Journal of Taibah University Medical Sciences (2023) 18(6), 1449–1458

Taibah University

Journal of Taibah University Medical Sciences

www.sciencedirect.com

Original Article

Evaluation of the level of integration of the dental curriculum in Umm Al-Qura University

Waad F. Khayat, DScD [a,*], Majed A. Almalki, MSc [a], Mashael S. Alqahtani, MSc [b] and Sara W. Taher, MSc [c]

[a] *Department of Restorative Dentistry, College of Dentistry, Umm Al-Qura University, Makkah, KSA*
[b] *Department of Basic Oral Sciences, College of Dentistry, Umm Al-Qura University, Makkah, KSA*
[c] *Department of Preventive Dentistry, College of Dentistry, Umm Al-Qura University, Makkah, KSA*

Received 16 September 2022; revised 23 March 2023; accepted 27 May 2023; Available online 8 June 2023

المخلص

أهداف البحث: التعرف على نماذج ومستويات التكامل لمنهج طب الأسنان لمرحلة البكالوريوس في جامعة أم القرى بالمملكة العربية السعودية. يساعد هذا التقييم والتحليل الشامل لمنهج طب الأسنان الحالي في التخطيط الأفضل لإصلاح المناهج الدراسية، مما يؤدي إلى تحسين جودة تعليم طب الأسنان.

طرق البحث: تم تقييم جميع المقررات من قبل ثلاثة مراجعين، قاموا بالتحقق بشكل مستقل من أحدث نماذج مواصفات المقررات الدراسية (2021) لاستخراج البيانات حول أوصاف المقررات ومحتوياتها. تم تحديد نموذج التكامل لكل دورة (باستخدام سلم تكامل هاردن المعدل). تم تحديد المقررات ووزنها (بالساعات المعتمدة) وفقا لمستوى التكامل حسب السنوات والأقسام وتصنيف المقررات والأساليب التعليمية. تم تحديد النمط العام لتكامل المناهج.

النتائج: تظهر جميع المقررات مستوى معينا من التكامل بدرجات متفاوتة على مدار السنوات وعبر الأقسام. نموذج التكامل المتداخل هو الأكثر استخداما. النمط العام لتكامل المناهج منخفض إلى متوسط. يتم تدريس المقررات المتكاملة للغاية فقط خلال العامين الثاني والأخير، وتديرها أقسام علوم الفم الأساسية وطب الأسنان الترميمي. تمثل الدورات السريرية 44.3٪ من المناهج الدراسية، ولكن 26.6٪ فقط من الدورات السريرية تظهر مستوى عال من التكامل. يتم تطبيق التعلم بحل المشكلات/التعلم القائم على الحالة واستراتيجيات التدريب السريري في الغالب في دورات متوسطة إلى متكاملة للغاية، ولكن التعلم بحل المشكلات/التعلم القائم على الحالة هي الطريقة التعليمية الأقل استخداما في جميع المناهج الدراسية.

الاستنتاجات: أظهرت جميع المقررات مستوى معينا من التكامل بنمط عام منخفض إلى متوسط. يوصى بمزيد من التخطيط التعاوني والعمل بين الأقسام لزيادة مستوى تكامل المقررات على مدار السنوات الأكاديمية. بالإضافة إلى ذلك، يجب تنفيذ الاستراتيجيات التعليمية الحديثة مثل التعلم بحل المشكلات/التعلم القائم على الحالة والتعلم المختلط بشكل أكبر في مناهج طب الأسنان لدينا.

الكلمات المفتاحية: تعليم طب الأسنان؛ المنهج المتكامل؛ نموذج التكامل؛ مستوى التكامل

Abstract

Objectives: To identify the models and levels of integration of the undergraduate dental curriculum in Umm Al-Qura University in KSA. This comprehensive evaluation and analysis of the current dental curriculum will facilitate better planning for curriculum reform, thus improving the quality of dental education.

Methods: All courses were evaluated by three reviewers who independently checked the most recent course specifications forms (2021) to extract data relating to course descriptions and contents. A model of integration was identified for each course (using a modified Harden's integration ladder). Courses and their relative weighting (by credit hours) were mapped to the level of integration by years, departments, course classification, and educational methods. The overall pattern of curriculum integration was then determined.

Results: All courses exhibited some level of integration to varying degrees throughout years and across departments. The most frequently used model is the nested model of integration. The overall pattern of curriculum integration is low to moderate. Highly integrated courses are only taught during the second and final years and are managed by the Departments of Basic Oral Sciences and

* Corresponding address: Department of Restorative Dentistry, College of Dentistry, Umm Al-Qura University, Makkah, KSA.
E-mail: wfkhayat@uqu.edu.sa (W.F. Khayat)

Peer review under responsibility of Taibah University.

Production and hosting by Elsevier

 https://doi.org/10.1016/j.jtumed.2023.05.019

Restorative Dentistry. Clinical courses represent 44.3% of the curriculum although only 26.6% of clinical courses have a high level of integration. Problem-based learning/case-based learning (PBL/CBL) and clinical training strategies are mostly applied in moderately to highly integrated courses, although PBL/CBL is the least used educational method throughout the curriculum.

Conclusion: All courses exhibited some level of integration with an overall low to moderate pattern. More collaborative planning and working between departments are recommended to increase the level of integration of courses throughout different academic years. In addition, modern educational strategies such as PBL/CBL and blended learning should be implemented more in our dental curriculum.

Keywords: Curriculum evaluation; Dentistry; Dental education; Integrated curriculum; Integration level; Integration model

Introduction

The recent exponential growth of knowledge and the massive advances in oral health care systems have raised demands to redesign dental education to prepare dentists for the modern era of dental practice. Therefore, many medical and dental reports from education associations worldwide have recommended the reform of dental curricula by focusing on developing higher skill levels of critical thinking, problem solving, and lifelong learning abilities that can be obtained through integrated education.[1–5]

Many studies have been conducted to assess the integration of dental curricula worldwide.[2,6–8] Integrated curricula have already been implemented, or are in the process of being implemented, in 36 dental schools in North America.[9] Many studies have described the benefits of integrated education, such as better student performance and lower stress levels during learning.[10–13] A review carried out in KSA reported that one of the weaknesses of traditional dental curricula was the separation between disciplines as this leads to overlap and redundancy, thus emphasizing the need to incorporate innovative teaching and learning methods in dental education.[14] Many Saudi dental schools have been recently evaluating and reforming their dental curricula in accordance with the modern modalities of dental education.[15–17] Furthermore, newly established dental schools, such as Princess Nourah University College of Dentistry[18] and Umm Al-Qura University Faculty of Dental Medicine (UQUDENT) have developed their current dental curricula by focusing on integration in accordance with international benchmarks.

Modern integrated dental curricula use many educational strategies to integrate basic, biomedical, clinical, professional, and behavioral sciences throughout the curricula to link knowledge, skills, and values.[19] Problem-based learning (PBL) and case-based learning (CBL), for example, are used by some universities to develop integrated reasoning skills in medical and dental education from a multidisciplinary perspective.[2,20] PBL has been increasingly utilized in dental schools in KSA, and many studies have been conducted to evaluate the efficacy of this strategy.[21–23] Other methods include integrating research and evidence-based dentistry, integrating technology into teaching and learning activities, early exposure to comprehensive clinical practice experience, integrating students from different academic levels in the learning experience of clinical case management and presentation, implementing community-based education, and integrating preventive approaches into health care practice.[5,24,25]

The levels and types of integration vary across different dental programs. Integration as a concept remains multidimensional, without clear measurement instruments that can be used to quantify integration in an objective manner.[20] Conceptually, the terms horizontal and vertical integration are most often used to provide subjective descriptions of how integration could be facilitated in a multilayered curriculum.[20] Harden's ladder of integration provides an objective evaluation of integrated curricula leading to better assessment and planning for the effective implementation of integration in education.[26] This system consists of 11 steps (models) of integration in the form of a continuum (represented by a ladder); each model is identified by a set of criteria. As we move forwards, models represent higher levels of integration and reduce the role of disciplines. Therefore, the aim of the current study was to analyze the pattern of integration in the dental curriculum at UQUDENT in KSA by identifying the model and level of integration of each course using a modified version of Harden's ladder of integration. Next, we mapped these courses (based on their credit hours) to levels of integration by academic years, dental department, type of course, and educational methods.

Materials and Methods

Method

The most recent course specifications forms (2021) of the courses taught in the undergraduate dental curriculum in UQUDENT were evaluated and reviewed by independent reviewers. The criteria used to select reviewers were individuals from the curriculum committee of UQUDENT who had a minimum of three years of experience in planning curricula and studies. All members who met the inclusion criteria were invited to participate by email. Three of total number of reviewers who accepted the invitation were selected at random. The reviewers were blinded to the objectives of the study. All biomedical and dental courses were included in the analysis, while general and elective non-dental courses were excluded.

Before the beginning of the study, a meeting was arranged with the reviewers to provide instructions on data extraction and to explain the method to be used to evaluate integration. Intra-reviewer and inter-reviewer consistency were determined at the beginning of the study. Intra-reviewer calibration was evaluated for each reviewer by considering the assessment of two courses that had been reviewed by the

same reviewer over the last two academic years (2020 and 2021), while inter-reviewer calibration was evaluated for the three reviewers by asking each individual to assess two courses (the same two courses were evaluated by all three reviewers). The Kappa test was used to determine intra-examiner and inter-examiner variability, which were 0.84 and 0.80, respectively.

The reviewers independently examined the forms to check the course description and contents and to extract the following data: the name and type of the course (course classification), the name of the department managing the course, the number of departments involved in teaching the course, the number of disciplines integrated into the course, the academic year in which the course is taught, the credit hours of the course, and all methods of teaching and learning applied in each course.

The model of integration for each course was determined based on a modified version of Harden's ladder of integration (Table 1). From a list of models (steps) ranked from one to ten, the reviewers selected the best model that illustrated the design, content, the number of involved disciplines and links between them, and the timing of course delivery. If more than one model could be applied, the reviewers selected the most appropriate model that best represented the majority of the course content. Conflicts were resolved by discussion between the reviewers in a single round using the nominal group technique.

The levels of integration were determined by grouping models of integration based on their ranking (steps) into low, moderate, and high integration levels to simplify the interpretation of data. The number and weighting of the courses (by credit hours) were mapped to levels of integration by various delivery factors (academic years, departments, types of courses, and educational activities).

The pattern of integration in the dental curriculum was analyzed by determining the integration score for each level, as calculated by combining the total credit hours for all courses belonging to that level of integration (each credit hour was equal to 15 contact hours of instructions per semester). The levels that showed the highest total of integration score (in percentages) indicated the general pattern of integration (low, low to moderate, moderate, moderate to high, and high). This analysis was performed for each of the delivery factors (year, department, course type, and educational method) as well as for the whole dental curriculum.

Statistical analysis

The Kappa coefficient was calculated to evaluate the level of agreement between the reviewers.[27] Statistical analysis was conducted using IBM SPSS version 28 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to define the characteristics of the variables considered (by frequency and percentages). The chi-squared test and Fisher's exact test were used to establish relationships between categorical variables.

Results

Frequency and percentage distribution of the courses

The dental program in UQUDENT is a six-year annual program followed by a mandatory internship year. The first year is considered as a preparatory year and all courses during this year are general and non-dental. We evaluated a total of 39 courses; these are taught throughout the second to the sixth year, and account for a total of 323 credit hours of education. These courses cover 29 various medical and dental disciplines, and are managed by four departments: Basic Oral Sciences, Preventive Dentistry, Restorative Dentistry, and Oral and Maxillo-

Table 1: Models of integration (modified Harden's ladder of integration).

Level	Rank	Model	Description
No Integration	1	Isolated (Fragmented)	- The course teaches a single discipline. - The content, depth, sequence, and timing are independent of any other course. - Any coincidental link is unplanned.
Low	2	Connected (Harmonized)	- The course teaches a single discipline. - The contents might be linked to other courses by informal or formal planning. - Taught concepts/skills are linked to earlier courses or lead to other concepts/skills within a single discipline.
	3	Coordinated (Parallel)	- The course teaches a single discipline. - The timing of content delivery in a discipline is arranged by informal or formal planning in parallel with related contents from other disciplines in a horizontal structure. - Students link the contents of related disciplines in a concurrent manner
	4	Nested (Infused)	- The course teaches a single discipline. - The contents are arranged by formal planning based on competencies in a structured vertical format. - Taught concepts/skills within a single discipline or from multiple disciplines are related to concepts/skills of other courses or disciplines taught later.

(*continued on next page*)

Table 1 (*continued*)

Level	Rank	Model	Description
Moderate	5	Shared (Joint)	- The course teaches two or more disciplines. - Some contents from different disciplines overlap in part of the course. - The focus is on the main discipline. Disciplines are taught in separate classes.
	6	Correlated (Concomitant)	- The course teaches two or more disciplines. - The contents from different disciplines overlap throughout the course. - The contents are primarily taught as discipline based with some integration.
	7	Mixed (Complementary)	- The course teaches two or more disciplines. - The contents are primarily taught integrated with other disciplines. - The focus of learning might be a topic or sometimes a theme to which the disciplines can contribute in integrated classes.
High	8	Multidisciplinary (Webbed)	- The course teaches multiple disciplines. - The contents are taught as integrated, but the disciplines preserve their identity. - The focus of learning is mainly themes, but the themes are viewed through the lenses of disciplines.
	9	Interdisciplinary (Monolithic)	- The course teaches multiple disciplines. - The contents are taught as integrated, and individual disciplines are not identified in the timetable. - The focus of learning is themes, where disciplines are blended.
	10	Transdisciplinary (Immersed)	- The course provides a framework of learning opportunities that is not based on disciplines. The integration occurs in the mind of the student. - The focus of learning is the learner, and disciplines become part of the learner's real-world experience over time.

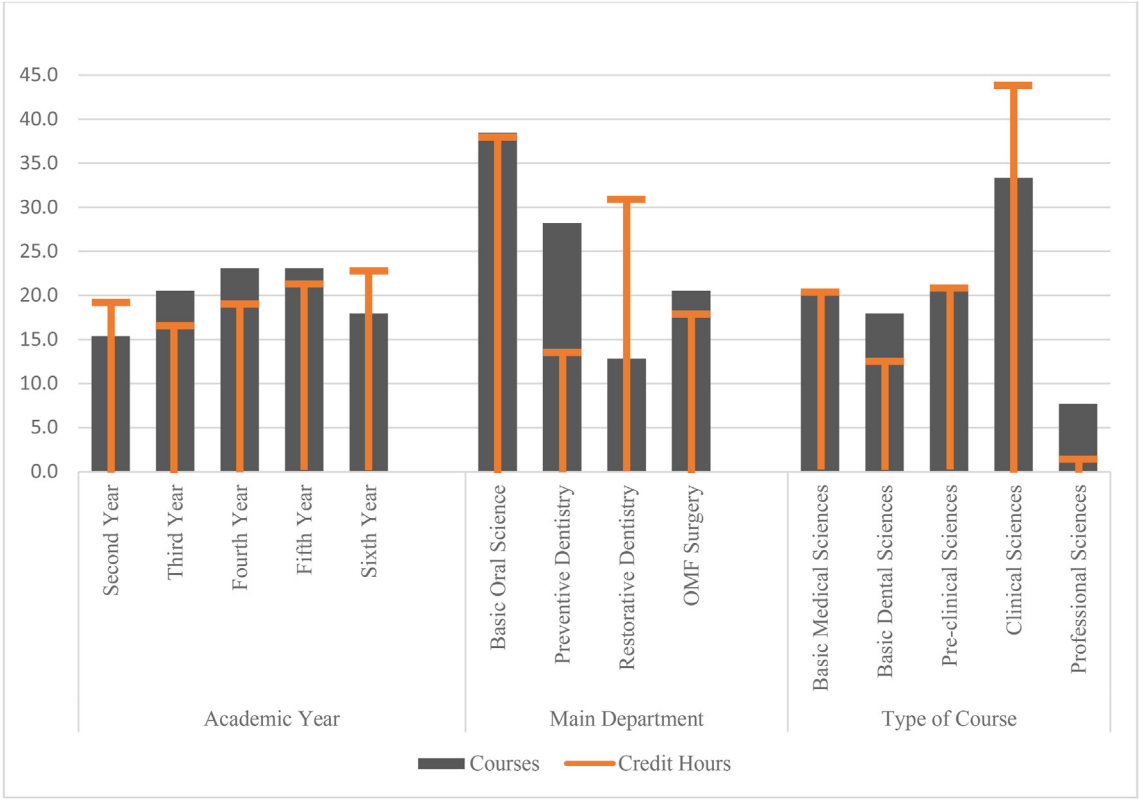

Figure 1: Proportional distribution (%) of courses and their credit hours by academic years, departments, and type of course.

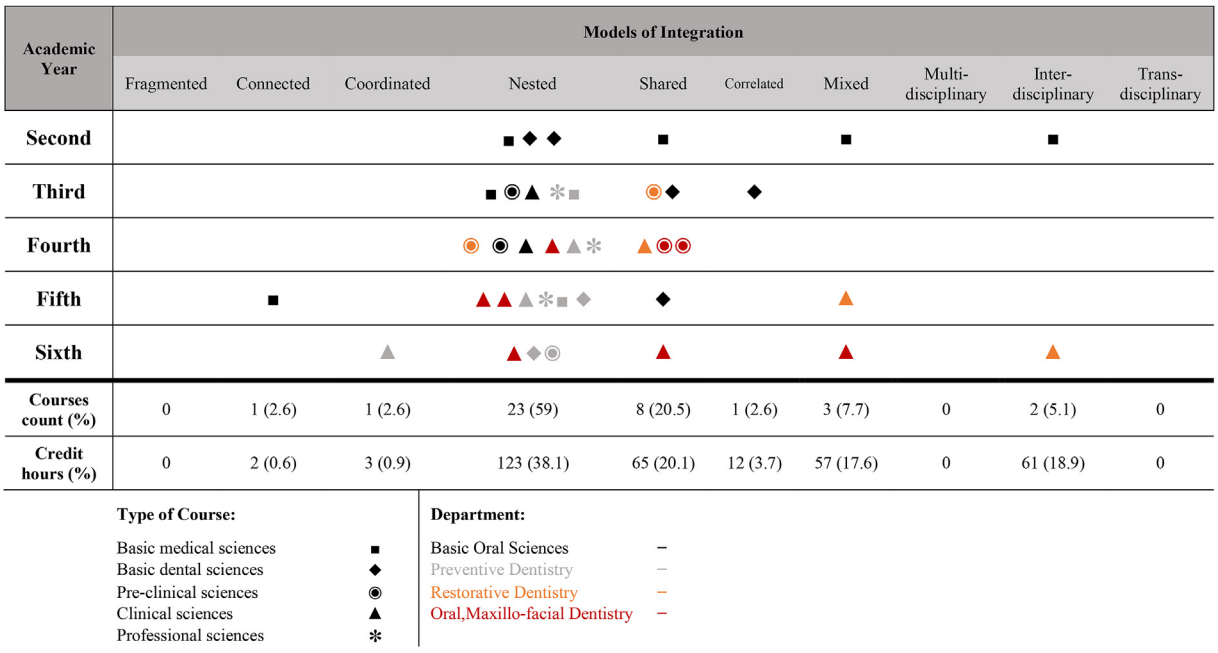

Figure 2: Mapping of courses to models of integration by academic years, managing departments and type of course.

facial Dentistry (OMFS); these departments coordinate the bachelor dental program in a coordinated manner.

The courses in UQUDENT were classified based on their respective types into basic medical sciences, basic dental sciences, preclinical sciences, clinical sciences, and professional and behavioral sciences (mainly teaching ethics, practice management and behavioral management). Clinical courses represent 44.3% of the dental curriculum. Dental education in our school utilizes various teaching and learning activities: traditional didactic lectures (instructor-centered face to face teaching in a classroom), PBL/CBL (involving guided group discussion in a

Table 2: Frequency and proportion of credit hours (%) of dental curriculum by delivery variables for each level of integration.

Mapping of Total Credit Hours of Dental Curriculum		Level of Integration (%)			Total (%)	p-value
		Low	Moderate	High		
Total		128 (39.6)	134 (41.5)	61 (18.9)	323 (100)	
Academic year	Second Year	15 (4.6)	26 (8.0)	23 (7.1)	**64 (19.8)**	**0.001**
	Third Year	20 (6.2)	33 (10.2)	0	**53 (16.4)**	
	Fourth Year	32 (9.9)	30 (9.3)	0	**62 (19.2)**	
	Fifth Year	34 (10.5)	35 (10.3)	0	**69 (21.4)**	
	Sixth Year	27 (8.4)	10 (3.1) *	38 (11.8) *	**75 (23.2)**	
Main department	Basic Oral Science	51 (15.8)	50 (15.5)	23 (7.1)	**124 (38.4)**	**0.001**
	Preventive Dentistry	44 (13.6) †	0 †	0	**44 (13.6)**	
	Restorative Dentistry	6 (1.9) †	54 (16.7)	38 (11.8) †	**98 (30.3)**	
	OMF Surgery	27 (8.4)	30 (9.3)	0	**57 (17.6)**	
Course classification	Basic Medical Sciences	16 (5.0)	26 (8.0)	23 (7.1)	**65 (20.1)**	**0.001**
	Basic Dental Sciences	19 (5.9)	24 (7.4)	0	**43 (13.3)**	
	Pre-clinical Sciences	32 (9.9)	34 (10.5)	0	**66 (20.4)**	
	Clinical Sciences	55 (17.0)	50 (15.5)	38 (11.8)	**143 (44.3)**	
	Professional Sciences	6 (1.9)	0	0	**6 (1.9)**	
Teaching and learning method	Didactic/Lectures	43 (13.3)	59 (18.3)	17 (5.3)	**119 (36.8)**	**0.001**
	PBL/CBL	0	1 (0.3)	6 (1.9)	**7 (2.2)**	
	Blended Learning	25 (7.7)	8 (2.5)	2 (0.6)	**35 (10.8)**	
	Laboratory Training	9 (2.8)	8 (2.5)	4 (1.2)	**21 (6.5)**	
	Pre-clinical Simulation	20 (6.2)	18 (5.6)	0	**38 (11.8)**	
	Clinical Training	31 (9.6)	40 (12.4)	32 (9.9)	**103 (31.9)**	

Chi-squared statistical analysis was performed to compare the level of integration within each categorical variable at $p < 0.05$.
The Bonferroni correction test was performed for multiple comparisons. (*) indicates a statistically significant difference at $p < 0.003$. (†) indicates a statistically significant difference at $p < 0.004$.

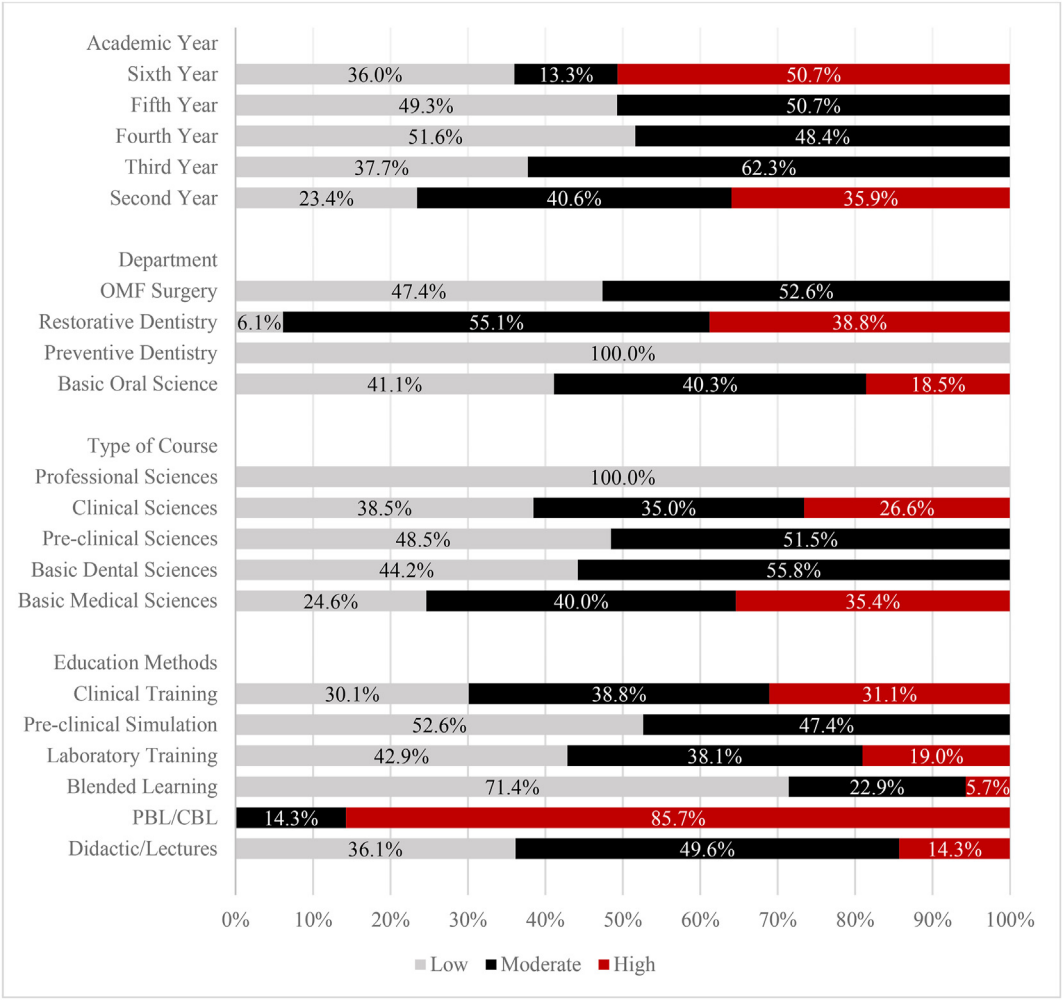

Figure 3: Distribution (%) of course credit hours by the level of integration within each academic year, department, course classification and educational method.

classroom), blended learning (student-centered, such as a flipped classroom using a mix of face to face and virtual e-learning strategies by technology), laboratory training, (involving demonstrations, practical training and research conduction), and preclinical simulation and clinical training (both attaining dental education through experiential learning that mimic the real-world practice under supervision). Lectures and clinical training are the most commonly used, while PBL/CBL and blended learning are the least used ones.

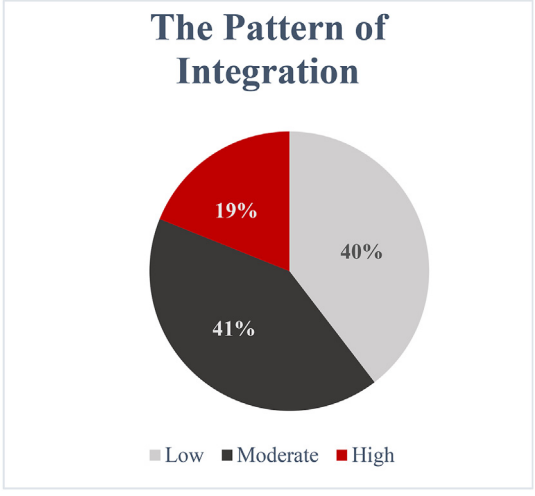

Figure 4: The overall pattern of integration in the dental curriculum (%).

The percentage distribution of the courses and their credit hours by academic years, departments, and types of courses are presented in Figure 1. Preclinical and clinical courses are taught throughout the third to sixth years and offered by all departments, while professional and behavioral science courses (taught during the third, fourth, and fifth years) are only offered by the Department of Preventive Dentistry. Basic medical and dental courses (taught during the second, third, and fifth years) are managed by the Departments of Basic Oral Sciences and Preventive Dentistry.

Models of integration

Figure 2 depicts the total number of courses for each model of integration as mapped by academic year, department, and type

of course. Analysis revealed that the most frequent model of integration within the dental curriculum is the nested model, accounting for 23 (59%) of the total courses for a total of 123 credit hours (38.1%). None of the courses are taught using fragmented, multidisciplinary, or transdisciplinary models. During the third and fourth academic year, the two main implemented models are the nested and shared models, while a higher number of models are implemented during the fifth and sixth academic years (years 4 and 5 respectively). The number of integrated disciplines within courses taught using mixed and interdisciplinary models ranges between four and seven, whereas correlated and shared models involve two to five disciplines.

Levels of integration

Only two courses in the curriculum (classified as basic medical sciences and clinical sciences) are ranked as high integration and are taught during the second and sixth years, respectively. Courses that show low and moderate levels of integration (25 and 12 courses, respectively) are offered throughout all the academic years of the program. The distribution of course credit hours according to study variables (years, departments, course types, and educational methods) for each level of integration is shown in Table 2. Furthermore, detailed insight on the percentage distribution of credit hours by the level of integration within each individual year, department, course classification, and educational method is presented in Figure 3. Analysis showed that 50% of education time during the final year involves a high level of integration.

Pattern of integration

The main pattern of integration is moderate to high during the second and sixth years, but low to moderate during the third, fourth and fifth years. Moderate to high-integration education is mainly applied within the Department of Restorative Dentistry, whereas low to moderate is the common pattern in both the Basic Oral Sciences and Oral and Maxillo-facial Surgery departments. Only a low level of integration is implemented within the Department of Preventive Dentistry. Basic medical courses show moderate to high levels of integration. On the other hand, basic dental, preclinical, and clinical courses are ranked as low to moderate, while professional and behavioral courses represent only low levels of integration. PBL/CBL and clinical training educational methods present generally moderate to high integration in the curriculum but lectures, blended learning, laboratory training, and simulation are used mainly in courses with low to moderate integration. The total score of each integration level is presented in Figure 4, which shows the overall integration pattern of the program. The chart indicates that the main pattern of integration of the UQUDENT dental curriculum is low to moderate (approximately 80%).

Discussion

This study offers insight on the integration pattern of the dental curriculum in UQUDENT. The analysis of the models and levels of the current integrated curriculum provides valuable information and objective assessment of its status to facilitate better planning of curriculum reform, as well as creating a reference base for future comparison with the updated curriculum. In our study, the assessment of integration was conducted using Harden's ladder of integration, which is commonly used in developing and evaluating medical curricula.[26] However, some modifications were made by the authors in accordance with the structure of the dental curriculum and the nature of dental disciplines.

Our modified version generally follows the same structure as the original model but differs slightly in terms of description and the order of models. The criteria for each model were more specific based on the number of disciplines, the horizontal versus vertical links between disciplines, and the amount of blending at the boundaries between the disciplines involved. The second model of the original ladder was combined with the next model (based on similarities between the criteria of both models for simplification); therefore, the total number of models was reduced to ten. Furthermore, the definition of the nested model was slightly modified based on its vertically structured integration (which features a higher form of integration), thus resulting in the reformation of order (by switching the order of the nested and coordinated models). The models were ranked based on the degree of integration (similar to the steps in the original model) and grouped into three levels (low, moderate, and high) based on the ranking of steps to simplify analysis of the curriculum integration. Models of integration mainly describe the criteria such that it is easier to determine the types of integration in the evaluated courses, while levels of integration are used to rate the degree of integration in order to analyze the pattern of integration.

Courses were mapped to levels of integration by years, departments, course classification, and educational methods, to provide better and more in-depth assessment of integration according to each aspect. An adequate distribution of integrated courses of different levels throughout different years is essential to ensure a balanced overall pattern of integration across academic years. The dental curriculum should adopt different models of integration in different courses to achieve integration in both the horizontal dimension (between disciplines within the same academic year) and the vertical dimension (between the disciplines of basic and clinical courses), showing an overall ascending trend over time.

Simply creating integrated courses does not necessarily build an integrated curriculum. Hence, departments (mainly contributing to the management of courses) should work collaboratively on designing and delivering integrated courses that must be combined and assembled carefully to create a truly integrated curriculum.[28] Furthermore, the analysis of course type and educational activities were considered in this study because various types of courses implement different teaching and learning strategies which may have variable impacts on integration. Therefore, it is critical to evaluate integration based on each of these variables.

Analysis showed that the nested model of integration was the most common one used in terms of quantity (exceeding one half of the total number of courses) and the time of education; this is best justified by the current construction of the curriculum that was designed to teach new concepts or skills built on previous curricula from prerequisite courses in a vertical format. Basic medical and dental sciences are

mainly taught during the second and third academic years and are considered prerequisites for preclinical courses (mainly during the third and fourth years) that precede the clinical courses delivered during a subsequent phase of education. Although some courses can still be appropriately created and delivered at such a low level of integration, we should consider implementing higher levels of integration in some courses. For example, integrating professional sciences (currently incorporating only a low level of integration) into clinical courses is recommended as this should prepare graduates to join the workforce and practice more efficiently.

The design of courses and the selection of integration level should be determined based on the desired learning outcome, the competences chosen, the requirements of stakeholders, staff and resources, and organizational structure.[3,11] Several challenges, however, can influence the implementation of integration; these include the resistance of educators to change, inflexible policies and regulations, and limited experience and resources. Although the thoughtful planning and design of an integrated curriculum is critical, emphasis on the training of educators delivering the integrated curriculum, as well as selecting accurate teaching strategies that appropriately emphasize the integration, is essential.[28]

We found that PBL/CBL is the least used educational method in our current curriculum (mainly for highly integrated courses). In medical education, the knowledge of basic science is difficult to connect to clinical scenarios for junior students who have limited or no clinical exposure at this phase; this challenge is overcome by integrating basic science and clinical cases to enhance the learning experience, often through PBL/CBL.[28] This concept is also applicable in dental education. Therefore, to improve the efficiency of the integrated curriculum, more PBL/CBL sessions should be included. Furthermore, blended learning (which is mainly used in courses with a low level of integration in the. curriculum) should be implemented more in highly integrated courses.

A previous study shown in the dental literature was conducted to assess the integration of dental curricula.[29] However, this particular study used a different method to assess integration which was introduced by Fogarty, who identified 10 models of integration and categorized these into four themes: within a discipline, across disciplines, within and across disciplines, and within and across learners.[29] We constructed a Harden's ladder based on the model previously proposed by Fogarty. Furthermore, earlier studies mapped courses (based on the number of courses) to themes by academic years and departments only, while our study mapped courses based on their weight (by credit hours) to the level of integration by incorporating more variables. Not all courses were weighted equally in our curriculum; therefore the patterns of integration in the curriculum were identified based on the weighting of courses (which reflects the time spent during education) to provide better assessment instead of relying on the number of courses without considering their weighting, as this may differ significantly between courses.

There are some limitations associated with our study that need to be considered. Some courses could encompass more than two models of integration but were only assigned to the single most applicable one. In addition, the courses delivered during the first preparatory year were not evaluated because they are generally fragmented subjects and not specifically delivered as part of the dental curriculum, although they are part of the education continuum of students. At UQUDENT, it is mandatory to complete a full year of internship in order to graduate, during which students consolidate all learned concepts and skills into a meaningful association applied to the real-world experience of a true transdisciplinary integration by viewing clinical cases from various perspectives and by incorporating all basic knowledge from different disciplines to manage cases in an appropriate manner. The inclusion of these academic years could influence the overall pattern, thereby creating slight changes in the overall equation. Furthermore, the level of integration in the entire curriculum cannot be simply determined by evaluating the models of integration for individual courses without analyzing the influence of various factors that contribute to the achievement of curriculum integration, such as the relationship of courses to each other, the scaffolding of content, the relationship between different learning constructs, educational strategies, and assessment methods.

Future studies might consider the in-depth evaluation of these factors, such as the assessment methods used in an integrated curriculum because the successful delivery of an integrated curriculum relies on assessment methods to efficiently evaluate the program outcome. In other words, creating an integrated course does not automatically initiate cognitive interaction by students unless the course is delivered and assessed appropriately.[28] Another suggestion is to evaluate the level of integration of new sciences that have emerged in the dental field. These new sciences currently include, but are not limited, to the fields of molecular biology, genetics, tissue engineering, nanotechnology, digital technology, artificial intelligence, and informatics.[25]

Conclusion

All courses have some level of integration that varies throughout years and across departments, with an overall low to moderate pattern of curriculum integration. More collaborative planning and cooperation between departments is recommended if we are to increase the ascending level of integration in taught courses throughout the academic years, particularly during the last three academic years, as well as between basic, clinical, and professional types of courses. In addition, modern teaching and learning strategies, such as PBL/CBL and blended learning, should be implemented more within the curriculum at a higher level of integration.

Source of funding

This study received no specific funding from any funding agency in the public, commercial, or nonprofit sectors.

Conflict of interest

The authors declare no known competing financial interests or personal relationships that could have influenced the data reported in this paper.

Ethics approval

This article does not feature any studies with human participants or animals.

Patient consent

This study did not require informed consent.

Authors' contributions

Conceptualization and design: WFK and MAA. Data curation and methods: WFK, MAA and SWT. Analysis and data interpretation: WFK. Writing and editing original draft: WFK and SWT. Reviewing the final draft: MSA. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

References

1. Nadershahi NA, Bender DJ, Beck L, Alexander S. A case study on development of an integrated, multidisciplinary dental curriculum. **J Dent Educ 2013**; 77(6): 679–687.
2. Elangovan S, Venugopalan SR, Srinivasan S, Karimbux NY, Weistroffer P, Allareddy V. Integration of basic-clinical sciences, PBL, CBL, and IPE in U.S. Dental schools' curricula and a proposed integrated curriculum model for the future. **J Dent Educ 2016**; 80(3): 281–290.
3. Malik AS, Malik RH. Twelve tips for developing an integrated curriculum. **Med Teach 2011**; 33(2): 99–104. https://doi.org/10.3109/0142159X.2010.507711.
4. MacNeil RLM, Hilario H. Input from practice: reshaping dental education for integrated patient care. **Front Oral Health 2021**; 2:659030. https://doi.org/10.3389/froh.2021.659030.
5. Ghassan A, Shukr I, Sadiq N, Ahsan R. Current trends in dental education. **Pak Armed Forces Med J 2021**; 71(3): 1107–1113.
6. Stewart TM. *A systematic approach to an integrated curriculum model for dental education*. Las Vegas: University of Nevada; 2008.
7. Haden NK, Hendricson WD, Kassebaum DK, Ranney RR, Weinstein G, Anderson EL, et al. Curriculum change in dental education, 2003-09. **J Dent Educ 2010**; 74(5): 539–557.
8. Safarnavadeh M, Ebrahimpour Koumleh S, Mousapur N. The experience of integration in the dental curriculum of the world's accredited universities and how to apply it in Iran. **Future Med Educ J 2018**; 8(1).
9. van der Hoeven D, Hachem LE, Chaudhry S, Holland 3rd JN, Shepherd KR. Methods and timing of curricular integration in U.S. dental education in preparation for the Integrated National Board Dental Examination. **J Dent Educ 2020**. https://doi.org/10.1002/jdd.12442.
10. Postma TCWJ. Developing integrated clinical reasoning competencies in dental students using Scaffolded case-based learning - empirical evidence. **Eur J Dent Educ 2016**; 3: 180–188.
11. Husain M, Khan S, Badyal D. Integration in medical education. **Indian Pediatr 2020**; 57(9): 842–847.
12. Maha Abdelsalam TER, Brallier Lynn. Student and faculty satisfaction with their dental curriculum in a dental College in Saudi Arabia. **Int J Dent 2020**; 2020. 5 pages.
13. Nguyen TTT, Seki N, Morio I. Stress predictors in two Asian dental schools with an integrated curriculum and traditional curriculum. **Eur J Dent Educ 2018**; 22(3): e594–e601. https://doi.org/10.1111/eje.12358.
14. Alkuwaiti A. Critical Appraisal of the Saudi Dental Curriculum and a proposal to improve the teaching and learning methods adopted at Saudi Dental Colleges. **Int J Med 2014**; 19(1): 43–48.
15. Alshihri AA, Salem DM, Alnassar TM, Alharbi NM, Lynch CD, Blum IR, et al. A nationwide survey assessing the satisfaction of dental colleges graduates with their undergraduate experience in Saudi Arabia. **J Dent 2021**; 110:103685. https://doi.org/10.1016/j.jdent.2021.103685.
16. Hussein KS. Perceptions of an integrated curriculum among dental students in a public university in Saudi Arabia. **Electron Physician 2017**; 9(7): 4828–4834. https://doi.org/10.19082/4828.
17. Vundavalli S. Self-perceived preparedness to work independently among graduating dental students in Saudi Arabia: traditional versus integrated curriculum. **Pesqui Bras Odontopediatria Clin Integr 2020**; 20. https://doi.org/10.1590/pboci.2020.066.
18. Al-Madi EM, AlShiddi M, Al-Saleh S, AbdelLatif H. Developing a dental curriculum for the 21(st) century in a new dental school in Saudi Arabia. **J Dent Educ 2018**; 82(6): 591–601. https://doi.org/10.21815/JDE.018.066.
19. Akram A, Bashir U, Yasmin S, Sattar K, Meo SA. Integrated undergraduate dental curriculum. **J Pakistan Med Assoc 2019**; 69(9): 1331–1336.
20. Postma TC, White JG. Students' perceptions of vertical and horizontal integration in a discipline-based dental school. **Eur J Dent Educ 2017**; 21(2): 101–107. https://doi.org/10.1111/eje.12186.
21. Al-Madi EM, Celur SL, Nasim M. Effectiveness of PBL methodology in a hybrid dentistry program to enhance students' knowledge and confidence. (A pilot study). **BMC Med Educ 2018**; 18(1): 270. https://doi.org/10.1186/s12909-018-1392-y.
22. Alkhuwaiter SS, Aljuailan RI, Banabilh SM. Problem-based learning: dental student's perception of their education environments at Qassim University. **J Int Soc Prev Community Dent 2016**; 6(6): 575–583. https://doi.org/10.4103/2231-0762.195512.
23. Binshabaib M, Shalabi M, Mansour S, Alageel L, Alsuwidan N, Alharthi SS. Role of problem-based learning in undergraduate dental education: a questionnaire-based study. **Adv Med Educ Pract 2019**; 10: 79–84. https://doi.org/10.2147/AMEP.S181658.
24. Shenoy GMDI, Pagni S, Murphy J, Karimbux N. Factors associated with evidence-based clinical questions presented in a vertically integrated seminar series at a U.S. Dental school. **J Dent Educ 2018**; 82(6): 625–629.
25. Safarnavadeh Maryam EKS, Soudeh Jafari. The examination of the reasons for the need to change and integrate in the dental curriculum in Iran and the world. **J Dent Sch Shahid Beheshti Univ Med Sci 2018**; 36(2): 65–70.

26. Harden RM. The integration ladder: a tool for curriculum planning and evaluation. **Med Educ 2000**; 34(7): 551–557. https://doi.org/10.1046/j.1365-2923.2000.00697.x.
27. Landis JR, Koch GG. The measurement of observer agreement for categorical data. **Biometrics 1977**; 33(1): 159–174.
28. Brauer DG, Ferguson KJ. The integrated curriculum in medical education: AMEE Guide No. 96. **Med Teach 2015**; 37(4): 312–322. https://doi.org/10.3109/0142159X.2014.970998.
29. Howard KM, Stewart T, Woodall W, Kingsley K, Ditmyer M. An integrated curriculum: evolution, evaluation, and future direction. **J Dent Educ 2009**; 73(8): 962–971.

How to cite this article: Khayat WF, Almalki MA, Alqahtani MS, Taher SW. Evaluation of the level of integration of the dental curriculum in Umm Al-Qura University. J Taibah Univ Med Sc 2023;18(6):1449–1458.