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## The Benefits of Integrating Dental and Dental Therapy and Hygiene Students in Undergraduate Curricula

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Inter-professional education, biomedical sciences, dental therapy and hygiene, multiple choice questions, direct access, enquiry-based learning.

**Conflict of Interest Disclosure:**

None of the authors have any conflicts of interest to disclose.

## Abstract

### Purpose

The purpose of the current study was to evaluate the impact of integrating the teaching of Bachelor of Dental Surgery (BDS) and Bachelor of Dental Therapy and Hygiene (BScDTH) students in Enquiry Based Learning (EBL) sessions, using performance on multiple related integrated dental science (IDS) multiple choice questions assessments.

### Method

IDS assessments are sat twice in the first stages of both the BDS and BScDTH programmes. IDS scores from integrated and non-integrated cohorts were collated and compared across test occasions (first or second assessment of the stage) and programmes (BDS and BScDTH).

### Results

The results revealed that IDS scores were, overall, significantly higher for students in integrated ( $M=63.46$ ,  $SD=13.06$ ) than non-integrated EBL groups ( $M= 60.75$ ,  $SD=13.67$ ;  $F_{(1,207)}=4.277$ ,  $p=0.040$ ,  $\eta^2_p=0.020$ ). Although this effect was not statistically significant when each programme was considered separately, the effect of integration on both programmes was nevertheless positive, with a more pronounced improvement for BScDTH (+7.88) than BDS (+0.63) students.

### Conclusions

Integrating students from different programmes for the teaching of core dental knowledge in team environments improves student performance in subsequent dental science assessments – and more so for BScDTH than BDS students. The fact that both groups benefit from integration should go some way towards reassuring institutions that are considering integration but are cautious of threats to ‘established’ programmes.

## Introduction

Following the recent introduction of Direct Access to Dental Care Professionals (UK), the responsibility for ensuring the safety of the patient being treated by a therapist has shifted from a supervising dentist to the individual dental therapist<sup>1</sup>. Training providers must now ensure that the graduating dental therapist can demonstrate sufficient understanding of the biomedical sciences that underpin safe, contemporary clinical practice, which can be achieved by evaluating dental therapy students' performance in scientific, knowledge-based assessments<sup>2,3</sup>.

With the advent and growing impact of policies such as the World Health Organisation's "Framework for Action on Inter-professional education and collaborative practice"<sup>4</sup>, and The Sydney Inter-Professional Declaration<sup>5</sup>, inter-professional education (IPE) is becoming a more prevalent pedagogic approach, and efforts are being made to integrate the teaching of students from a wide range of related courses<sup>6</sup>. Contemporary dental practice revolves around shared care. An IPE programme provides the opportunity to help overcome some of the key barriers to effective collaborative education and patient care, namely; the lack of understanding of each other's roles, establishment of hierarchies, and unfounded preconceptions about each other's place in the provision of care before entering clinical practice<sup>7</sup>. In the dental professions, however, implementation of IPE at undergraduate level is inconsistent, and evidence to describe its efficacy is lacking<sup>5,8</sup>.

Given the overlapping scope of practice of Dentists and Dental Therapists and Hygienists, there is opportunity to provide fully integrated programmes for both groups of students. This approach aims to ensure both the robustness of scientific content, and the benefits of IPE to collaborative practice. Nevertheless, introduction of IPE to any existing dental training programme must benefit both professions.

Our Dental School has an established Enquiry - Based Learning (EBL) Bachelor of Dental Surgery (BDS) programme<sup>9</sup>, and a Bachelor of Dental Therapy and Hygiene (BScDTH) programme which started in 2014. EBL is a variant of a problem based pedagogic approach in which students meet together in groups of 6 - 8 under the guidance of a facilitator, usually an experienced dental clinician, to work through problems based around real-world clinical scenarios blueprinted to specific learning outcomes. These small group sessions are supplemented with plenary lectures, workshops and self-directed learning sessions, allowing interaction with subject specialists in specific areas, for example, the biomedical sciences. Each Scenario is presented to the student group in the form of a 'case'. Each lasts 2 weeks and students are expected to work through up to 15 cases per academic year.

In both the BDS and BScDTH programmes, students complete a number of EBL sessions, and two knowledge-based integrated dental science (IDS) assessments per year. EBL for both programmes consists of four sessions per case, comprising an initial brainstorming exercise where students autonomously identify and work-up pertinent learning outcomes for set patient case-studies. This is followed by two sessions of dissemination and analysis of new knowledge acquired by self-directed learning. Each

EBL case culminates with an unseen "mini case"; another related, but separate, clinical scenario in which students are required to consolidate and apply knowledge to address the issues raised in the mini case<sup>9</sup>.

To ease facilitation of integration, only material that is in the Scope of Practice of both professions is covered in stage one. For the first two cohorts in the integrated programme, BScDTH and BDS students were in separate EBL groups, but all other aspects of the academic and clinical curriculum were integrated. Integration within EBL sessions was introduced for the 2016-17 cohort as part of the developing ethos of complete inter-professional education, including response to student feedback. Apart from EBL integration, all other aspects of curriculum delivery and student selection have remained the same. The EBL groups were led by the same group of facilitators in both integrated and non-integrated cohorts, and the same EBL scenarios were for the integrated and non-integrated cohorts. This means that by comparing scores achieved in the first two cohorts of the programme with that in the third, it becomes possible to compare non-integrated with integrated curriculum.

A large amount of the learning covered by EBL is assessed as part of the IDS assessments. These are 60-item single-best-answer multiple-choice-question (MCQ) format assessments, completed online twice in Stage 1 of study in both the BDS and BScDTH programmes. Different tests are constructed for the first and second test sat by each cohort (two test papers per academic year, six different test papers in total between 2014-15 and 2016-17), but each IDS test is constructed to cover the material taught up to that point in the curriculum and as such the test difficulty and expected standard for the first and second tests across cohorts is considered comparable. This is supported by the standards setting process, whereby each test is standard set using a combined Angoff-Hofstee method. The difference in pass-marks set by this process between integrated and non-integrated cohorts was 0.66% for the first test and 1.01% for the second. Furthermore, thorough post-test analyses are conducted following the completion of each test to ensure parity and fairness, and such analyses provide little reason to suspect any significant difference in difficulty between the first and second tests across cohorts.

Since the start of the BScDTH programme, each test of the year (of which there are two, each comprising a different test paper) has been sat simultaneously by both BScDTH and BDS students. Within a wider programme of evaluation of the integrated curriculum, this provides a valuable opportunity to investigate the impact of integrated EBL on student performance in MCQ-based assessments. In order for such an integrated approach to be more widely adopted in dental education, any concerns that one group may be disadvantaged by integration should be tested empirically.

The aim of the current study was therefore to quantitatively evaluate the impact of integrated BDS and BScDTH EBL teaching sessions on student performance in knowledge based science assessments using performance on the IDS assessments.

## Method

Ethical approval for this work was obtained from the [anonymised] research ethics committee [17/18-839].

Scores for all IDS tests were collated and categorised as from non-integrated (2014-15 and 2015-16) and integrated (2016-17) IDS assessments. Based on available admissions data the average age of students in the non-integrated group was 23 years for BDS (20-43 years) and 26 years for BScDTH (21-40 years) students, with female students accounting for 55% and 93% of the groups respectively. The average age of students in the integrated group was 21 years for BDS (20-29 years), and 26 years for BScDTH (21-37 years), with female students accounting for 43% and 77% of the groups respectively. Routine post-test analyses of IDS test performance in our school has not shown gender to be a significant factor in test performance. Only data from students sitting the assessments as a first attempt were included. The final dataset comprised 424 assessment scores from 213 students (2014-15, 57 BDS, 15 BScDTH; 2015-16, 55 BDS, 15 BScDTH; 2016-17, 58 BDS, 13 BScDTH).

IDS performance between the integrated and non-integrated groups was compared using a 2 Test (First – IDS1.1, Second – IDS1.2) by 2 Integration (Integrated, Non-integrated) by 2 Programme (BDS, BScDTH) analysis of variance, with IDS percentage score as the outcome measure.

## Results

The average performance of students by test occasion, programme, and integration status are shown in Table 1.

*Table 1: Descriptive Statistics (IDS percentage score) by Test, Programme, and Integration*

	Programme		Non-integrated	Integrated	Total
<b>First Test</b>	BDS	Mean	64.51	64.66	64.56
		SD	10.39	11.05	10.59
		N	112	58	170
	BScDTH	Mean	48.71	55.61	50.68
		SD	14.99	15.89	15.38
		N	30	13	43
	Total	Mean	61.15	63.11	61.80
		SD	13.17	12.37	12.91
		N	142	71	213
<b>Second Test</b>	BDS	Mean	64.48	65.59	64.86
		SD	9.85	12.44	10.79
		N	111	58	169
	BScDTH	Mean	45.94	54.80	48.48
		SD	17.65	17.26	17.80
		N	30	12	42

Total	Mean	60.54	63.74	61.60
	SD	14.10	13.86	14.07
	N	141	70	211

Further statistical analysis revealed a significant main effect of Integration, showing that IDS percentage scores were significantly higher for integrated ( $M=63.46$ ,  $SD=13.06$ ) than non-integrated EBL groups ( $M= 60.75$ ,  $SD=13.68$ ;  $F_{(1,207)}=4.277$ ,  $p=0.040$ ,  $\eta^2_p=0.020$ ). The lack of any significant Programme by Integration effect ( $F_{(1,207)}=3.108$ ,  $p=0.079$ ,  $\eta^2_p=0.015$ ) suggests that the effect of integration is the same in both programmes. Whilst there was no significant difference between integrated and non-integrated EBL groups within programmes, the improvement following integration was more pronounced for BScDTH (+7.88%) than for BDS (+0.63%) students (Figure 1).

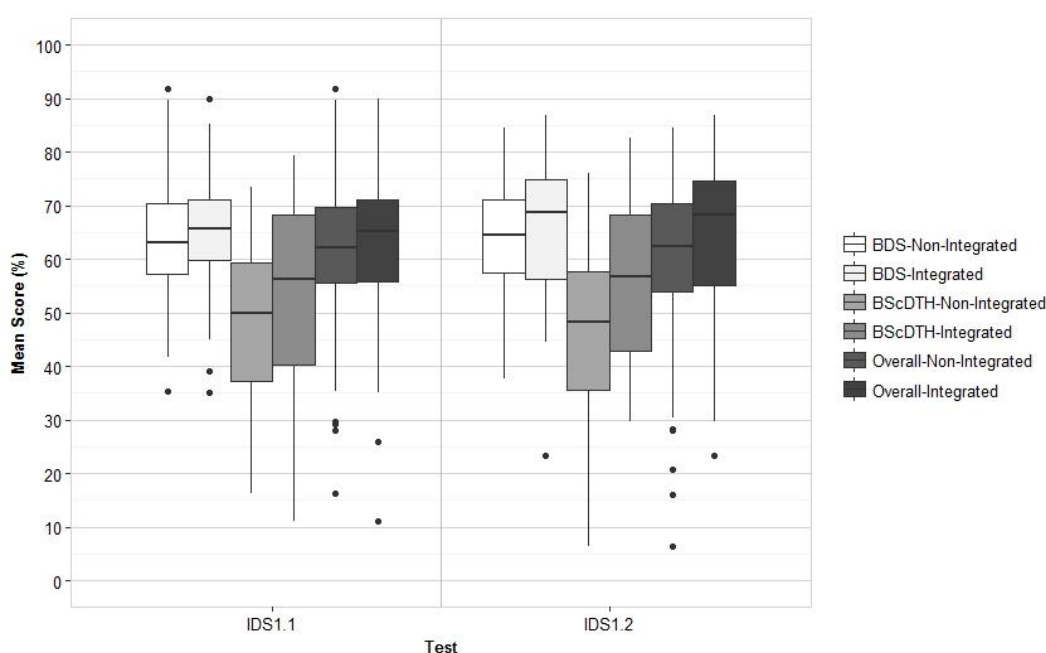


Figure 1: IDS percentage scores by Test, Programme, and Integration.

The analysis also showed that there was no statistically significant main effect of Test, nor any statistically significant interactions between Test and Programme, Test and Integration, or any three-way interaction between all of the factors, such that performance averaged across programmes did not show any change between the first and second test occasions. There was, however, a statistically significant difference in overall performance by Programme, with BDS students ( $M=64.71$ ,  $SD=10.69$ ) scoring higher than BScDTH students ( $M= 49.58$ ,  $SD=16.59$ ;  $F_{(1,207)}=43.325$ ,  $p<0.001$ ,  $\eta^2_p=0.173$ ).

Furthermore, failure rates were lower in integrated EBL groups (mean failure rate of 8.45% for the first test, 7.14% for the second test) than in non-integrated EBL groups (mean failure rate of 9.15% for the first test, 8.51% for the second test). However, this association was not found to be statistically significant.

## Discussion

In response to the WHO IPE framework<sup>4</sup>, NHS England Workforce planning strategy for shared care<sup>10</sup>, changes to the skill mix in delivery of dental care<sup>11</sup> and the need for efficiency savings for course providers in shared staff and resources, UK universities are increasingly looking to employ modes of IPE in their curriculum delivery<sup>12,8,13</sup>. Whilst the advantages of IPE in subjective elements of dental programmes, such as improved understanding of professional roles and responsibilities, reduction in negative stereotypes, and reduction of detrimental hierarchies have already been documented<sup>6</sup>, the present results extend this to demonstrate the advantages of IPE on student performance in MCQ - based knowledge tests. Our results demonstrate, for the first time, that both BDS and BScDTH students achieve higher scores on knowledge based MCQ assessments when they learn in integrated as opposed to non-integrated EBL groups. This is the first study to report that integration has a positive effect on student performance in knowledge-based science assessments, whilst also showing that no group of students is disadvantaged.

Entry requirements, prior qualifications, interview scores and format, teaching delivery, staff, MCQ format, and subject content have remained the same. Therefore, there is little reason to suspect gross differences in student ability between the pre- and post-integration cohorts, which may account for differences in scores pre- and post- integration. The only significant change between cohorts has been the integration of EBL. Furthermore, the IDS assessments are two discrete tests (i.e. not a measure of cumulative progress) sat twice per year to capture content taught up to that point, and as such the lack of any statistically significant effects of Test are not surprising.

As Billett<sup>14</sup> notes with respect to clinical curricula, learning in multi-disciplinary environments with peers from related programmes may serve to augment individual learning<sup>14</sup>. The current results indicate that this is true in terms of knowledge based assessments, and future exploratory work may serve to illuminate the underlying mechanisms of these benefits. Our data demonstrate that whilst the increase in assessment scores in the integrated groups is more pronounced for BScDTH students than that of BDS students, there is a positive impact on both programmes. Furthermore, when seeking feedback from the BScDTH group as part of routine programme evaluation processes, it was apparent that they greatly appreciated being part of a wider student community and being able to participate in the challenges this posed, for example:

*"I have enjoyed the first year integration of BDS and DTH students and have been learning a lot from this. Whilst also having acquired a good social group of friends who are on the BDS programme"* <sup>15</sup>.

The beneficial effects this had on the student experience should not be underestimated. The fact that neither group were disadvantaged should go some way towards reassuring institutions that are considering integration but are cautious of threats to 'established' programmes.



Though these results are promising and support the potential benefits of IPE in dental education, we acknowledge the disproportionate number of BDS students, and hope to expand our analyses over coming years as the BScDTH cohort sizes increase. Furthermore, whilst we have focussed on the impact of IPE on multiple-choice knowledge tests, and these tests are similar to those used in many other dental schools, there are other ways of assessing knowledge which may be affected differently by integrated teaching. Finally, although the feedback from students above is positive, IPE also raises challenges which need to be considered and overcome. For example, one student commented that some of the teaching sessions may be 'better (for BScDTH students) if (they) were not just thrown in with the BDS students', and wondering if it may 'be better if (BScDTH students) were assessed as a separate course'. Given the positive impact of IPE reported here, and elsewhere in the literature, and the overwhelming support from the majority of students in our routine programme reviews, these particular points highlight the importance of communicating the goals of an integrated programme, and the underlying justification and evidence-base for IPE to students in relation to both teaching and assessment; something we hope the current work goes some way to supporting.

Whilst this particular student would have preferred separate assessments, the quantitative data shows that integration increases IDS scores. The current examples of feedback are representative of general themes reported by the students; as such student perceptions and core themes are being analysed in an ongoing qualitative study.

## Conclusion

The present study provides a clearly focussed assessment of the impact of integration in EBL sessions, as reflected in student performance on knowledge tests. Although the specifics of the EBL and MCQ components are unique to the current programmes, our findings are of relevance to other UK schools looking to develop BScDTH programmes in light of current pressures such as the NHS England skill mix projections and skills escalator.

In conclusion, the integrated teaching of related dental programmes appears beneficial, though to varying degrees across different student groups. Data from the present study show a positive effect of integration on achievement in knowledge based assessments, and that there is no negative impact for either programme. Taken together, this study provides evidence that complete integration of BDS and BScDTH students is an educational strategy that works. We would cite this as a positive finding and encourage other dental education programmes to further explore the possibilities, and impacts, of integration in their institutions to further develop our understanding of IPE's impact on student performance.

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## Conflict of Interest Disclosure

None of the authors have any conflicts of interest to disclose.

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