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Original Article

Integration of arts into dental education: Beauty in the histological photomicrographs

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Abstract *Background/purpose:* Integration of arts and humanities into dental education is important for developing holistically oriented dental professionals. This study aimed to survey dental students' perception of integrating arts and sciences into dental education with an innovative pedagogical approach through a photomicrograph competition.

Materials and methods: Students used digital imaging tools and creative approaches to capture photomicrographs that revealed hidden beauty in oral tissue sections. The photomicrograph works were posted online for scoring. The scoring activity, questionnaire survey, and complimentary comments of the participants were conducted online using a Google form.

Results: The photomicrograph competition garnered a 24% participation rate from the 490 undergraduate dental students. Of the 116 participants, 65% agreed that the photomicrograph competition increased their interest in learning microscopic lessons, 87% very strongly or strongly supported to hold the photomicrograph competition every year, and 72% believed that the photomicrograph competition could be adopted to the dental students in all dental schools in Taiwan. The overall satisfaction rate of the photomicrograph competition was 91%. The free comments from all participants were generally positive towards this photomicrograph competition.

Conclusion: The photomicrograph competition shows the transformative potential of integrating arts and humanities into dental education. Through the lens of photomicrography, the hidden wonders in oral tissue sections have been unveiled. This photomicrograph competition, a pioneering endeavor with no precedent in English literature, has proven to be a

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resounding success that unites the realms of scientific inquiry and artistic expression, and may be a transformative agent in nurturing holistic dental professionals.

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Introduction

Integration of humanity into dental education is important for developing holistically oriented dental professionals.¹ Recognizing the importance of arts and humanities to physicians, the Association of American Medical Colleges (AAMC) highlights their distinctive, yet underexplored, role in preparing physicians for the complicated challenges in the 21st century. This perspective underscores medicine as an intricate interplay of science and art, which is underpinned by humanistic values, principles, and proficiencies, including a profound understanding of the human condition. The AAMC promotes the integration of artistic disciplines into the medical curriculum and this is substantiated by recommendations to improve the well-being of aspiring medical professionals and experienced physicians.²

Similarly, comparable principles are evidenced in the historical context of Chinese medical education. Si-Miao Sun, a venerable medical sage during the Tang Dynasty, emphasized the parity between professional aptitude and humanistic attributes in achieving the pinnacle of medical excellence, as articulated in seminal works such as "Virtue of the Great Physician" and "Education of the Great Physician."

Diverse methodologies are proposed to infuse artistic sensibilities into dental education, including narrative medicine,^{3–5} literature,^{6,7} history,⁸ art,⁹ and interdisciplinary approaches.¹⁰ Additionally, the integration of digital imaging, prominently in basic medical education such as pathology, has become universal. Pathologists employ digital imaging for education, diagnosis, patient reports, publication, and data preservation.¹¹

This study introduced an innovative pedagogical approach to merge artistry and dental education through a photomicrograph competition within the "oral histology" and "oral pathology" laboratory curriculum for second-year and third-year dental students, respectively. Photomicrography, an art form encapsulating the capture of microscopic images, was employed to reveal the intricate beauty and complexity inherent in the microscopic world invisible to the unaided eye. We hope that this pioneering initiative may enrich dental education by infusing artistic expression, fostering a holistic understanding of oral histopathology while cultivating students' creativity and visual insight.

Materials and methods

With the theme of "beauty in the microscope", there were two photomicrograph competition items: the "oral histology" item for the second-year students and the "oral pathology" item for the third-year students. For each item, dental students were divided into 14 and 12 teams, with 5 or 6 members

in each team, where appropriate. The photomicrograph competition information was distributed at the semester's beginning to ensure that the dental students had enough time to take their best photomicrographs from oral histology and oral pathology tissue sections. For the scoring activity, all undergraduate dental students from the School of Dentistry, Chung Shan Medical University (CSMU), were invited to participate in scoring the photomicrograph works. Information about the photomicrograph competition activity and the link to score the photomicrograph works was pronounced with posters and social media to all the dental students of CSMU.

The materials used for making the photomicrograph works for the competition were histopathological teaching slides for the oral embryology and histology laboratory (second-year-grade) and oral pathology laboratory (third-year-grade) curricula. Dental students were advised to take photomicrographs with the same microscope (Nikon Eclipse Ni-U, Nikon Instruments Inc., Tokyo, Japan) and software (CaseViewer 2.4, 3DHISTECH Ltd., Budapest, Hungary) to obtain the best quality of the photomicrograph. Good-quality photomicrographs taken with their smartphones were also accepted. Then, they submitted their photomicrograph works without renovating them to the teacher's e-mail box for the subsequent competition procedures.

The scoring activity, questionnaire survey, and complementary comments of the participants were conducted online using a Google form. The questionnaire was composed of four questions and one open question about the comments of this photomicrograph competition. Informed consent from the participant was obtained via a questionnaire at the beginning of the Google form. Participation was voluntary, and all participants had to log in with their school Google e-mail address to ensure anonymity. The name and other personal information of the participants were protected. All participants had to score their three favorite photomicrographs from each of the two items. The work got 5, 3, and 1 points when rated 1, 2, and 3, respectively. The summation of the points determined the final rank. The scoring activity lasted for two weeks.

All data obtained from the Google form system were stored in excel files and used for statistical analysis by descriptive statistics. This study was carried out following the Declaration of Helsinki. The participants were voluntary. There was no advantage for those who joined this photomicrograph competition and scoring activity and no disadvantage for those who chose not to participate in the photomicrograph competition and scoring activity.

Results

A total of 26 photomicrograph works were submitted to the photomicrograph competition, including 14 for the "oral

histology” category and 12 for the “oral pathology” category. Fig. 1 shows the photomicrograph works that rank from the first to third place of each of the two items.

The distribution of the participants from the first-year-grade to sixth-year-grade is shown in Table 1. In total, 118 (24%) of the 490 undergraduate dental students participated in the scoring activity. The number of participants (proportions to the total number of participants) were 10 (8%), 40 (34%), 38 (32%), 17 (15%), 5 (4%), and 8 (7%) for the first-, second-, third-, fourth-, fifth-, and sixth-year-grades, respectively. Furthermore, the proportion of the number of participants to the total number of dental students in each year-grade was highest for the second-year-grade (48%), followed by the third-year-grade (47%) and the fourth-year-grade (21%). The lowest proportion was 6% for the fifth-year-grade (Table 1).

Of the 118 participants, 116 (98%) responded to the questionnaires. The responses to each of the four questions are shown in Table 2. Of 116 participants, 75 (65%) agreed that the photomicrograph competition increased their interest in learning the microscopic lessons, 110 (87%) very strongly or strongly supported to hold this photomicrograph competition activity every year, and 84 (72%) strongly agreed or agreed that this photomicrograph competition activity was appropriate for the dental students in all dental schools in Taiwan to participate. The overall satisfaction rate of the photomicrograph competition activity was 91% (Table 2). The free comments from the participants are shown in Table 3. The feedback comments from all participants was generally positive towards the holding of this photomicrograph competition.

The “beauty in the microscope” award ceremony was held in the first week of the subsequent semester in September 2022. Award-winning teams or students were invited to present their photomicrograph works at the Annual Meeting of Taiwan Academy of Oral Pathology in October 2022. Their photomicrograph works were also exhibited for one month during the celebration of the anniversary of CSMU in November 2022.

Discussion

Photomicrographs offer a unique and beautiful window into the real world around us, allowing us to appreciate the beauty and complexity of the oral tissue sections at a level that is not otherwise visible to us. The “beauty in the microscope” photomicrograph competition represents a noteworthy initiative that integrates the arts and humanities into the dental education. To the best of our knowledge, there have been no similar studies in the English literature.

The submission of 26 photomicrograph works across the two distinct categories – oral histology and oral pathology – underscores the importance of artistic expression in the kingdom of scientific investigation. These submissions of photomicrograph works signify the successful fusion of visual arts with dental sciences, opening avenues for students to communicate scientific concepts through a creative lens of photomicrography.

The distribution of participants across six different year-grades revealed an interesting trend. The proportions of

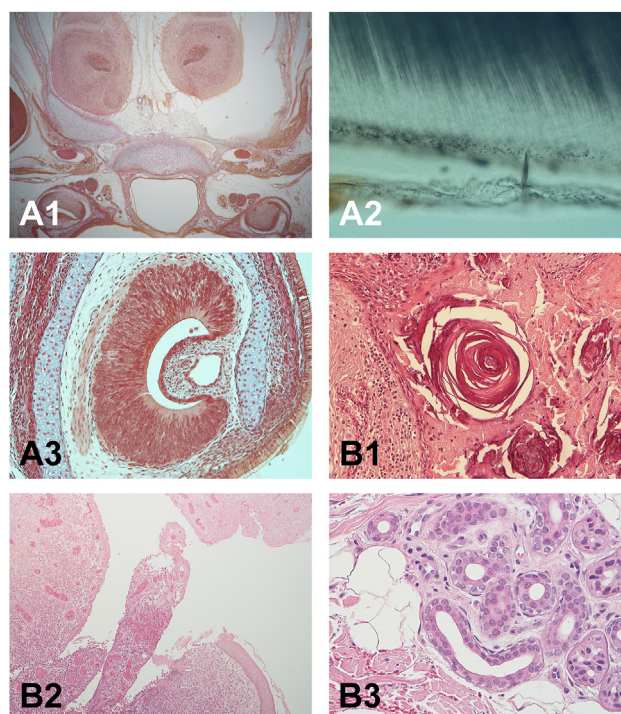


Figure 1 Photomicrograph works of the “beauty in the microscope” photomicrograph competition award. (A1–A3) The first-to third-place photomicrograph works in the “oral histology” item, respectively. (A1) The frontal section through the head of an embryo showing fusion of the right and left palatal shelves with the nasal septum, the right and left inferior conchae in the nasal cavity (the upper part), and the right and left tooth germs of the maxillary central incisors (the lower part). For a student who did not learn the oral histology before, this photomicrograph looked like “Found a page not yet finished 5 min before the end of the test”. (A2) A ground section of the tooth showing the vertical dentinal tubules (like raindrops, the upper part), horizontal dentinoenamel junction (like a river, the lower part), and a vertical enamel lamella (like the sail of a sailboat, the lower right part). The whole picture looked like a sailboat “sailing through the raindrops” on a river. (A3) A histologic section of an optic cup composed of a densely-staining optic cup rim (like a mouth, at the center) partially surrounding a central lumen (like the oral cavity) containing a projection of a lens vesicle (like a nipple). The whole picture looked like a mouth “catching” a nipple. (B1–B3) The first-to third-place photomicrograph works in the “oral pathology” item, respectively. (B1) A histopathologic section of a well-differentiated squamous cell carcinoma with invasion into the muscle layer and formation of a whorl of keratin pearl (at the center) looking like a flower “blooming in the cancer”. (B2) A histopathologic section of a pyogenic granuloma with focal surface ulceration. At the center, there was a thin separate granulation tissue (like the body of a “birdman”) with a small round granulation tissue mass on the top (like the head a “birdman”). (B3) A histologic section of a salivary gland tissue exhibiting the cross section of two intercalated ducts (like two eyes of a “clown”), the tangential cut of an intercalated duct (like the nose of a “clown”), and the cross section of a curved intercalated duct (like the mouth of a “clown”).

Table 1 Distribution of the participants in each year-grade of dental students.

Year-grade	First	Second	Third	Fourth	Fifth	Sixth	Total
Total number of the dental students	87	83	81	80	79	80	490
Number of participants (Proportion to the total number of participants)	10 (8%)	40 (34%)	38 (32%)	17 (15%)	5 (4%)	8 (7%)	118 (100%)
Number of participants (Proportion to the total number of dental students)	10 (11%)	40 (48%)	38 (47%)	17 (21%)	5 (6%)	8 (10%)	118 (24%)

Table 2 The questionnaire survey results of the photomicrograph competition.

Questions	Number		
This activity increases my interests in learning the microscopic lessons.	Agree 75 (65%)	Neutral 37 (32%)	Disagree 4 (3%)
I support to hold this photomicrograph competition activity every year.	Very strong 54 (43%)	Strong 56 (44%)	Neutral 16 (13%)
This photomicrograph competition activity is appropriate for all students in the dental schools in Taiwan.	Strongly agree 40 (34%)	Agree 44 (38%)	Neutral 32 (28%)
The overall satisfaction rate of the photomicrograph competition activity	Very satisfied 53 (46%)	Satisfied 52 (45%)	Neutral 11 (9%)

Response rate: 98% (116/118).

Table 3 Free comments from the participants. The sentences were originally written in Chinese and were translated into English. Similar comments were integrated to the same item.

Points concerning the learning.	
1	It is very interesting to learn histology with imagination.
2	It is very interesting to know the individual interpretation of the oral histologic image.
3	The photomicrograph competition is full of art that can provoke student's imagination.
4	I learn a lot of art from microscopic photographs of oral histology and oral pathology.
5	I can understand that there are different interpretations for the same histologic image.
Good aspects for the photomicrograph competition activity.	
1	Many thanks for teacher's hard work.
2	Very good/cool/great activity.
Points for improvement of the photomicrograph competition activity.	
1	It is better to put the photomicrograph works in a high-resolution webpage.
2	I learn a lot of art from the microscopic photographs.
3	Maybe there is a better way to show the photomicrograph works because the arrangement order may influence the participants' decision.
Other comments	
1	My classmates are very creative.
2	I want the award prize.
3	I hope to win the first award.
4	I am waiting for more interesting and beautiful photomicrograph works in the future.
5	Some titles are not as good as their photomicrograph works and they may influence my decision.

the number of participants varied among six year-grades, with the second- and third-year-grades demonstrating the highest participation rates (48% and 47%, respectively) and

the participation rates declined gradually to the bottom (6%) for the fifth-year-grade and raised slightly to 10% for the sixth-year-grade. These distribution features indicate

that the fresh memory of the dental students after learning the oral histology (which is given in the second-year-grade) and oral pathology (which is given in the third-year-grade) courses may increase their interests to participate in the oral histology and oral pathology parts of the photomicrograph competition, respectively. As the time goes by, the dental students gradually lose their memory and interest about the oral histology and oral pathology courses and thus reduce their desires to participate in the photomicrograph competition. We hope that if the photomicrograph competition can hold every year, it may provoke the dental students to like the oral histology and oral pathology laboratory courses and further increase their potential for integrating artistic activities into dental education in both the early and later stages of their dental education.

The questionnaire responses shed light on the impact of the photomicrograph competition on the participants' attitudes towards dental education related to microscope such as oral histology and oral pathology laboratory courses. The majority (87%) of the participants very strongly and strongly supported the continuation of holding the photomicrograph competition annually, emphasizing its positive influence on the learning experiences towards the oral histology and oral pathology laboratory courses. In particular, 65% of the participants reported an increased interest in microscopic lessons due to the participation of the photomicrograph competition (Table 2). This finding suggests that integrating artistic elements into the dental education can effectively enhance engagement and motivation in traditionally scientific subjects, thus further enriching the dental educational journey.

The potential of the photomicrograph competition for promoting interscholastic communication is evident in the enthusiastic responses from the participants. The agreement rate of 72% from the participants also suggests that the photomicrograph competition is suitable for the dental students in all dental schools in Taiwan to participate. Therefore, the "beauty in the microscope" photomicrograph competition has the potential to serve as a unifying platform for dental education across different dental schools in Taiwan. This further supports the broader vision of integrating the arts and humanities to nurture well-rounded and holistic dental professionals.

The "beauty in the microscope" award ceremony and the subsequent presentations of the photomicrograph works in detail at the esteemed events further emphasized the recognition and platform that artistic endeavors could provide. The photomicrograph competition bridged the gap between the sciences and the arts by showcasing award-winning photomicrograph works at the prominent academic gatherings and celebratory occasions. All of these designs for the photomicrograph competition encouraged students to transcend disciplinary boundaries and communicate their findings to the diverse audiences.

In conclusion, the "beauty in the microscope" photomicrograph competition shows the transformative potential

of integrating arts and humanities into dental education. Through the lens of photomicrography, the hidden wonders of the oral tissue sections have been unveiled, transcending the limits of our ordinary perception. This photomicrograph competition, a pioneering endeavor with no precedent in English literature, has proven to be a resounding success that unites the realms of scientific inquiry and artistic expression, and may be a transformative agent in nurturing holistic dental professionals.

Declaration of competing interest

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

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