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Original Article

The implication of integrating pediatric education into a pediatric dentistry course for undergraduate dental students

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Abstract *Background/purpose:* The separation of dentistry and medicine was initiated as a historical root. The purpose of this study was to evaluate the implication of integrating pediatric education into a pediatric dentistry course (so-called the integrated pediatric dentistry course in this study) for undergraduate dental students through students' perspectives.
Materials and methods: A total of the 34 fifth-year dental students were invited to fill out the questionnaire for the integrated pediatric dentistry course survey after the class of integrated pediatric dentistry course.
Results: Of the 34 dental students, all participated in the survey with a 100% valid response rate. The results showed that most of dental students found this integrated pediatric dentistry course to be helpful in improving their knowledge and clinical skills for pediatric dentistry, and

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knowledge about pediatrics related to dentistry. However, in comparison, the acquisition of clinical skills was less than that of knowledge for pediatric dentistry.
Conclusion: We conclude that the integrated pediatric dentistry course improves dental students' knowledge and clinical skills about pediatric dentistry, and knowledge about pediatrics related to dentistry. Considering the effectiveness of this integrated pediatric dentistry course on students' knowledge and clinical skills, and positive attitude towards pediatric dentistry, this model shows promising for the further use in the dental education.

Introduction

Today, the medical system includes two independent professions, dentistry and medicine. However, the separation of dentistry and medicine was initiated as a historical root and was subsequently substantiated with legislation, education, and insurance.[1,2] Especially since the world's first dental school (the Baltimore College of Dental Surgery) was established in 1840, oral health education has historically been lacking in the medical school curricula.[3,4] Likewise, with the expansion of the knowledge system of dentistry, general medical education has logically been reduced in the dental school curricula. The separation between dental education and medical education has serious negative implications in terms of healthcare delivery.[5] Hence, in the United States, there are the criticism of a "mouthless" medical education and the requests to bring the mouth back into the body for medical education.[6] Similarly, in dental education, there are the statement of treating your dental patient as the whole but not a hole and the advocation to increase the content of general medicine in the dental education.[7]

In Taiwan, pediatric dentistry was one of the legally recognized dental professions during the Japanese colonial period (1895—1945), although there was no dental school in those days.[8] The dental school of National Taiwan University (NTU), established after the World War II, first started pediatric dentistry course in 1960 which was offered to the fifth-year undergraduate dental students. In addition to the content of pediatric dentistry, the course design integrated the content of pediatrics into this course from the beginning, and pediatricians were invited to give the related lectures. Although the dental curriculum was expanded with the creation of dental courses unassociated with medical schools, according to the description of Dr. Guo, the former leader of Pediatric Dentistry of National Taiwan University Hospital (NTUH), since he took this course during his student days and he was responsible for this course in 1976, the dental school of NTU has maintained this approach for over 60 years. Currently, Taiwan's dental education system does not have a nationally consistent standard of guidelines aimed at establishing the minimum competencies and objectives of each discipline for dental students at the end of their undergraduate courses. Internationally, however, the undergraduate pediatric dentistry curriculum in most countries is purely dental-oriented, and there is relatively no practice of integrating pediatric knowledge into pediatric dentistry curriculum. Moreover, the curriculum guidelines published in 2009 by the European Academy of Paediatric Dentistry (EAPD) specify objectives of the disciplines focusing on the skills and competencies of dentistry for each dental student expected to acquire during the undergraduate dental courses.[9]

The dental school of NTU offers a two-credit compulsory pediatric dentistry course for the fifth-year undergraduate dental students. The course design was determined when the dental school offered this course for the first time in 1960. The implementation of this course has been for over 60 years, which integrates pediatric education into the pediatric dentistry course (so-called the integrated pediatric dentistry course in this study), and the integrated pediatric dentistry course aims to improve students' understanding of the growing relationship between oral health and general health by introducing pediatric knowledge to the dental students. The goal of this integrated pediatric dentistry course is to hopefully prepare dental students to become dentists with a more comprehensive consideration of pediatric health in the future. Therefore, the purpose of this study was to evaluate dental student learning outcomes by assessing dental student perceptions towards this integrated pediatric dentistry course.

Materials and methods

Participants

A total of the 34 fifth-year undergraduate dental students who took the compulsory course entitled "Pediatric Dentistry" in the dental school of NTU in 2022 were included in this study.

Teaching process

The integrated pediatric dentistry course was a specific subject for dental students in the first semester of the fifth academic year of the Department of Dentistry, NTU, which was a two-credit course and was taught in the form of classroom lectures and discussions. The learning topics, distribution, and teacher specialties for the integrated pediatric dentistry course are shown in Tables 1 and 2. There were 23 learning topics in total. It was a 1-h or 2-h lecture for a topic and was taught by the senior attending dentists and physicians with specialist qualifications from related departments of NTUH and its branches. Seven pedodontists were responsible for the 13 topics to introduce knowledge and clinical skills about pediatric dentistry, as well as 9 pediatricians and another psychiatrist were responsible for 10

Table 1 Learning topics of the integrated pediatric dentistry course for the fifth-year dental students in the dental school of National Taiwan University (NTU) in 2022.

Item	Topic	Hour	Teacher	
			Specialty	Gender
1	Normal dental development	1	Dentist, pedodontist	Male
2	Psychological growth and development	1		
3	Treatment planning for the child patients	1	Dentist, pedodontist	Female
4	Dental caries: prevention	1	Dentist, pedodontist	Female
5	Pit and fissure sealant and preventive resin restoration	1		
6	Dental caries in young children	1	Dentist, pedodontist	Male
7	Management of child's behavior in dental practice	2	Dentist, pedodontist	Female
8	Pulp therapy for primary and young permanent teeth	2		
9	Management of dental trauma in children	2		
10	Restoration of primary dentition	2	Dentist, pedodontist	Male
11	Problems in transition of dentition	2		
12	Sedation and general anesthesia for child dental patients	1	Dentist, pedodontist	Female
13	Dentistry for the special needs	1		
14	Infant nutrition and feeding related to oral health	1	Physician, pediatrician	Female
15	Blood diseases and its relevant to dental management	1	Physician, pediatrician	Male
16	Neurological disorders and the management	1	Physician, pediatrician	Male
17	Growth and development (general)	1	Physician, pediatrician	Male
18	Endocrine disorders	1	Physician, pediatrician	Female
19	Inherited and metabolic diseases	1	Physician, pediatrician	Female
20	Cardiac diseases and its relevant to dental management	1	Physician, pediatrician	Male
21	Allergy and the management	1	Physician, pediatrician	Male
22	Common childhood viral diseases (Influenza, Epstein-Barr virus and enterovirus 71)	1	Physician, pediatrician	Male
23	Mental problems in children	1	Physician, psychiatrist	Male

Table 2 Distribution and teacher specialties for the integrated pediatric dentistry course in the dental school of National Taiwan University (NTU) in 2022.

Classification	Number of learning topics	Teaching hours	Number of teachers			
			Specialty	Male	Female	Total
Dentistry	13	19	7 pedodontists	3	4	7
Medicine	10	10	9 pediatricians and one psychiatrist	7	3	10
Overall	23	29	7 dental specialists and 10 medical specialists	10	7	17

topics to introduce knowledge about pediatrics (including one topic to introduce mental problems in children). It should be noted that the clinical skills in this integrated pediatric dentistry course refers to the knowledge of treatment methods and considerations related to pediatric dentistry, not the actual operation of these clinical skills. In terms of distribution of course content, in addition to dentistry content, one-third of the course content belongs to medicine content. It is the feature of this integrated pediatric dentistry course design, hoping to prepare dental students to become dentists with a more comprehensive consideration of pediatric health in the future.

Survey tool

All dental students who took the course of "Pediatric Dentistry" were invited to fill out the questionnaire for the integrated pediatric dentistry course survey after the semester of this course was finished. The purpose of this survey was to analyze students' cognition for concepts of pediatric dentistry after the integrated course. All students were invited to join in this survey at their free will to fill out the questionnaires without the pressure from the investigators. A structured questionnaire was used as the survey tool. The questions included the basic data such as students' gender, weekly studying time, and learning experience by their self-assessment. The investigated questions included 1) the experience for learning systemic diseases (questions 1 and 2), 2) the self-assessment of students' cognition for knowledge and clinical skills about pediatric dentistry, and knowledge about pediatrics related to dentistry (questions 3—5), 3) the attitude towards pediatric dentistry (questions 6—10), and 4) personal viewpoints for this integrated pediatric dentistry course (questions 11—13).

In the investigated questions, the answer was designed to let the student to raise a score ranging from 1 to 5. If the

Table 3 Gender distribution of dental students (n = 34) who took the compulsory integrated pediatric dentistry course in the dental school of National Taiwan University (NTU) in 2022, and the weekly studying time of the integrated pediatric dentistry course (including pre-class preview, after-class review, and related reading) and the learning experience about general and pediatric systemic diseases by their self-assessment.

Category	Number (proportion) of students			
Gender	Male		Female	
	22 (64.71%)		12 (35.29%)	
Weekly studying time	Less than 1 h	1–1.5 h	1.5–2 h	More than 2 h
	9 (26.47%)	9 (26.47%)	9 (26.47%)	7 (20.59%)
	(3 males and 6 females)	(7 males and 2 females)	(6 males and 3 females)	(6 males and one female)
	Less than 1.5 h		More than 1.5 h	
	18 (52.94%)		16 (47.06%)	
	(10 males and 8 females)		(12 males and 4 females)	
Learning experience sufficient about general systemic diseases	Yes		No	
	23 (67.65%)		11 (32.35%)	
	(14 males and 9 females)*		(8 males and 3 females)	
Learning experience sufficient about pediatric systemic diseases	Yes		No	
	11 (32.35%)		23 (67.65%)	
	(10 males and one female)#		(12 males and 11 females)	

*Among them, 16 dental students specifically mentioned the names (frequency) of the courses that taught the relevant knowledge during their first four years in the dental school of NTU as follows: Pathology (6), Periodontics (5), Oral Pathology (4), Introduction to Internal Medicine (3), Introduction to Surgery (3), Oral and Maxillofacial Surgery (3), Physiology (2), Clinical Diagnostics (2), Gross Anatomy (1), Pharmacology (1), and Oral Diagnostics (1).
#Among them, 8 dental students specifically mentioned the names (frequency) of the courses that taught the relevant knowledge during their first four years in the dental school of NTU as follows: Introduction to Internal Medicine (4), Introduction to Surgery (4), Pathology (2), Oral Pathology (1), Oral and Maxillofacial Surgery (1), and Embryology (1).

intensity or response for each question was extremely agreed, the score was 5. If the intensity or response for each question was neutral, the score was 3. In contrast, if the intensity or response for each question was extremely disagreed, the score was 1. The mean score of 3 or more meant that the students agreed the investigated questions on average, and the higher the score, the higher the degree of their agreement. The participating students were suggested to fill the score in fresh memory.

Statistical analysis

All data obtained from dental students were stored in excel files and used for statistical analysis. The differences in the mean scores (the degree of agreement) of various investigated questions were compared between two different groups of dental students by independent sample *t*-test. The result was considered to be significant if the *P*-value was less than 0.05.

Results

Basic data of participants

A total of the 34 dental students who completed this integrated pediatric dentistry course filled out the questionnaires in this study (Table 3). The valid response rate was 100%. Of these 34 students, there were 22 (64.71%) males and 12 (35.29%) females. For weekly studying time of the course, there were 18 (52.94%) students who studied less than 1.5 h per week and 16 (47.06%) students who studied more than 1.5 h per week. By their self-assessment, 23 (67.65%) of them had learning experience sufficient about general systemic diseases during their first four years in the dental school. Among them, 16 students specifically mentioned the names (frequency) of the courses that taught the relevant knowledge, and the top three of which were as follows: Pathology (6), Periodontics (5), and Oral Pathology (4). On the contrary, only 11 (32.35%) of them had learning experience sufficient about pediatric systemic diseases. Among them, 8 students specifically mentioned the names (frequency) of the courses that taught the relevant knowledge, and the top three of which were as follows: Introduction to Internal Medicine (4), Introduction to Surgery (4), and Pathology (2) (Table 3).

The students' cognition for concepts of pediatric dentistry after the class of integrated pediatric dentistry course

There were 13 investigated questions for analyzing the students' cognition for concepts of pediatric dentistry after the class of integrated pediatric dentistry course as follows:

Table 4 Question content and question types used in the survey by the self-assessment of dental students (n = 34) for concepts of pediatric dentistry learning after the class of integrated pediatric dentistry course and the survey results.

Question content	Question type	Mean score ± SD	Number (rate) of students who answered as agree
1. I have acquired sufficient knowledge of dentistry-related "general" systemic diseases during my first four years in the dental school.	For experience, multiple choice	3.47 ± 0.96	19 (55.88%)
2. I have acquired sufficient knowledge of dentistry-related "pediatric" systemic diseases during my first four years in the dental school.	For experience, multiple choice	2.97 ± 0.87	8 (23.53%)
3. After taking this course, I have acquired knowledge about pediatric dentistry.	For knowledge, multiple choice	4.15 ± 0.70	28 (82.35%)
4. After taking this course, I have acquired clinical skills about pediatric dentistry.	For skill, multiple choice	3.79 ± 0.81	21 (61.76%)
5. After taking this course, I have acquired knowledge about pediatrics related to dentistry.	For knowledge, multiple choice	4.12 ± 0.64	29 (85.29%)
6. I consider that dental students should learn about "general" systemic diseases related to dentistry.	For attitude, multiple choice	4.35 ± 0.85	31 (91.18%)
7. I consider that dental students should also learn about "pediatric" systemic diseases related to dentistry.	For attitude, multiple choice	4.18 ± 0.80	31 (91.18%)
8. I agree with this course design which combines two parts - introduction to pediatric dentistry in overall and lectures on pediatric systemic diseases related to dentistry.	For attitude, multiple choice	4.03 ± 0.67	27 (79.41%)
9. I consider that dental clinical subjects (such as Pediatric Dentistry) should teach more relevant treatment techniques and no more the knowledge of systemic diseases.	For attitude, multiple choice	3.09 ± 1.14	12 (35.29%)
10. I consider that it is necessary to teach knowledge of "pediatric" systemic diseases related to dentistry in pediatric dentistry, which will be helpful for future diagnosis and treatment of children.	For attitude, multiple choice	4.09 ± 0.67	28 (82.35%)
11. After taking this course, I have a more comprehensive understanding of pediatric dentistry.	For viewpoint, multiple choice	4.24 ± 0.65	30 (88.24%)
12. After taking this course, I am interested in pediatric dentistry as my future career.	For viewpoint, multiple choice	3.50 ± 0.93	16 (47.06%)
13. Overall, I am satisfied with this course.	For viewpoint, multiple choice	4.12 ± 0.69	28 (82.35%)

1) the experience for learning systemic diseases, 2) the self-assessment of their cognition for knowledge and clinical skills about pediatric dentistry, and knowledge about pediatrics related to dentistry, 3) the attitude towards pediatric dentistry, and 4) personal viewpoints for this integrated pediatric dentistry course after the class of integrated pediatric dentistry course (Table 4).

According to dental students' experience, less than 60% (55.88%) of them agreed that they had acquired sufficient knowledge of dentistry-related "general" systemic diseases during their first four years in the dental school of NTU. However, less than a quarter (23.53%) of them agreed that they had acquired sufficient knowledge of dentistry-related "pediatric" systemic diseases. The mean scores for above questions were 3.47 ± 0.96 and 2.97 ± 0.87, respectively (Table 4). Most of them found this integrated pediatric dentistry course to be helpful in improving their knowledge and clinical skills about pediatric dentistry, and knowledge about pediatrics related to dentistry. However, in comparison, the acquisition of clinical skills was less than that of knowledge for pediatric dentistry. The mean scores for above questions were between 3.79 and 4.15. The numbers (rates) of dental students who answered as agree were between 21 and 29 (between 61.76% and 85.29%) (Table 4).

Moreover, except for the statement that dental clinical subjects should teach more relevant treatment techniques and no more the knowledge of systemic diseases (only 35.29% of students agreed), most dental students agreed all other statements about their attitude towards learning of general and pediatric systemic diseases in pediatric dentistry. The mean scores for above questions were between 4.03 and 4.35. The numbers (rates) of dental students who answered as agree were between 27 and 31 (between 79.41% and 91.18%) (Table 4). However, less than 50% (47.06%) of them agreed this integrated course to be helpful in raising their interest in pediatric dentistry as the future career. Most students agreed that they had a more comprehensive understanding of pediatric dentistry after the class, and they were satisfied with the integrated pediatric dentistry course. The mean scores for above

Table 5 The comparison of dental students' concepts of pediatric dentistry learning between male and female dental students after the class of the integrated pediatric dentistry course.

Questions	Male (n = 22)		Female (n = 12)		*t-test*
	Mean score ± SD	Number (rate) of students who answered as agree	Mean score ± SD	Number (rate) of students who answered as agree	*P*-value
Question 1	3.36 ± 1.09	12 (54.55%)	3.67 ± 0.65	7 (58.33%)	0.194
Question 2	2.86 ± 0.94	6 (27.27%)	3.17 ± 0.72	2 (16.67%)	0.170
Question 3	4.23 ± 0.75	18 (81.82%)	4.00 ± 0.60	10 (83.33%)	0.188
Question 4	3.95 ± 0.84	16 (72.73%)	3.50 ± 0.67	5 (41.67%)	0.059
Question 5	4.27 ± 0.63	20 (90.91%)	3.83 ± 0.58	9 (75%)	0.027*
Question 6	4.23 ± 0.97	19 (86.36%)	4.58 ± 0.51	12 (100%)	0.124
Question 7	4.18 ± 0.91	20 (90.91%)	4.17 ± 0.58	11 (91.67%)	0.479
Question 8	4.14 ± 0.64	19 (86.36%)	3.83 ± 0.72	8 (66.67%)	0.107
Question 9	3.18 ± 1.22	9 (40.91%)	2.92 ± 1.00	3 (25%)	0.262
Question 10	4.14 ± 0.71	18 (81.82%)	4.00 ± 0.60	10 (83.33%)	0.289
Question 11	4.27 ± 0.70	19 (86.36%)	4.17 ± 0.58	11 (91.67%)	0.329
Question 12	3.59 ± 0.96	11 (50%)	3.33 ± 0.89	5 (41.67%)	0.224
Question 13	4.23 ± 0.69	19 (86.36%)	3.92 ± 0.67	9 (75%)	0.106

*$P < 0.05$.

questions were 4.24 ± 0.65 and 4.12 ± 0.69, respectively. The numbers (rates) of students who answered as agree were 30 (88.24%) and 28 (82.35%), respectively. Since most of the investigated questions had a mean score of more than 3, this meant that dental students agreed with most of the investigated questions on average (Table 4).

The comparisons of cognition for concepts of pediatric dentistry after the class of integrated pediatric dentistry course

The differences in the mean scores of investigated questions were compared between male and female dental students, between dental students with weekly studying time of less than 1.5 h and those with weekly studying time of more than 1.5 h, and between dental students with and without learning experience sufficient about general or pediatric systemic diseases by their self-assessment (Tables 5–8).

For the comparison between male and female dental students, female dental students were more likely to consider that they had acquired sufficient knowledge of dentistry-related general and pediatric systemic diseases during their first four years in the dental school, and dental students should learn about general systemic diseases. On the other hand, male dental students were more likely to agree that this integrated pediatric dentistry course to be helpful in improving their knowledge and clinical skills about pediatric dentistry, and knowledge about pediatrics related to dentistry, as well as their attitude towards learning of pediatric diseases in pediatric dentistry, and their interest in pediatric dentistry as the future career. Overall, male dental students were more satisfied with this integrated course than female dental students. The difference in the mean score of question 5 ($P < 0.05$) was significant between male and female dental students (Table 5).

For the comparison between dental students with weekly studying time of less than 1.5 h and those with weekly studying time of more than 1.5 h, dental students with less studying time were more likely to consider that they had acquired sufficient knowledge of dentistry-related general and pediatric systemic diseases during their first four years in the dental school, and dental students should learn about general and pediatric systemic diseases. On the other hand, dental students with more studying time were more likely to agree that this integrated course to be helpful in improving their knowledge and clinical skills about pediatric dentistry, and knowledge about pediatrics related to dentistry, as well as their attitude towards learning of pediatric diseases in the pediatric dentistry course. Overall, dental students with more weekly studying time were more satisfied with this integrated course than dental students with less weekly studying time. The difference in the mean score of question 5 ($P < 0.05$) was significant between dental students with more weekly studying time and dental students with less weekly studying time (Table 6).

For the comparison between dental students with and without learning experience sufficient about general systemic diseases, dental students with sufficient learning experience were more likely to consider that they had acquired sufficient knowledge of dentistry-related general systemic diseases during their first four years in the dental school, and to agree that this integrated course to be helpful in improving their knowledge and clinical skills about pediatric dentistry, and knowledge about pediatrics related to dentistry, as well as their interest in pediatric dentistry as the future career. On the other hand, dental students without sufficient learning experience were more likely to consider that dental students should learn about general and pediatric systemic diseases, and to agree that this integrated course to be helpful in improving their attitude towards learning of pediatric diseases in the

Table 6 The comparison of dental students' concepts of pediatric dentistry learning between dental students with weekly studying time of less than 1.5 h and those with weekly studying time of more than 1.5 h after the class of integrated pediatric dentistry course.

Questions	Weekly studying time of less than 1.5 h (n = 18)		Weekly studying time of more than 1.5 h (n = 16)		*t-test*
	Mean score ± SD	Number (rate) of dental students who answered as agree	Mean score ± SD	Number (rate) of dental students who answered as agree	*P*-value
Question 1	3.72 ± 0.67	11 (61.11%)	3.19 ± 1.17	8 (50%)	0.053
Question 2	3.11 ± 0.68	6 (16.67%)	2.81 ± 1.05	5 (31.25%)	0.163
Question 3	4.00 ± 0.59	15 (83.33%)	4.31 ± 0.79	13 (81.25%)	0.100
Question 4	3.61 ± 0.70	9 (50%)	4.00 ± 0.89	12 (75%)	0.082
Question 5	3.94 ± 0.64	14 (77.78%)	4.31 ± 0.60	15 (93.75%)	0.047*
Question 6	4.50 ± 0.62	17 (94.44%)	4.19 ± 1.05	14 (87.5%)	0.145
Question 7	4.22 ± 0.65	16 (88.89%)	4.13 ± 0.96	15 (93.75%)	0.364
Question 8	3.89 ± 0.58	14 (77.78%)	4.19 ± 0.75	13 (81.25%)	0.101
Question 9	2.94 ± 1.00	5 (27.78%)	3.25 ± 1.29	7 (43.75%)	0.222
Question 10	3.94 ± 0.64	14 (77.78%)	4.25 ± 0.68	14 (87.5%)	0.094
Question 11	4.11 ± 0.58	16 (88.89%)	4.38 ± 0.72	14 (87.5%)	0.123
Question 12	3.50 ± 0.79	8 (44.44%)	3.50 ± 1.10	8 (50%)	0.500
Question 13	4.00 ± 0.69	14 (77.78%)	4.25 ± 0.68	14 (87.5%)	0.148

*$P < 0.05$.

Table 7 The comparison of dental students' concepts of pediatric dentistry learning between dental students with and without learning experience sufficient about general systemic diseases by their self-assessment after the class of the integrated pediatric dentistry course.

Questions	With learning experience sufficient about general systemic diseases (n = 23)		Without learning experience sufficient about general systemic diseases (n = 11)		*t-test*
	Mean score ± SD	Number (rate) of dental students who answered as agree	Mean score ± SD	Number (rate) of dental students who answered as agree	*P*-value
Question 1	3.61 ± 0.84	14 (60.87%)	3.18 ± 1.17	5 (45.45%)	0.116
Question 2	2.91 ± 0.79	5 (21.74%)	3.09 ± 1.04	3 (27.27%)	0.292
Question 3	4.17 ± 0.65	20 (86.96%)	4.09 ± 0.83	8 (72.73%)	0.376
Question 4	3.83 ± 0.78	14 (60.87%)	3.73 ± 0.90	7 (63.64%)	0.372
Question 5	4.13 ± 0.63	20 (86.96%)	4.09 ± 0.70	9 (81.82%)	0.435
Question 6	4.22 ± 0.90	21 (91.30%)	4.64 ± 0.67	10 (90.91%)	0.091
Question 7	4.04 ± 0.82	21 (91.30%)	4.45 ± 0.69	10 (90.91%)	0.081
Question 8	4.00 ± 0.67	18 (78.26%)	4.09 ± 0.70	9 (81.82%)	0.359
Question 9	3.22 ± 1.20	10 (43.48%)	2.82 ± 0.98	2 (18.19%)	0.173
Question 10	4.00 ± 0.67	18 (78.26%)	4.27 ± 0.65	10 (90.91%)	0.136
Question 11	4.22 ± 0.60	21 (91.30%)	4.27 ± 0.79	9 (81.82%)	0.411
Question 12	3.65 ± 0.88	13 (56.52%)	3.18 ± 0.98	3 (27.27%)	0.085
Question 13	4.04 ± 0.64	19 (82.61%)	4.27 ± 0.79	9 (81.82%)	0.185

pediatric dentistry course. Overall, dental students without sufficient learning experience were more satisfied with this integrated course than dental students with sufficient learning experience. However, the differences in the mean scores of all questions were not significant between the two dental student groups (Table 7).

For the comparison between dental students with and without learning experience sufficient about pediatric systemic diseases, dental students with sufficient learning experience were more likely to consider that they had acquired sufficient knowledge of dentistry-related general and pediatric systemic diseases during their first four years in the dental school, and to agree that this integrated course to be helpful in improving their knowledge and clinical skills about pediatric dentistry, and knowledge about pediatrics related to dentistry, as well as their interest in pediatric dentistry as the future career. On the other hand, dental students without sufficient learning experience were more likely to consider that dental students should learn about general and pediatric systemic diseases. Overall, dental students with sufficient learning experience were more satisfied with this integrated course

Table 8 The comparison of dental students' concepts of pediatric dentistry learning between dental students with and without learning experience sufficient about pediatric systemic diseases by their self-assessment after the class of the integrated pediatric dentistry course.

Questions	With learning experience sufficient about pediatric systemic diseases (n = 11)		Without learning experience sufficient about pediatric systemic diseases (n = 23)		*t-test*
	Mean score ± SD	Number (rate) of dental students who answered as agree	Mean score ± SD	Number (rate) of dental students who answered as agree	*P*-value
Question 1	3.64 ± 1.12	7 (63.64%)	3.39 ± 0.89	12 (52.17%)	0.248
Question 2	3.09 ± 0.83	3 (27.27%)	2.91 ± 0.90	5 (21.74%)	0.292
Question 3	4.27 ± 0.79	9 (81.82%)	4.09 ± 0.67	19 (82.61%)	0.239
Question 4	3.91 ± 0.83	7 (63.64%)	3.74 ± 0.81	14 (60.87%)	0.287
Question 5	4.27 ± 0.79	9 (81.82%)	4.04 ± 0.56	20 (86.96%)	0.168
Question 6	4.00 ± 1.81	9 (81.82%)	4.52 ± 0.59	22 (95.65%)	0.047*
Question 7	3.91 ± 1.14	9 (81.82%)	4.30 ± 0.56	22 (95.65%)	0.090
Question 8	4.18 ± 0.75	9 (81.82%)	3.96 ± 0.64	18 (78.26%)	0.185
Question 9	3.09 ± 1.30	4 (36.36%)	3.09 ± 1.08	8 (34.78%)	0.496
Question 10	4.09 ± 0.83	8 (72.73%)	4.09 ± 0.60	20 (86.96%)	0.494
Question 11	4.18 ± 0.75	9 (81.82%)	4.26 ± 0.62	21 (91.30%)	0.374
Question 12	3.82 ± 0.75	7 (63.64%)	3.35 ± 0.98	9 (39.13%)	0.085
Question 13	4.18 ± 0.75	9 (81.82%)	4.09 ± 0.67	19 (82.61%)	0.356

*$P < 0.05$.

than dental students without sufficient learning experience. The difference in the mean score of question 6 ($P < 0.05$) was significant between the two dental student groups (Table 8).

Discussion

The results of this study showed that the integrated pediatric dentistry course could improve dental students' knowledge and clinical skills about pediatric dentistry, and knowledge about pediatrics related to dentistry, although in comparison, the acquisition of clinical skills was less than that of knowledge for pediatric dentistry. Most dental students achieved a positive attitude towards learning of general systemic and pediatric diseases in the integrated pediatric dentistry course, and had a more comprehensive understanding of pediatric dentistry after the class of integrated pediatric dentistry course. The clinical skills in this course refers to the knowledge of treatment methods and considerations related to pediatric dentistry, not the actual operation of these clinical skills. This is especially the concept of oral-systemic link, which includes awareness of problems and connections between oral and general health, avoiding the physical distress caused by dental treatment, and understanding the risk of treating pediatric patients with systemic diseases.

In addition, most of them did not agree the statement that dental clinical subjects should teach more relevant treatment techniques and no more the knowledge of systemic diseases. The above-mentioned content may assist in their career, especially in cases of interprofessional consultations. Indeed, we build a bridge for interprofessional communication between pediatrics and pediatric dentistry in this integrated pediatric dentistry course. Due to the separation of medical and dental education, the teaching and learning of dentistry seems to focus on the oral cavity rather than the whole body. Therefore, the separation of general health education from dental education indeed has serious negative implications for the delivery of oral health care.

This integrated pediatric dentistry course exposed the fifth-year dental students to the concepts of oral health related to general health. Moreover, this integrated course was also designed to prepare dental students to become dentists with a more comprehensive consideration of pediatric health in the future. Some subsequent selective topics of pediatrics might be challenges for the dental students. However, most dental students were able to get good learning outcomes, indicating that they are indeed capable of taking the integrated course and gaining knowledge about pediatrics from the integrated course. This may also expose the fact that our dental students have the opportunities to learn the knowledge of systemic diseases in courses like the Introduction to Internal Medicine, Introduction to Surgery, Pathology, Oral Pathology, Periodontics, and others. The American Academy of Pediatrics (AAP) policy "Oral Health Risk Assessment Timing and Establishment of the Dental Home" encourages pediatricians to play an important role in the oral health of children, indicating that the physicians across the entire medical profession are valuable assets in the prevention and detection of oral disease.[3,5] In the same way, integrating pediatric education into a pediatric dentistry course for the undergraduate dental students is an important design to further develop educational interprofessional learning and incorporate curriculum content on the interaction of oral and systemic conditions. Oral health is an integral part of general health, and educational curricula should reflect the need for collaboration among healthcare professionals to achieve optimal patient care. As dental education increasingly focuses on the oral cavity,

interprofessional training opportunities at the undergraduate stage are important for dental students. There are many studies supporting the need for more interdisciplinary projects and interprofessional education in the dental education curricula.[10–14] However, in addition to learning together with students from different professionals, it is also a kind of interdisciplinary learning for dental students to arrange pediatrics in the integrated pediatric dentistry course in this study. Our interprofessional pediatric dentistry course for the fifth-year dental students helps them to learn some basic knowledge of pediatrics through the senior attending pediatricians in the teaching hospital. The initial feedback from dental students was almost entirely positive.

The curriculum guidelines of EAPD for arrangement of pediatric dentistry are to hope that after completing the pediatric dentistry course, dental students will be able to diagnose oral diseases, understand the growth and development related problems for children and adolescents with general or special needs, and provide the comprehensive treatment and prevention of oral diseases.[9] The arrangement of the pediatric dentistry course is completely based on dentistry itself. However, the multi-faceted integrated medical care is the cooperation between physicians with medical specialties and dentists with dental specialties. This may require other curriculum arrangements to compensate for the in-depth exploration of pediatric systemic problems. On the other hand, the advantage of our arrangement for the integrated pediatric dentistry course is that it incorporates the specialty of pediatricians and provides a comprehensive understanding of pediatric systemic development and diseases. However, the possible disadvantage is that there is only one semester. In the limited time period, it may have to consider whether the depth and breadth of the course content can be achieved, and whether dental students can absorb the knowledge of all course contents. Furthermore, with the expansion of dental knowledge, the changes in our dental school curriculum over the past 60 years also tend to reduce the proportion of medical courses and increase the proportion of dental courses, but the pediatric dentistry course has the least change among the subjects of dental specialties.[7] The current pediatric dentistry courses only have 2 credits of lectures and 2 credits of clinical practice, which may be very difficult to meet the goal of comprehensive understanding of both pediatric dentistry and pediatrics.

In this study, male dental students and dental students with more studying time were more likely to agree that this integrated pediatric dentistry course to be helpful in improving their knowledge about pediatrics related to dentistry, while dental students without learning experience sufficient about pediatric systemic diseases were more likely to agree that dental students should learn more about general systemic diseases related to dentistry. This means that the gender, studying time, and previous learning experience may affect dental students' cognition for concepts of pediatric dentistry after the class of integrated pediatric dentistry course. However, the above differences still need further researches to explore the reasons why we obtained these results.

The field of pediatric dentistry in Taiwan developed very early, starting from the Japanese colonial period (1895–1945).[8] Since the government recognized a dental specialty in 1998 for the first time, Taiwan has implemented a comprehensive specialist system, including 11 recognized dental specialties, and pediatric dentistry is the fourth government recognized dental specialty. Since it was recognized in 2019, a curriculum standard for specialist training of pediatric dentistry was established.[15] In addition, since Taiwan's two-year postgraduate year training program for dentists (PGYD) implemented in 2010, the elective training item for pediatric dentistry also has a relevant curriculum standard in this training program.[16] Currently, however, Taiwan's dental education system still does not have an undergraduate curriculum standard for pediatric dentistry.

Pediatric dentists are not the only ones who treat children. General dentists may often face children in their daily practice. Therefore, it is very important to establish a comprehensive curriculum standard of pediatric dentistry for the undergraduate dental students. In addition to basic knowledge and skills of pediatric dentistry, pediatric knowledge related to dentistry should also be taken into consideration. Although there are relatively few opportunities for the undergraduate dental students to learn pediatric dentistry, perhaps adding pediatric dentistry courses to the dentist continuing education system and the PGYD is a more feasible solution to make up for this shortcoming.

Considering the effectiveness of this integrated pediatric dentistry course on dental students' knowledge and clinical skills about pediatric dentistry, and knowledge about pediatrics related to dentistry, as well as their more positive attitude towards pediatric dentistry, this model shows promising for the further use in the dental education. In this study, the design of this integrated pediatric dentistry course can improve the problem of over-separation between medical education and dental education. We have verified from the positive feedback of dental students and suggest that this course design of integrating medicine content into a dentistry curriculum is suitable for other dental professional courses. We believe that in addition to specialist training, a comprehensive pediatric dentistry education system shall be established in the near future, including both the undergraduate dental courses for dental students and the postgraduate clinical training courses for practicing dentists. The advanced pediatric dentistry courses designed for dental students and the postgraduate clinical training courses of pediatric dentistry developed for practicing dentists shall be considered. However, these may need a long-term promotion to achieve this goal.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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