1). https://doi.org/10.1080/10872 981.2023.2171700.
- Alnafaiy SM, et al. Digital technology implementation in prosthodontics postgraduate programs in Saudi Arabia: a multi-institutional survey of program directors. BMC Oral Health. 2024;24(1):1136. https://doi.org/10. 1186/S12903-024-04908-0/FIGURES/4.

- Barnett T, et al. The relationship of primary care providers to dental practitioners in rural and remote Australia. Springer. 2017;17(1). https://doi.org/ 10.1186/s12913-017-2473-z.
- 5. Basic Dental Education | FDI. Available at: https://www.fdiworlddental. org/basic-dental-education. Accessed 14 Jul 2024.
- Basudan S, Binanzan N, Alhassan A. Depression, anxiety and stress in dental students. Int J Med Educ. 2017;8:179–86. https://doi.org/10.5116/ ijme.5910.b961.
- Beetz G, et al. Dental sleep medicine: time to incorporate sleep apnoea education in the dental curriculum. Wiley Online Libr. 2020;24(3):605–10. https://doi.org/10.1111/eje.12533.
- Bharath C, et al. Students perception toward effectiveness of online learning during COVID-19 pandemic among university dental students in India and United Arab Emirates: a multi centric study. J Pharm Bioallied Sci. 2022;14(5):87. https://doi.org/10.4103/jpbs.jpbs_562_21.
- Buitenhoff ten cate J. Leadership challenges in dental practice management. BDJ Team. 2024;11(6):250–1. https://doi.org/10.1038/ s41407-024-2687-y.
- Dental degree Wikipedia. Available at: https://en.wikipedia.org/wiki/ Dental_degree. Accessed 14 Jul 2024.
- Dental education throughout the world Wikipedia. Available at: https:// en.wikipedia.org/wiki/Dental_education_throughout_the_world. Accessed 14 Jul 2024.
- 12. Fita S, et al. Possible future Career challenges and Associated factors among Dental Students and interns. Int J Dent. 2020;2020. https://doi.org/10.1155/2020/9730125.
- 13. Friedlander LT, Meldrum AM, Lyons K. Curriculum development in final year dentistry to enhance competency and professionalism for contemporary general dental practice. Eur J Dent Educ. 2019;23(4):498–506. https://doi.org/10.1111/EJE.12458.
- GeethaPriya PR, Asokan S, Viswanath S. Job satisfaction and stress among dental faculty members: a mixed-method approach. J Dent Educ. 2021;85(10):1606–15. https://doi.org/10.1002/JDD.12730.
- Güneri P, et al. Obstructive sleep apnoea and the need for its introduction into dental curricula. Eur J Dent Educ. 2017;21(2):121–9. https://doi.org/ 10.1111/EJE.12190.
- Hanks S. Current arrangements for training dentists in the U.K. in primary care dentistry. J Dent. 2024. https://doi.org/10.1016/JJDENT.2024.104959. 144.
- Haridy R, et al. A cross-sectional multicenter survey on the future of dental education in the era of COVID-19: Alternatives and implications. J Dent Educ. 2021;85(4):483–93. https://doi.org/10.1002/JDD.12498.
- 18. Hayashi M, et al. Dentistry in the 21st century: challenges of a globalizing world. Int Dent J. 2014;64(6):333–42. https://doi.org/10.1111/idj.12132.
- Islam NM, et al. Adopting artificial intelligence in dental education: a model for academic leadership and innovation. J Dent Educ. 2022;86(11):1545–51. https://doi.org/10.1002/JDD.13010.
- Khalaf ME, et al. The motivation and confidence in choosing dentistry as a career amongst dental students: a mixed-methods study. Eur J Dent Educ. 2022;26(1):66–75. https://doi.org/10.1111/EJE.12673.
- 21. Manakil J, Rihani S, George R. Preparedness and practice management skills of graduating Dental students entering the Work Force. Educ Res Int. 2015;2015(1):976124. https://doi.org/10.1155/2015/976124.
- 22. Mara M. Interdisciplinary Education and Health Care in Geriatric Dental Medicine. Clin Geriatr Med. 2023;327–41. https://doi.org/10.1016/j.cger. 2023.01.006.
- Mariño R, et al. Preparedness for practice of newly qualified dental professionals in Australia educator, employer, and consumer perspectives. BMC Med Educ. 2022;22(1). https://doi.org/10.1186/S12909-022-03476-7.
- Mehboob B, et al. Needs analysis for an undergraduate dental curriculum in KPK, Pakistan: gap identification and general needs assessment. Pakistan J Med Sci. 2024;40(5):967–73. https://doi.org/10.12669/PJMS.40.5. 8364.
- Mohan M, et al. Unemployment and vulnerable financial situation among recent dental graduates of Kerala, India - results from a cross-sectional study. J Global Oral Health. 2019;1(1):49–57. https://doi.org/10.25259/ JGOH-12-2018.
- Mothupi KA, Adefuye AO. Contextualizing the relevance of specialtyspecific electives in dental education: perspectives of dental and oral hygiene graduates. Eur J Dent Educ. 2020;24(1):26–35. https://doi.org/10. 1111/EJE.12464.

- Mustilwar RG, et al. Skill and Simulation Lab in Dentistry A futuristic era. J Pharm Negat Results. 2022;3258–64. https://doi.org/10.47750/PNR.2022. 13.506.440.
- Nanji N, et al. Advancing dental care access for patients with disabilities: a global scoping review of predoctoral training. J Dent Educ. 2024;88(7):957–73. https://doi.org/10.1002/JDD.13508.
- 29. Nitschke S, et al. Undergraduate Dental Education in Gerodontology in Germany between 2004 and 2019 A case for compulsory teaching? Eur J Dent Education: Official J Association Dent Educ Europe. 2022;26(3):523–38. https://doi.org/10.1111/EJE.12729.
- Peanchitlertkajorn S, et al. Dental Sleep Medicine Education Amongst Accredited Orthodontic Programmes in Thailand. Int Dent J. 2024;74(3):573–80. https://doi.org/10.1016/J.IDENTJ.2023.10.020.
- Pllana A. Expanding Entire Volume of Knowledge Influences on Incrementing Individual Knowledge. Global J Human Soc Sci. 2019;19(H8):33– 42. Available at: https://socialscienceresearch.org/index.php/GJHSS/artic le/view/3032/5-Expanding-Entire-Volume-of-Knowledge_html. Accessed 15 Jul 2024.
- Prosser GM, Louca C, Radford DR. Potential educational and workforce strategies to meet the oral health challenges of an increasingly older population: a qualitative study. BDJ Open 2022. 2022;8:1(1):1–9. https:// doi.org/10.1038/s41405-022-00098-5.
- Reddy M, Hughes S. Dental education: but not as we know it. J Calif Dent Assoc. 2020;48(3):133–8. https://doi.org/10.1080/19424396.2020.12222 559.
- Safi Y, et al. Designing and Implementation of a Course on Successful Dental Practice for Dentists. J Dentistry (Tehran, Iran). 2015;12(6):447– 55. Available at: http://www.ncbi.nlm.nih.gov/pubmed/26884 779. Accessed 14 Jul 2024.
- Seki N, et al. Critical thinking education for dental schools in Asia: perceptions of educators. J Dent Sci. 2023;18(1):443–7. https://doi.org/10.1016/j. jds.2022.08.024.
- Spielman Al. Dental education and practice: past, present, and future trends. Front Oral Health. 2024. https://doi.org/10.3389/FROH.2024.13681 21/FULL. 5.
- Suganna M, et al. The Digital Era heralds a paradigm shift in Dentistry: a cross-sectional study. Cureus. 2024;16(1). https://doi.org/10.7759/ CUREUS.53300.
- Taylor M, Carr S, Kujan O. Community-Based Dental Education (CBDE): A Survey of Current Program Implementation at Australian Dental Schools. Int J Dentistr. 2024. https://doi.org/10.1155/2024/2890518.
- Toit J, Du, et al. Dental Students' motivations for their Career choice: an International Investigative Report. J Dent Educ. 2014;78(4):605–13. https://doi.org/10.1002/j.0022-0337.2014.78.4.tb05712.x.
- Tussanapirom T, et al. Economic burden of becoming a dentist in Thailand. BDJ Open. 2023;9(1). https://doi.org/10.1038/s41405-023-00131-1.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.