

The value of inter-professional education: a comparative study of dental technology students' perceptions across four countries

J. Evans,^{*1,2} A. J. Henderson,^{1,4} J. Sun,^{1,3} H. Haugen,⁵ T. Myhrer,⁵ C. Maryan,⁶ K. N. Ivanow,⁷ A. Cameron² and N. W. Johnson^{1,2}

IN BRIEF

- Identifies 'episodes' when it is most advantageous for dental technicians to collaborate with other members of the dental care team through a brief outline and explanation of curricula.
- Offers strategies to bring shared learning principles into dental curricula.
- Provides evidence that suggests collaboration and teamwork are best developed through 'real-life' prosthetic cases.

The ability to function as an effective member of a dental care team is a highly desirable – frequently mandated – attribute of dental technology (DT) graduates. Currently, there is little rigorous examination of how the learning of team-working skills might best be structured in a DT curriculum. This research compares DT curricula, and students' attitudes and perceptions regarding collaboration in practice, from four countries. Students ($n = 376$) were invited to complete an education profile questionnaire, and the standardised measure – the shared learning scale. There were 196 (52%) responses. Students given opportunities to engage with others had better perceptions of inter-professional learning (IPL). Most believed that team-work and collaborative skills were best acquired by learning together with other dental care professionals, preferably sharing cases for real patients. Curricula should maximise opportunities for dental technology students to experience authentic IPL. Collaboration and team-work needs to be embedded through the whole undergraduate programme.

INTRODUCTION

An essential component of dental programmes is teaching, learning and assessment that prepares graduates to perform effectively in teams.¹ Team-working skills are now a mandatory competency required of most dental care professionals (DCP).^{2–4} Dental care teams (DCT) are multidisciplinary. Members contribute diverse and distinct skills to patient care. Historically, there has been little emphasis on team-working skills as the dentist directed the activities of the various professionals involved in treating his/her individual patient.⁵ Dentists commissioned work from dental technicians and this was usually carried out in a separate geographical location.⁶

Inter-professional education (IPE) assists students to develop a greater understanding of their professional roles and of how they may best contribute to healthcare,⁷ arguably increasing their confidence to collaborate.⁸ It has been shown that IPE enhances

team-work and collaboration in subsequent professional practice^{9,10} especially if it is embedded in the management of clinical cases.¹¹ However, there is little empirical evidence to assist educational designers in planning and implementation of strategies that foster collaborative practice across the dental team.

AIM

This research explored dental technology (DT) curricula across four countries and analysed the perceptions of students towards IPE and collaborative practice. This descriptive-focused,¹² evaluative study¹³ uses a mixed method approach, with data collected from curriculum documents, researchers' knowledge and observations of teaching, and from a standardised IPE test instrument. Quantitative and qualitative methods were used to interpret these data to better understand students' experiences of the teaching, learning and assessment of collaborative practice in their programme.¹⁴

CONTEXT

The study was conducted in four institutions in four countries: Manchester Metropolitan University (England); Karolinska Institute (Sweden); Oslo University College (Norway) and Griffith University (Australia). Teaching of communication and team-working skills are core components of the curricula in all programmes. This is consistent with international quality standards, as defined in the

Dublin descriptors,¹⁵ and with registration requirements in each jurisdiction. Table 1 provides an overview of the student numbers, hours of contact and experiences of collaboration within each curriculum.

DESCRIPTION OF THE FOUR DT CURRICULA

The contents of each curriculum were initially tabulated on a Microsoft Excel spreadsheet, colour coded by content and timing. Similar core elements are included in the majority of dentistry curricula worldwide.^{16,17} We used broad terms such as 'fixed prosthodontics' for crown and bridge, 'removable prosthodontics' for complete and partial dentures, and then expanded into subject areas that represent core elements. The curriculum contents of the four programmes were then organised according to common threshold learning outcomes (TLO) used in Australia,¹⁸ these being not dissimilar to the Dublin descriptors used in Europe.¹⁵ In Australia, the TLOs were developed collaboratively across allied health, medicine and veterinary education using: professional competency; graduate standards; professional codes of ethics/conduct and accreditation requirements.¹⁸ The TLOs are displayed in Table 2 (first column): the subsequent columns identify the subject areas and the inclusion of practical work and IPE. The four curricula are relatively consistent in content and broad learning outcomes, commensurate with educational quality

¹Menzies Health Institute Queensland, ²School of Dentistry and Oral Health, ³School of Medicine, Griffith University, Queensland, Australia; ⁴Metro South Health Service District, Brisbane, Australia; ⁵Faculty of Health Sciences, Oslo and Akerhus University College of Applied Sciences, Oslo, Norway; ⁶Division of Health Science, School of Healthcare Science, Manchester Metropolitan University, UK; ⁷Karolinska Institutet, Huddinge, Sweden

Refereed Paper

Accepted 4 March 2015

DOI: 10.1038/sj.bdj.2015.296

©British Dental Journal 2015; 218: 481–487

assurance and dental accreditation agencies in their home countries.^{2,19–21} Information on entry requirements, assessment methods and funding models are not included.

While the core elements of each university are similar, each has distinctive nuances. A brief overview of each institution describes the main premises on which the programmes were developed.

Manchester Metropolitan University (MMU)

The Bachelor of Science (honours) in DT at MMU is the only programme with a provision to study part time, and is physically isolated from dentistry students. As depicted in Table 2, opportunities for communication and collaboration occur only in the final year and only in one content area: students take part in a case-based learning experience; they construct at least one dental appliance for a patient as part of a team where one dental technology student is grouped with two dentistry students. Graduates can apply for registration as a dental technician with the GDC (UK).

Karolinska Institute (KI)

The Bachelor of Medical Science in the DT programme at KI provides students with an opportunity to develop IP skills. The programme is integrated with those in dentistry and in oral health therapy. It has 22 courses, four of which include specific shared learning experiences. The latter are woven through the curriculum, starting with shared lectures introducing wide aspects of oral health/disease, and behavioural sciences. As can be seen in Table 2, 10 of the 33 elements contain IPE. Dental technology students collaborate with dentistry students on anatomy exercises, and hold group discussions about promoting effective team-work before finally completing pre-clinical collaborations in fixed prosthodontics.

Oslo University College (OUC)

The Bachelor of DT at OUC develops the professional role of dental technology students independent from dental students, who are taught in a separate institution. However, OUC has a dental clinic and engages a part-time dentist to enable its students to work with a clinician and observe the fitting of oral prostheses/appliances. The goal is for students to gain competence in planning and organising integrated treatment measures in collaboration, after graduation, not only with dentists and patients, but also with other health care providers. Work integrated learning (WIL) is a key component of this curriculum, whereby two supervised practical internships (16–20 weeks) are undertaken

Table 1 Overview of student numbers, hours of contact and experiences of collaboration

Institution		MMU	KI	OUC	GU
Country		England	Sweden	Norway	Australia
Established		1993	1993	1999	2004
Years of Programme		3	3	3	3
Full-(F)/Part-time (PT)		F/pt	FT only	FT only	FT only
2011 Students	1st Yr	82	22	0	79
	2nd Yr	62	13	22	11
	3rd Yr	47	16	16	6
Total no of students in 2011		191	51	38	96
DT academics employed		7	5.5	4.5	2
DT lab hrs/wk		9	12	14	24
Contact hrs/wk (lec/tut/lab)		14–18	23	14–18	28–30
Contact wks/yr		24	40	40	32
Total no. of laboratory hrs/yr		216	480	560	768
Experience shared lectures with dentistry students		No	Yes	No	Yes
Experience collaboration in laboratory with dentistry students		No	Yes	No	Yes
Practice collaborative prosthetic case with dentistry students		Yes - minimal	Yes - several	No	Yes - several
Experience practical collaboration with registered dentist		No	Yes	Yes	Yes
Professionally accredited programme		Yes GDC 2003	No	Yes SAK 2002	Yes DTDPBQ 2005

GDC: General Dental Council; SAK: Norwegian Registration Authority for Health Personnel; DTDPBQ: Dental Prosthetists and Dental Technicians Board of Queensland, renamed Dental Technicians Board of Queensland 2011 and Legislation Revoked 2013.

at external workplaces. While this is practice-based learning, these external workplaces do not have multidisciplinary teams: rather they are uni-professional as indicated in Table 2. Graduates may apply for a licence to practice as a dental technician in accordance with national legislation.²²

Griffith University (GU)

The GU Bachelor of Oral Health in DT is one of a suite of dental programmes.¹ The curriculum is founded on IPE – whereby dentistry, and dental technology students learn from, with and about each other.¹¹ The aim is to prepare graduating DCPs to have comparable knowledge, complementary skills and collegial attitudes. This programme comprises 24 courses, plus a 12-week external WIL experience. Of these courses, 14 have components of IPE, or team-work¹¹ as can be observed in Table 2, where collaborative learning covers three quarters of the elements in the curriculum. Opportunities for collaboration increase throughout the semesters toward graduation: for example third year students’ work with dentistry students on prosthetic patient cases. At the time of this study, graduates could apply

for registration with the Dental Technicians Board of Queensland.

METHOD

Student perceptions of IPE were gathered across the four institutions. Correspondence was formally established between GU and KI in 2007, informally with GU and MMU in 2005 and with OUC in 2010. The chief investigator from GU visited each location and met the teaching teams in mid-2011. Data were collected during May and June of 2011. Paper-based, self-administered questionnaires, in English, were employed and included a personal profile and the quantitative and qualitative shared learning scale.²³ All students were notified by email and invited to a given location at their institution on a specified day for one hour. The chief investigator and a researcher from each location distributed the questionnaires and fielded questions or misunderstandings. Ethics approval for this study was obtained from the Griffith University Human Ethics Committee (protocol no. DOH/10/08).

Profile questionnaire

Information was collected on participant’s institution, year of study, age, gender,

Table 2 Content areas organised according to TLOs

Threshold learning outcomes	Elements in DT curricula	Institution							
		MMU		KI		OUC		GU	
		Prac	SL	Prac	SL	Prac	SL	Prac	SL
1. Demonstrate professional behaviours	Ethics & governance	✓		✓	✓✓	✓		✓	
	Record keeping							✓	✓✓
	Confidentiality							✓	✓✓
2. Assess individual and/or population health status and, where necessary, formulate, implement and monitor management plans in consultation with patients/clients/carers/animal owners/communities	Infection control	✓		✓	✓✓	✓		✓	✓✓
	Models	✓		✓		✓		✓	✓✓
	Impression trays	✓		✓		✓		✓	✓✓
	Thermoformed appliances	✓		✓		✓		✓	✓✓
	Registration rims	✓		✓		✓		✓	✓✓
	Articulation	✓		✓		✓		✓	✓✓
	Occlusion	✓		✓	✓✓	✓		✓	✓✓
	Complete dentures	✓	✓✓	✓		✓		✓	✓✓
	Repairs/relines	✓		✓		✓		✓	✓✓
	Immediate dentures	✓				✓		✓	
	Partial denture	✓		✓		✓		✓	✓✓
	Crown and bridge	✓		✓	✓✓	✓		✓	✓✓
	Orthodontics	✓		✓		✓		✓	✓✓
	Oral splints	✓		✓		✓		✓	✓✓
Maxillofacial devices	✓		✓						
3. Promote and optimise the health and welfare of individuals and/or populations	Psychology				✓✓				
	Public health							✓	✓✓
	Disease and prevention								✓✓
	Workplace health and safety	✓		✓		✓		✓	
4. Retrieve, critically evaluate, and apply evidence in the performance of health-related activities	Research	✓		✓		✓		✓	✓✓
	Dental materials	✓		✓		✓		✓	
	Chemistry and physics	✓		✓		✓		✓	✓✓
	Oral biology	✓				✓		✓	✓✓
	Anatomy and physiology	✓		✓	✓✓	✓		✓	✓✓
	Tooth morphology	✓		✓	✓✓	✓		✓	✓✓
5. Deliver safe and effective collaborative healthcare	Teamwork	*	*	✓	✓✓	✓		✓	✓✓
	Communication	✓		✓	✓✓	✓		✓	✓✓
	Business studies			*		✓		✓	
	Work integrated learning	✓		✓	✓✓	✓		✓	✓✓
6. Reflect on current skills, knowledge and attitudes, and plan ongoing personal and professional development.	External work experience and reflection	*		✓		✓		✓	

#Element not covered in theory or practical
 ✓ practical application; ✓✓ inclusion of shared learning experiences

schooling, previous qualifications, expected salary on graduation, role on graduation, number of years participants expected to stay in the profession, intention of further study and attitudes to continuing professional development.

Shared learning scale

The shared learning scale²³ collected students' perceptions and attitudes towards IPE. It consisted of 25 items, 20 requiring Likert-type responses (one – strongly agree; five – strongly

disagree), five being open-ended questions. The Likert questions explored students' attitudes and perceptions of:

- The importance of roles and responsibilities of others (questions 1, 2, 9, 13 & 16)
- How best to learn with students from other oral health professions, namely dentistry and oral health therapy (questions 3, 5, 8, 17, 19 & 20)
- Team-work and collaboration (questions 4, 6, 7, 10, 11, 12, 14, 15 & 18).

The open-ended questions allowed respondents to clarify their responses, explain their understanding and perspectives of 'shared learning' and comment on the most or least positive aspects of shared learning.

Data analysis

Quantitative data were evaluated using Statistical Package for the Social Sciences (SPSS) (version 19.0). To test for any statistical differences between the four groups, the One-way Analysis of Variance (ANOVA)

was used where all dependent variables were normally distributed, and Kruskal-Wallis non-parametric test was employed when the dependent variables were not.²⁴ Significant differences between groups were further analysed using post-hoc Tukey's t tests, which are appropriate for comparing group differences.²⁵

For reliability tests for the total- and subscales, reliabilities relating to the internal consistency of statement items were analysed using Cronbach's alpha. Item-total correlations were analysed to assess the relationship between each statement and its corresponding subscale. Mplus (version 6.0) was used for confirmatory factor analysis to confirm the factor structure based on a scale published by Morison and Jenkins in 2007.²³

Several fit statistics were reported to evaluate how well the previous scale structure with three subscales²³ was replicated in the present study sample. The relative chi-square (χ^2) index was computed, which should be close to one, with values below three considered indicative of a close fit between the hypothetical model and the sample data. Indices of fit including comparative fit index (CFI) and Tucker Lewis index (TLI) vary between zero and one: values greater than 0.9 are indicative of an excellent fit. Root mean square error of approximation (RMSEA) compares the model optimal parameter values with the population covariance matrix. Values less than 0.05 indicate good fit, and values between 0.05–0.08 indicate reasonable fit.²⁶

Qualitative findings were initially explored manually, using a coding frame in an Excel® spreadsheet. The responses were further analysed using the semantic mapping software programme, Leximancer²⁷ (version 4). This analyses large pieces of textual data and formulates concepts, their relative occurrence, and draws relationships between concepts.²⁸

Two independent external researchers with no involvement in this particular study scrutinised the qualitative data²⁹ to critically analyse the identification of the emergent themes and to check for reliability between the manual coding and the Leximancer outputs. The emerging concepts from open-ended questions were triangulated with self-report measures and curriculum documents.

RESULTS

Profile questionnaire

Not all students completed all components of all questionnaires. From the 376 potential dental technology students enrolled, 52% (196) responded. A larger proportion of the Karolinska students (70%) responded compared to the other institutions (MMU 55%,

OUC 29%, GU 46%). Overall, the majority of respondents were females, especially at OUC with ten females and one male (Table 3). A larger proportion of the GU students were younger than other students (18/44 were 19 years or less).

Five (11%) GU and four (4%) MMU students had worked in the profession of dental assisting. Eleven of the 44 (25%) GU, ten out of 105 (9.5%) MMU and five out of 36 KI (14%) students were interested in studying dentistry, whereas 12 (6%) students (two MMU, one KI, four OUC and five GU) indicated they would continue studying clinical dental technology, three out of the 11 (27%) OUC students would consider a Masters degree in the future and two of the 105 (2%) MMU students indicated they would like to complete a PhD. A higher proportion of OUC students expect to remain in the dental technology profession.

Shared learning scale

Reliability analysis using item-total correlations showed that item 3 (subscale 3), 4, 6, 7, and 15 (subscale 3) had low item-total correlation level with -0.11, -0.13, -0.01, 0.24 and 0.16 coefficients respectively. These five items were therefore removed to improve reliability levels for the two relevant subscales and the overall scale. The reliability analysis demonstrated that the three subscales had Cronbach's alpha levels of 0.53, 0.59 and 0.63 respectively, and an acceptable level of 0.73 for the total scale.

Confirmatory factor analysis demonstrated that there is an overall good model fit with acceptable levels of all fit indices: $\chi^2 = 212.55/86 = 2.47$, CFI = 0.85, TLI = 0.82, RMSEA = 0.08. This suggests that the convergent validity of the scale is good for the present study sample.

For the overall ratings, attitudes did not differ significantly between institutions, $F(3, 184) = 0.79$, $p = 0.49$. GU respondents did not differ from those in another university relating to the perception of the value of shared learning. Across the four groups, perceptions were similar about the importance of learning about the roles and responsibilities of team members in an IPE environment. A difference was found around students' perceptions of the actual existence of team-work and collaboration during their learning experiences, results for this subscale showed that attitudes differed significantly with OUC respondents scoring higher than other institutions ($p = 0.00$, Table 4).

With regard to individual items in the shared learning scale, significant differences were apparent in items 10 ($p = 0.00$), 11 ($p = 0.03$), 12 ($p = 0.04$), 14 ($p = 0.00$) and 18 ($p = 0.01$) from subscale three. For

Table 3 Participant profiles

Variable	N	%
Institution		
Manchester Metropolitan University	105	53.6
Karolinska Institute	36	18.4
Oslo University College	11	5.6
Griffith University	44	22.4
Total	196	100
Year level		
First	60	30.6
Second	70	35.7
Third	66	33.7
Total	196	100
Age		
19 years or less	29	14.9
20–30 years	142	72.8
31 years or more	24	12.3
Total	195	100
Gender		
Female	134	68.4
Male	62	31.6
Total	196	100

items 10, 11 and 12, GU respondents indicated that positive working relations and consultation exists between DCT members, whereas OUC respondents were unsure. Item 14 shows that OUC respondents do not have the opportunity to work collaboratively with other oral health care students, whereas the others do, the most significant difference being between MMU (mean 2.27) and OUC (mean 4.45). KI and GU respondents shared similar views. Item 18 indicates that GU respondents expect dentists to act as the leader of the team, whereas OUC students were the least sure.

Open-ended questions

For all open-ended questions the overall participation rate was 75% at MMU and KI, 82% at OUC and 52% at GU. In their comments, students explained their understanding of 'shared learning' or IPE and identified the most or least positive aspects. The question about positive aspects of IPE elicited the most responses (118 text blocks). Students of OUC and KI used consistent language styles and were much more definite in their responses than those from GU and MMU. The similarities are evident on the conceptual map in Figure 1 where KI and OUC are physically situated close to one another and connected to the concept of respect. KI and

Table 4 Mean and standard deviation of shared learning scale sub-scales between groups

Measure Sub-scales M	MMU (n = 102)		KI (n = 34)		OUC (n = 11)		GU (n = 42)		
	SD	M	SD	M	SD	M	SD	M	
SLS	Roles and responsibilities	2.70	0.65	2.63	0.37	2.62	0.45	2.68	0.73
	Learning with other OHCP	2.60	0.63	2.64	0.30	2.45	0.35	2.59	0.41
	Teamwork and collaboration*	2.90	0.48	3.03	0.29	3.51	0.25	2.80	0.45
	Total*	2.76	0.45	2.81	0.21	2.97	0.20	2.71	0.45

SLS: shared learning scale
 *Significant difference: 0.05
 Scale: strongly agree (1) – strongly disagree (5), a higher rating indicates that they disagree about the value of shared learning

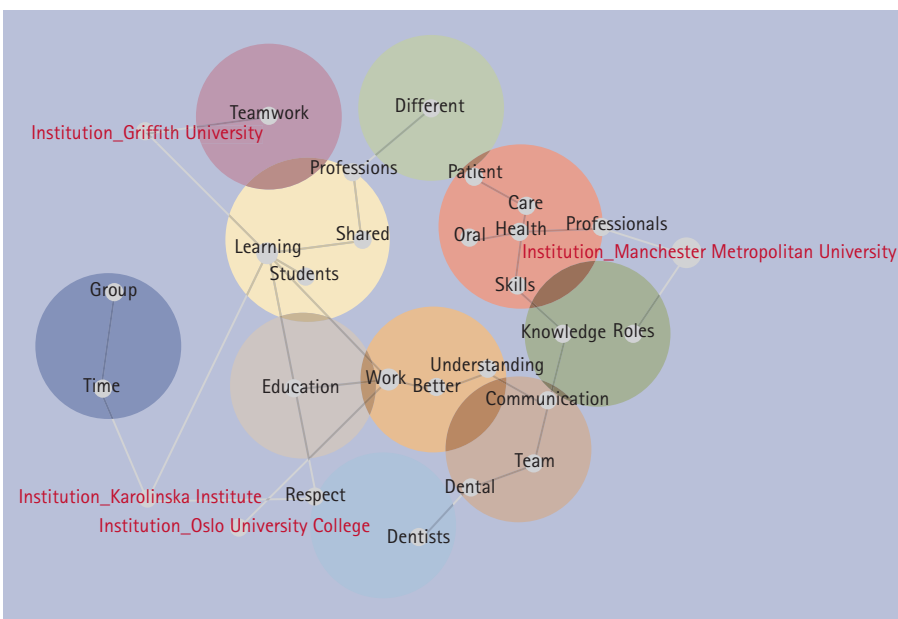


Fig. 1 Leximancer analysis: conceptual map of all questions, comparison between groups

GU align IPE with the concept of learning, as a priority and OUC and GU perceive work as a conduit to IPE. MMU has the closest connection around knowledge of roles, understanding, and communication groupings; however other groups engage with other content areas that lead to these three groupings. Respondents from GU closely aligned shared learning to team-work.

Manual coding and Leximancer analyses showed respondents were consistent about the meaning of IPE across all four universities. Respondents displayed a clear understanding of the concept of IPE and the collegial approach it aims to foster. The dominant themes regarding the contribution of IPE to learning were:

- IPE fosters learning and expands knowledge particularly in authentic situations
- IPE enhances respect and knowledge of roles
- IPE improves safe and collaborative care (TLO five).

A further issue arose that did not pertain specifically to the benefits of IPE but rather provided information about the logistics and difficulties (item four) that cause tensions in IPE.

IPE fosters learning and expands knowledge particularly in authentic situations

Detailed analyses using Leximancer revealed ‘enhanced learning’ to be the dominant concept (98 ranked counts). ‘Work’ was the second most-mentioned word (87 ranked counts). ‘Improved understanding’ was the third most dominant concept (66 ranked counts). The Leximancer ‘overall output’ diagram shows that respondents from KI and GU recognise a direct link between IPE and learning. KI and GU respondents stated that by learning the ‘anatomy and clinical procedures together’ as a team on prosthetic cases – where each student ‘plays their part’ and ‘interacts’, they ‘learn to understand the possibilities and limitations of each profession’.

Other statements indicate that IPE not only fosters learning but also expands knowledge and viewpoints. An MMU respondent thought that dental technology and dentistry students would learn ‘from each other’s experiences and failures’. Two OUC respondents thought IPE would enhance their learning by ‘gaining a broader perspective’ and they would ‘learn how to work in a team’ and thus how to ‘better collaborate’.

Some KI respondents positioned themselves in IPE by writing statements starting with ‘we learn...’. As with GU, the KI group also suggested that IPE entails doing ‘exercises’ together, ‘group work’ or learning ‘real world’ techniques. More of the GU and OUC students believe IPE needs to be experienced in authentic workplace settings. A GU respondent thought ‘... it’s important for students to learn and work as a team at uni, as this prepares them for working in team situations on clinical case’. Similarly, an OUC respondent suggested that if IPE is based around specific prosthetic cases ‘you learn new things and experience and learn how to handle problems that you have never seen before’.

IPE enhances respect and knowledge of roles – relates to ‘professional behaviours’ (TLO one)

The need for graduates to have respect for, and knowledge of, others’ roles directly relates to the first threshold-learning outcome (demonstrate professional behaviours). Students spoke in terms of building respect, and better understanding of professional roles. An MMU student thought IPE would facilitate students to ‘learn what their responsibilities are’ and MMU, KI and GU students thought IPE would provide clarity around professional roles. A few GU students thought IPE presented students with a ‘better understanding of roles’, ‘professional mutual respect’, and promoted ‘efficiency around problem solving’. Similarly KI respondents expressed that IPE would enhance students ability to ‘understand the other professional problems’, ‘build respect’, ‘come up with treatment together’, ‘discuss problems’ and lead to ‘better products’.

IPE improves safe and collaborative care (TLO five)

Safe and collaborative patient care is reliant on good communication and social interaction. All groups included participants who thought IPE would improve communication. Enhanced communication featured in the majority of responses across all four groups and had a ranked count of 61 (making it the fourth most mentioned term). Nearly all MMU respondents thought it would increase,

improve or enhance communication and one thought this would increase his/her confidence in collaborating.

MMU respondents aligned IPE with oral health care and related it to better outcomes for patients – ‘...it is important for dental clinicians to work together to produce the best possible care for the patient’. Another MMU student supported ‘collaborative learning as it should improve delivery of care to patients and improve the status and quality of life of a technician’. Some from each group thought the purpose of IPE is to enhance patient care. One KI student talked of shared learning as providing an opportunity for the dental team to get the ‘job done quicker’ with a better result for the patient.

Logistics and difficulties

The two groups with greater exposure to IPE (KI and GU) spoke more of logistics of time-tabling and scheduling, rather than conflict issues. Participants from all groups mentioned that IPE might result in dental technology students learning ‘irrelevant content’, such as microbiology.

They thought IPE is ‘time consuming’ or ‘wastes time’ and sometimes results in ‘discord’ (GU) or ‘lack of team feeling, it depends on the teacher – are they a dentist or dental technician, they should be equal’ (KI). A GU respondent expressed concern about the lack of independence, as they are ‘relying on others, group timing, and a discord between groups.’ The MMU group spoke more strongly, stating that IPE would ‘cause conflicts’, due to ‘difference of opinions as to whose role is more important’. Another expressed that there would be ‘an instant dislike due to roles- dentists may think they are superior, and therefore not capable of holding discussions with other professions with different aspects and thoughts’. The OUC students thought that students ‘interests across the DCT might not be the same, maybe it will be harder to focus on your own profession/area’ another suggests, ‘maybe there will be too many people in one group if everyone is together’. Another thought it would be hard to reach consensus due to ‘different background - different state of minds’.

A KI respondent thought ‘IPE was great if limited to prosthetics’. Similarly a GU respondent who experienced IPE says ‘*it feels like some subjects have been thrown into our course to fill up space. No relevance to dental technology*’. A third year KI student thought ‘shared learning is good for team-work and communication but the content must be relevant. Technicians do not need to go into so much in depth’ in theoretical courses.

Some first and second year students from MMU and OUC said they had never

experienced shared learning with dentistry students; therefore they were unable to elaborate. However a MMU respondent would like to see more opportunities for IPE: ‘*I think more connection needs to be made between all professional fields in dental care*’. Similarly an OUC student added that IPE is linked to better working relationships on graduation: ‘*in Norway dental technology students and dental students don’t work together I think they really should so that communication can be better later when we’re working*’.

DISCUSSION

Overall differences are revealed in students’ attitudes and perceptions of IPE, particularly with threshold learning outcome one, professional behaviour, and five, safe and collaborative care. The convergent validity of the shared learning scale is a good fit for the present study sample and therefore an acceptable scale for this purpose.

It is apparent from the student responses that the KI and GU curricula have a strong focus on IPE, whereas the MMU curriculum has only one specific collaborative learning opportunity, namely for third year DT students, and OUC engage a dentist to provide some clinical team-based interaction. Despite OUC not engaging with dental students throughout the curriculum, the open-ended responses displayed a clear understanding of the benefits of collaboration, and expressed the ‘need to’ and a ‘desire to’ learn ‘how’ to work as a team.

Those who experienced IPE throughout their curriculum (KI: n = 34 and GU: n = 42) displayed a more positive perception towards learning in teams than their colleagues, more so than at OUC (n = 11). Consistent with the literature, respondents from all groups thought IPE enhanced communication, and would increase the knowledge of professional roles.^{7,11} There was consistency across a range of scores that indicates a trend that students believe team-work skills should be learned with other oral health care students and communication is an important skill to learn.

Thus, it would be beneficial if all potential members of DCT’s were to learn together. Dental technicians are a small proportion of the DCT, so it is not surprising that some respondents expressed concern that their contribution is overshadowed. There is a need to keep some elements specific to dental technology, to ensure professional identity, because the OUC group who had not experienced IPE had a stronger commitment to this as a lifelong profession. So the OUC curriculum is achieving what it set out to accomplish: this group had a greater

propensity to value their professional role, even though the curriculum takes a modest approach to fostering communication and collaboration. In keeping with the literature, a student from OUC believed IPE would enhance their ability to communicate with the DCT once in professional practice.¹⁰

Several respondents expressed the need to make IPE more meaningful and relevant to the learning needs of the dental technology students. As with an earlier study, these respondents thought IPE should be associated with specific ‘prosthetic cases’⁶ which some thought would lead to better treatment options for patients. In particular, the OUC group, who experienced a close working relationship with a dentist, felt that IPE would provide them with a broader perspective toward their professional practice, but they would still need to learn ‘how’ to collaborate within a team.

It seems that those who were exposed to an IPE curriculum are less likely to stay in the profession long term, which may mean these graduates are more flexible due to their knowledge of the roles of others, and have wider career expectations. They may consider dental technology as a pathway to other professional roles in the DCT: indeed within those three groups who had IPE in their curriculum, 26 respondents contemplate studying dentistry in the future; 12 across all four institutions considered becoming a clinical dental technician.

Congruent with the literature, MMU respondents believed IPE would enhance their confidence to collaborate.⁸ None of the other groups mentioned confidence, but spoke in terms of IPE providing the ‘ability to’ and ‘opportunity to’ learn together. So, rather than directly relating the experience to the outcome of confidence, they simply recognise IPE as an opening to engage, communicate and collaborate through meaningful practical applications.

Limitations of study

Differences between the perceptions of students may result from factors other than exposure to IPE, such as: different programme entry requirements; learning time; assessment methods, and exposure to other professionals while engaged in study. As well as individual’s propensity to be: introverted or extroverted; judgemental or perceiving; individual-orientated or group-orientated; or inventive or consistent. Recommendations for future studies could include a psychological preference measure to determine the base line personalities that exist in participants.

The modest number of dental technology students at KI, OUC and GU is a limiting factor. The dental technology profession is

a much smaller than their counterparts in dentistry and maybe this study can spur on other research in this arena. Response rates were low in some institutions as the students were away on work experience and some were preparing for a vacation, so the survey may not have been a priority for them. The fact that the questionnaires were written in English may have limited KI and OUC students.

Students had only one opportunity to complete the questionnaire. Electronic questionnaires, with follow up email prompts, may have resulted in a larger response rate, in particular for the OUC group who were off-campus at the time. Efforts were made to minimise researcher bias by using dual analyses.

CONCLUSION

While dental technicians comprise a small group among the DCT, they play a critical role in prosthetic services. When considering curriculum or programme improvements, components of IPE and team-work throughout the curriculum are seen to enhance dental technology student's sense of their professional role, and their ability to communicate, which leads to successful collaboration. Dentistry students study a number of similar elements to dental technology students so there are numerous opportunities for IPE to be introduced to new or existing programmes of study.

Clearly, there needs to be opportunities for students to learn how to work in teams, not just to be allocated to teams. This needs to be enhanced or confirmed by close involvement in 'real life' prosthetic cases. The findings from this study provide confidence in the benefits of IPE in dental education.

We are grateful to all contributing students; to Associate Professor Gunilla Sandborgh, Englund Institute of Odontology, Karolinska Institutet for help in establishing a formal agreement between KI and GU; to the Director of Studies at Oslo University College, Agnes Vinorum, for her persistence and help in establishing our partnership.

The first author was supported by a modest grant from Griffith Health Learning and Teaching fund. The authors report no conflict of interest. The contributing authors alone are responsible for the writing and content of this paper.

- Evans J L, Henderson A J, Johnson N W. The future of education and training in dental technology: Designing a dental curriculum that facilitates team-work across the oral health professions. *Br Dent J* 2010; **208**: 227–230.
- General Dental Council. *Developing the dental team 2nd edition (interim)*. 2009. Online information available at <http://www.gdc-uk.org/Dentalprofessionals/Education/Documents/DevelopingTheDentalTeam.pdf> (accessed March 2015).
- Australian Dental Council. *Professional attributes and competencies of the newly qualified dentist*. 2010. Online information available at http://www.adc.org.au/documents/Attributes&Competencies_Dentist%20v1.0%20Final%2010-06-11%20Updated%20July%202013 (accessed March 2015).
- Cowpe J, Plasschaert A, Harzer W, Vinkka-Puhakka H, Walmsley A D. Profile and competences for the graduating European dentist – update 2009. *Eur J Dent Educ* 2010; **14**: 193–202.
- Stuart-Wilson F. *Professionalism and ethics*. London: Quay Books, 2009.
- Evans J L, Henderson A J, Johnson N W. Traditional and interprofessional curricula: perceptions of students across two dental technology programs. *J Dent Educ* 2013; **77**: 1225–1236.
- Cameron S, Rutherford I, Mountain K. Debating the use of work-based learning and interprofessional education in promoting collaborative practice in primary care: a discussion paper. *Qual Prim Care* 2012; **20**: 211–217.
- Eccott L, Greig A, Hall W, Lee M, Newton C, Wood V. Evaluating students' perceptions of an interprofessional problem-based pilot learning project. *J Allied Health* 2012; **41**: 185–189.
- Morison S, Marley J, Stevenson M, Milner S. Preparing for the dental team: Investigating the views of dental and dental care professional students. *Eur J Dent Educ* 2008; **12**: 23–28.
- Thistlewaite J. *Interprofessional education: a review of context, learning and the research agenda*. *Med Educ* 2012; **46**: 58–70.
- Evans J L, Henderson A J, Johnson N W. Interprofessional learning enhances knowledge of roles but is less able to shift attitudes: a case study from dental education. *Eur J Dent Educ* 2012; **16**: 239–245.
- Patton M Q. *Data collection: options strategies and cautions*. In Rutman L (ed) *Evaluation of research methods: a basic guide*. 2nd ed. Newbury Park CA: SAGE Publications, 1984.
- Gray D E. *Doing research in the real world*. 3rd ed. London: SAGE Publications, 2012.
- Stake R E. *Standards based and responsive evaluation*. California: SAGE Publications, 2004.
- Joint Quality Initiative Informal Group. *Shared 'Dublin' descriptors for short cycle, first cycle, second cycle and third cycle awards*. 2004. Online information available at http://paginas.fe.up.pt/~sfeyo/Docs_SFA_Bologna/120_Ref%20Doc_20041018%20%5BQJIG%20Dublin%20Descriptors%5D.pdf (accessed March 2015).
- Mossey P A, Holsgrove G J, Stirrups D R, Davenport E S. *Essential skills for dentists*. Oxford: Oxford University Press, 2006.
- General Dental Council. *The first five years*. 2008. Online information available at <http://www.gdc-uk.org/Aboutus/education/Documents/TheFirstFiveYears.pdf> (accessed March 2015).
- O'Keefe M, Henderson A, Pitt R. *Learning and teaching academic standards project*. Australian Learning and Teaching Council Ltd. 2011. Online information available at http://disciplinestandards.pbworks.com/w/file/fetch/52723773/altc_standards_HMVS_210611.pdf (accessed March 2015).
- Australian Qualifications Framework Council. *Australian qualifications framework*, 2nd edition. 2013. Online information available at <http://www.aqf.edu.au/aqf/in-detail/2nd-ed-jan-2013/> (accessed March 2015).
- Norwegian Agency for Quality Assurance in Education. *The Norwegian qualifications framework for lifelong learning*. 2011, updated 2014. Online information available at <http://www.nokut.no/en/Facts-and-statistics/The-Norwegian-Educational-System/The-Norwegian-qualifications-framework/> (accessed March 2015).
- European Commission. *The European qualifications framework (EQF), education and training*. 2012 [2nd September 2013]. Available from: <http://www.ehfa-standards.eu/?q=node/11>
- Norwegian Registration Authority for Health Personnel (SAFH). *Norwegian Health Personnel Act*. Oslo: 1999. <https://www.regjeringen.no/nb/dokumenter/act-of-2-july-1999-no-64-relating-to-health/id107079/> (accessed April 2015).
- Morison S, Jenkins J. Sustained effects of interprofessional learning on student attitudes to communication and team working depend on shared learning opportunities on clinical placement as well as in the classroom. *Med Teach* 2007; **29**: 450–456.
- Coakes S J, Steed L, Price J. *SPSS analysis without anguish: using SPSS version 15.0 for Windows*. Brisbane: Wiley and Sons, 2008.
- Tabachnick B G, Fidell L S. *Using multivariate statistics*. 5th ed. Boston: Pearson, Allyn and Bacon, 2007.
- Hu L T, Bentler P M. *Evaluating model fit*. In Hoyle R H (ed) *Structural equation modeling: concepts, issues and applications*. pp 76–99. Thousand Oaks, CA: SAGE Publications, 1995.
- Smith A E, Humphreys M S. Evaluation of unsupervised semantic mapping of natural language with Leximancer. *Behav Res Methods* 2006; **38**: 262–279.
- Smith A E. *Automatic extraction of semantic networks from text using Leximancer*. Companion Volume of the Proceedings of the 2003 Human Language Technology Conference of the North American Chapter of the Association for Computational Linguistics, 2003. Online information available at <http://www.aclweb.org/anthology/N03-4012>. (accessed April 2015).
- Strauss A, Corbin J. *Basics of qualitative research*. Newbury Park, CA: SAGE Publications, 1990.