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Perspective article

The significance of using dental elements as a design theme: A case report of modular mobile dental system in the 2023 young designers' exhibition in Taiwan

Feng-Chou Cheng [a,b,c], Ling-Hsia Wang [d**], Chun-Pin Chiang [e,f,g,h*]

[a] *Chia-Te Dental Clinic, New Taipei City, Taiwan*
[b] *School of Life Science, College of Science, National Taiwan Normal University, Taipei, Taiwan*
[c] *Science Education Center, National Taiwan Normal University, Taipei, Taiwan*
[d] *Center for the Literature and Art, Hsin Sheng Junior College of Medical Care and Management, Taoyuan, Taiwan*
[e] *Department of Dentistry, National Taiwan University Hospital, College of Medicine, National Taiwan University, Taipei, Taiwan*
[f] *Graduate Institute of Clinical Dentistry, School of Dentistry, National Taiwan University, Taipei, Taiwan*
[g] *Graduate Institute of Oral Biology, School of Dentistry, National Taiwan University, Taipei, Taiwan*
[h] *Department of Dentistry, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, Hualien, Taiwan*

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* Corresponding author. Department of Dentistry, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, No. 707, Section 3, Chung-Yang Road, Hualien, 970, Taiwan.
** Corresponding author. Center for the Literature and Art, Hsin Sheng Junior College of Medical Care and Management, No. 418, Gaoping Section, Jhongfong Road, Longtan Township, Taoyuan, 32544, Taiwan.
E-mail addresses: milkegg5452001@gmail.com (L.-H. Wang), cpchiang@ntu.edu.tw (C.-P. Chiang).

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The students in the design-related disciplines should complete a graduation project in their final year of studying and present their results publicly. Internationally, this is a fine tradition inherent in the design education. The graduation project in the design education usually combines researches on the design topics from the industry and academia, and is also an important practical course for the students in the design departments (so-called the design students) to examine the outcomes of their studying. This is equivalent to a clinical internship for the students in the medical-related disciplines. However, the design students should also demonstrate their graduate productions publicly to complete the final mile of their design training. This is usually a graduation exhibition within the school and further an inter-school design display and competition.

In Taiwan, the young designers' exhibition (YODEX) is jointly promoted by the Ministry of Economic Affairs and the Ministry of Education. Since its inception in 1981, it has been committed to promoting the exhibition in the direction of branding, professionalism, and internationalization. It is a large-scale design industry-university exchange and co-creation platform in the world. The exhibition content spans multiple fields such as the product design, the graphic design, the package design, the visual communication design, the space and landscape design, the fashion design, the digital media design, and the craft design. Every year, over 4000 entries and 10,000 young designers from 140 design-related departments of over 60 schools participate in the exhibition.[1] Over the years, there were relatively few of the exhibited entries involving the medical-related industries, and those involving the dental-related industries were even rarer. The only entry, called doctors without borders — the modular mobile dental system (MMDS) involving the dental-related industries of the 2023 YODEX won the first prize in the competition. This aroused our curiosity. In this article, we attempted to explore the significance of using dental elements as a design theme through an interview with a design student who was the primary inventor of this design work.

In this study, we used purposeful sampling to select a design student (from the Department of Creative Product Design in the Southern Taiwan University of Science and Technology) who participated in the design work of the MMDS to conduct an interview with him. The work of his design team belonging to industrial design was exhibited in the YODEX, Taipei, Taiwan from May 19 to 22, 2023 and won the first prize as shown in Fig. 1. Furthermore, there was an animated video on line (https://youtu.be/XKHb20Hsmus?si=ygmGfOUGQiSRKmPP) for providing their explanations.

The design team including mainly the design student and the instructors used a stage-like design to display their work on the stage. The stage backboard was used to display the original design concept and the graphic description of the work. The award-winning record of this work was posted on the upper right side of the stage backboard (Fig. 1A). This work consisted of 3 main parts to form the MMDS. The dental clinic composed of the MMDS could be more portable. The main body of the dental unit adopted a camping chair structure with a simple installation (Fig. 1B). The intuitive assembly had the advantage for quick setup of the clinic site. It is suitable for all occasions indoors and outdoors. The working chair for the dentist had a tool tray and the storage grooves for storage, and it could be adjusted in height (Fig. 1C). The extendable platform had a dental tray and a medicine vial and cement mixing tray, and it could be configured with the essential dental electric tools (Fig. 1D). These changes let the dental volunteering be more convenient and have also optimized the working route. The MMDS provides the dentists, the dental assistants, and the patients with the suitable moving lines and assists the dental volunteer team integrating the healthcare models and tools. It increases the portability of the dental tools, increases the clinic identification, and improves the workflow. The clear area division enhances the efficiency for the dentists, the dental assistants, and the dental patients.

The interview outline for this design student had 5 major items related to the issues of the significance of using dental elements as a design theme, including the interviewee's background, the introduction of his school's graduation project curriculum, the motivation for the MMDS design proposal, the implementation process, and the thoughts after the completion. The interviewee was a design graduate of the Southern Taiwan University of Science and Technology. His school required the design students to take a compulsory graduation project with a total of 6 credits in the fourth grade. They should use the teamwork to complete a design work within one year. The learning objectives of this graduation project included the design practice project production, the design project proposal writing and theme setting, the project presentation, and the design display and competition. Moreover, the students were expected to complete the graduate design project by use of the knowledge of the industry and academics, and finally presented their abilities of performing a design project in the YODEX.

The interviewee pointed out that there is a dental practitioner in his family and he has been familiar with dental treatment units since his childhood. He has had this idea since he studied the design courses. People are accustomed to those who need dental treatment going to a place with a dental unit for treatment. If there is a mobile dental treatment system that can be moved freely to any locations for those who need dental treatment, it will be a great help for the patients with special needs, the elderly, the patients with the limited mobility, and the patients in the remote areas with the insufficient dental resources. Therefore, taking the opportunity of the graduation project, he proposed the mobile dental treatment system without borders to his instructors and partners, and received everyone's support at the time. Hence, they were dedicated to this one-year project.

The execution process of this design project included the steps such as the design thinking, the survey of user needs (such as the dentists and dental assistants), the graphic arrangement, the illustration drawing, the animation video production, the 3-dimensional modeling, the model making, and the model spraying. Especially, in the survey of user needs, they interviewed the hospital dentists, the dentists who ever participated in the dental

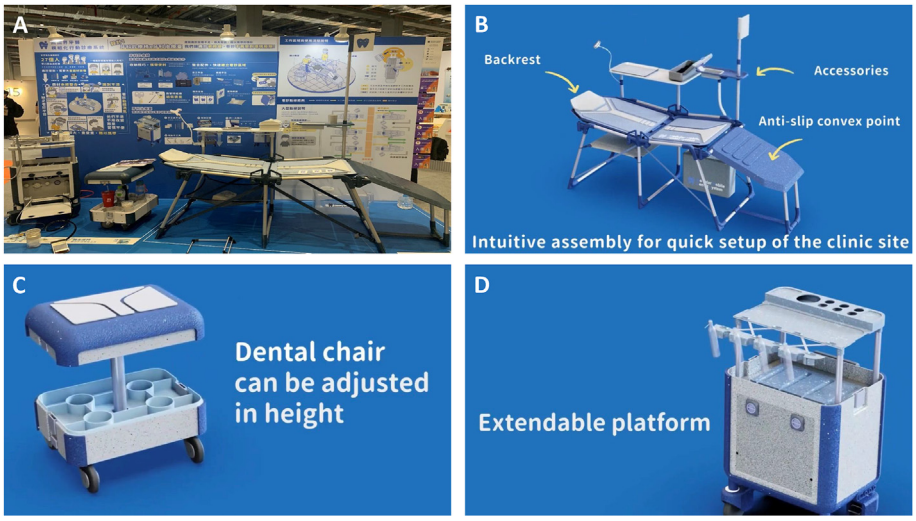

Figure 1 The design work of the modular mobile dental system (MMDS) displayed in the 2023 young designers' exhibition (YODEX). (A) A stage-like design was used to display the industrial design of the MMDS on the stage. (B) The main body of the dental unit adopted a camping chair structure with a simple installation. (C) The working chair for the dentist had a tool tray and the storage grooves for storage, and it could be adjusted in height. (D) The extendable platform had a dental tray and a medicine vial and cement mixing tray, and it could be configured with the essential dental electric tools. (The photograph of figure A was taken on May 22, 2023 just before the 2023 YODEX ended, while figures B, C and D were provided by the interviewee).

volunteering overseas or in the remote areas, and the experienced dental assistants. This process impressed them deeply because they understood the difficulties encountered by the dental volunteer team in serving patients in the remote areas.

Finally, they completed the design work and participated in the school graduation exhibition and the YODEX, and then won the first prize. The interviewee felt that this design project not only gave them the opportunity to apply the design principles and knowledge they learned to the actual design work, but more importantly, they learned more about the oral health care concept from the practical process of the proposal, understood the problem of the uneven distribution of medical and dental resources, and realized the importance of medical equality. In addition, improving the oral health care concept can also help to improve their self-oral care behavior.

The history of the mobile dentistry can be dated back to the early 20th century when dental professionals began to realize the need to provide a greater access to oral care to otherwise underserved communities.[2] In 1917, the army of the United States received a "dental ambulance" from the Red Cross. Four dentists and one to two assistants operated the ambulance.[3] Another earliest record suggested the utilization of the "mobile dental van" other than the military setting in Virginia.[4] One of the earliest examples of the mobile dentistry was the "dental bus", a concept first introduced in the United States in the 1920s. Equipped with the basic dental equipment and staffed by dental professionals, these buses were dispatched to rural and urban areas to provide oral care to those without access to services. By the 1970s, the mobile dentistry continued to evolve with the development of new mobile dental clinics and the use of portable equipment that could be easily transported to the different locations. In the United States, the mobile dentistry is now used to provide care to a wide range of populations, including the children, the elderly, and the patients with disabilities. It is also an important tool for emergency response teams who utilize the mobile dental clinics to provide the oral care after the natural disasters and other crises.[2]

The mobile and portable dental units are an effective and efficient way to take the sophisticated oral care to the doorsteps of the remote residents and the school premises and the urban disadvantaged groups through optimal utilization of the dental institutions, dentists, and dental auxiliaries.[3] Some studies conducted to evaluate the cost-effectiveness of the mobile and portable dental services in comparison with the fixed private and public dental clinics have found the mobile dental clinics to be more cost-effective than the fixed dental clinics. In addition to the cost-effectiveness, the mobile and portable dental services offer the advantage of overcoming some physical and cultural barriers related to the oral care.[5–7] Although the mobile and portable dental services have some disadvantages that need to be overcome in the oral care delivery, their potential advantages in providing the basic oral care for otherwise underserved population outweigh the disadvantages.[3]

In the history of the mobile dentistry, it is obvious that the MMDS is an important development direction for the mobile dentistry based on its more convenient movement and portability. In this study, we indicate that the idea and results of the MMDS design project have become one of the driving forces for the continued development of the mobile dentistry. From the perspective of dentistry, this is of great significance to the development of dental technology and facilities for the oral care of the remote residents and the disadvantaged groups. From the perspective of the design education, we consider that the application of the design in

dental and medical treatment can be roughly divided into three types: (1) the invention and innovation of products created due to demand; (2) the improvement of equipment or functions due to the discovering and solving existing problems; and (3) the optimization or establishment of processes. In addition, these are all based on the purpose of satisfying the human desires, needs or imagination. The results of the implementation of the MMDS design project have the effect of promoting the improvement of the mobile dentistry, the optimization of the treatment process, and the improvement of the lack of dental resources for the patients in the remote areas and in the disadvantaged groups. Thus, similar ideas involving dentistry may have a positive impact on the future development of dental materials and equipment.

Furthermore, the World Health Organization (WHO) defined the health literacy as the cognitive and social skills that determine the ability and skills to acquire information, knowledge, and understanding, including the ability to provide advice on the health of individuals, families, and communities.[8] The health literacy is also associated with the favorable health outcomes, such as the lower prevalence of chronic diseases, the fewer hospitalizations, and the lower health care expenditures.[9,10]

The significance of using dental elements as a design theme is not only for the design education, but also for the improvement of the oral health care concept and the health literacy for the design students. During the practice of making dental-related design works, the students have the opportunity to acquire the dental-related knowledge, which promotes the improvement of their self-oral care behavior and the humane care for the medical needs of vulnerable people. Thus, the accumulation of more knowledge and concepts related to the dentistry and medicine will further promote the improvement of the students' health literacy, while the role of the good health literacy is related to the good health outcomes.

The MMDS design project reported in this article is a good demonstration of combining the design education with the dental elements, which not only improves the oral health concept and the health literacy of participating students but also proves that the dental elements are a good subject for the design project.

Declaration of competing interest

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

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