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Questionnaire Research on How to Train Innovation Stomatology Undergraduates in China Using Practical Domestic and International Experience

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Abstract

The curriculum of interdisciplinary oral undergraduates can help train stomatologists with better analytical, creative and critical thinking. The curriculum reform of stomatology students is a hot topic in domestic colleges and universities. The aims of this study were to (1) analyze the necessity and feasibility of setting up interdisciplinary courses through advanced cases at home and abroad and to summarize successful experiences; (2) understand the cognition, learning interest and knowledge mastery of interdisciplinary students majoring in stomatology to lay a foundation for the formulation of training programs and development strategies for interdisciplinary innovative talent; and (3) summarize the current situation of undergraduate discipline cross-training and propose improvement measures. This study collected successful curriculum reform data both domestically and internationally and designed a questionnaire on the understanding of undergraduate students majoring in stomatology at Lanzhou University on the basis of their curriculum design. The study revealed that most students recognized the overlap between oral medicine and other fields, viewing interdisciplinary knowledge as valuable for scientific research. However, over half of the students rated their interdisciplinary knowledge as average or below, whereas 95.1% expressed an eagerness to learn more. The findings suggest a need to further enhance curriculum development, establish an interdisciplinary collaboration base, and deepen cooperative models for better outcomes in stomatology education.

Keywords: cross-disciplinary, curriculum reform, stomatology, undergraduate education

1. Introduction

According to updated data from the Global Scholars Bank concerning the top 100000 scientists worldwide in 2023, only two Chinese scientists are in medical disciplines among the top 1000 scientists. Among the 256 dentistry scientists, 238 are American and 18 are Chinese(Academics, December 1, 2023). These results suggest a significant gap between China and developed countries such as the United States. In recent decades, most breakthroughs in the clinic have been attributed to progress in fundamental research. For example, early in 1955, Buonocore of the Eastman School of Dentistry linked materials to stomatology and reported that dental adhesives could be used to treat dental caries(Handelman & Shey, 1996). Therefore, China urgently needs to change its training methods at the critical undergraduate stage to train excellent physician-scientists for the development of medicine.

(Fischer, 2012). However, the current stomatology education model in China was established and developed with reference to that of the former Soviet Union in the 1950s, with the major goal of training practical medical physicians to acquire essential medical knowledge and operational skills. This mode focuses on the knowledge indoctrination of "discipline as the center", and the assessment is mainly the rote learning of subjec. It is well known that higher medical education undertakes the important task of training high-quality medical talent, and undergraduate education undoubtedly plays the most important role in knowledge points. However, the development of medicine requires continuous research and innovation. The graduate stage is important for enriching professional knowledge, and an increasing number of

medical students choose to study as master's degree students or even PhD students. For example, the number of applicants for a stomatology degree at Sichuan University has markedly increased in recent years, from 345 in 2017 to 749 in 2022 for postgraduate applicants.

However, the common academic misconduct of medical graduate students in recent years has become a highly concerning issue that needs to be solved (Su & He, 2023). The main reasons for the academic misconduct of medical students are an impetuous academic environment and a lack of scientific research ability(Jin et al., 2024). Therefore, to accelerate the comprehensive reform of medical education, the Chinese government recently implemented an "excellent doctor education and training plan" to promote the scientific training of undergraduate students. To achieve this purpose, the construction of a university curriculum system and training in research labs are urgently needed (M. o. E. o. t. P. s. R. o. China, May 7th, 2012).

In the past decade, many medical colleges and affiliated hospitals have broken through the boundaries of the curriculum system between traditional basic medical courses, clinical medical disciplines and professional fields to implement cross-disciplinary integration. More importantly, cross-penetration between disciplines is the inevitable choice for realizing the self-development of disciplines and solving major problems. This is especially remarkable in stomatology, which involves deep cross-talk with other disciplines, indicating high requirements for stomatology education. Specifically, disciplines such as materials, mathematics, electronics, information, machinery, and engineering are all involved in clinical practice and fundamental research for stomatology. Thus, many Chinese stomatology schools have proposed a novel and powerful "Medicine+ X" program to promote the development of stomatology, where X represents one of those disciplines(T. S. C. o. t. P. s. R. o. China, February 1, 2023; Medicine, April 21, 2021; H. M. University, April 20, 2022; Z. University, January 11, 2023). Some schools have established undergraduate research training programs, enrolled undergraduates in different majors throughout the university, and realized the mentorship system for undergraduates. This interdisciplinary training provides great advantages for the research ability of students, including obtaining essential multidisciplinary knowledge, promoting interdepartmental connections, and solving scientific problems from different perspectives. At present, however, undergraduate stomatology education in China is still in an initial stage in the field of interdisciplinarity, with limited training directions. As a result, some common problems are generally found for Chinese stomatology undergraduates, such as a lack of a professional frontier, simple knowledge structure, and weak scientific research ability. Obviously, much effort should be made to meet the requirements of current medical career development(Chen, 2022). In this context, an educational experimental design should be used to evaluate the real effects of cross-disciplinary classes and scientific research training on the career development of dentists. On the basis of the literature, the infiltration and integration modes of stomatology and cross-discipline were explored to determine feasible innovative education methods for training excellent medical scientists in stomatology.

In this study, we conducted a questionnaire survey of stomatology students in three schools to determine their understanding, attitudes and views on interdisciplinary learning and to investigate the feedback of students majoring in stomatology in interdisciplinary learning. This survey revealed that it is urgently necessary to carry out interdisciplinary education in the undergraduate education stage to train innovative talent in interdisciplinary stomatology. Moreover, the study reviewers described in detail the recent progress in medical training reform, especially the involvement of interdisciplinary education at the undergraduate stage in China and developed foreign countries. Therefore, we discuss strategies for improving interdisciplinary education in our school at Lanzhou University. Our study has great value in training stomatology studies in higher medical schools with interdisciplinary approaches worldwide.

2. Methods

2.1 Subjects of Investigation

This study was conducted from October to November 2020 among stomatology undergraduate students at three universities, Lanzhou University, Xi'an Jiaotong University, and Northwest Minzu University. A total of 513 questionnaires were collected via a combination of paper questionnaires and the "Questionnaire Star" electronic questionnaire. Questionnaires were considered invalid when more than 10% of the content was missing or when there were obvious logical errors. Ultimately, 451 valid questionnaires were collected from undergraduates (387/451) and graduate students (64/451). Informed consent was provided by the participants, and our study was approved by the Ethics Committee of the School of Stomatology, Lanzhou University.

2.2 Questionnaire Content

The data were collected via a questionnaire designed for the "Cognition of Interdisciplinary Subjects among Stomatology Majors". The questionnaire mainly investigated the following: 1) the cognitions and attitudes of stomatology students toward interdisciplinary subjects, 2) the existence of interdisciplinary subjects in the existing training program, 3) the willingness of students to acquire interdisciplinary knowledge, and 4) the perceptions of postgraduate students toward interdisciplinary education at the undergraduate level.

2.3 Statistical Analysis

The data were analyzed via SPSS 24.0 software, and the count data are expressed as numbers and percentages.

3. Results

3.1 Perceptions and Attitudes Toward Interdisciplinary Disciplines

As shown in Figure 1, we interviewed 451 stomatology undergraduates (387/451) and graduate students (64/451) from 3 schools. Among the undergraduate students, 16.62% were freshmen, 23.72% were sophomores, 25.93% were juniors, 17.12% were seniors, and 2.4% were graduating students. In addition, 14.21% were postgraduate students. A total of 83.6% of the respondents thought there was substantial crossover between dentistry and other majors, mainly including literature, mathematics, law, materials science, biomedical engineering, chemistry, physics, life science, and computer science (Fig. 2). With respect to the role of interdisciplinary knowledge in the scientific research of this discipline, nearly all the respondents (99.8%) considered it to be either very beneficial or somewhat beneficial, whereas only one individual believed it was not beneficial. These survey data indicate that most students agreed that cross-disciplinary training is beneficial for dental students.

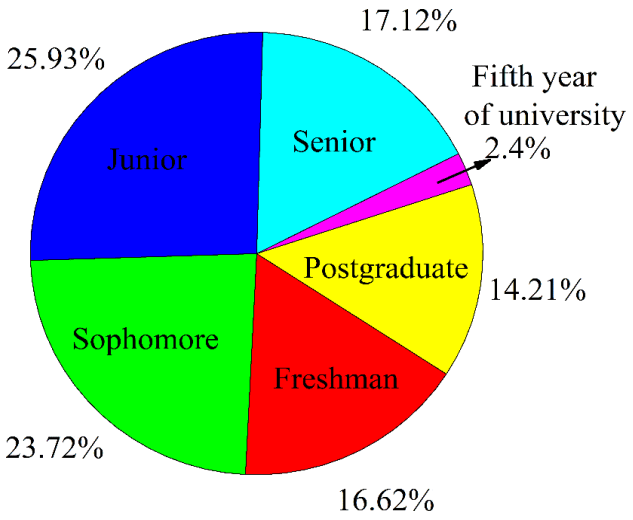

Figure 1. The Grade Distribution of Respondents

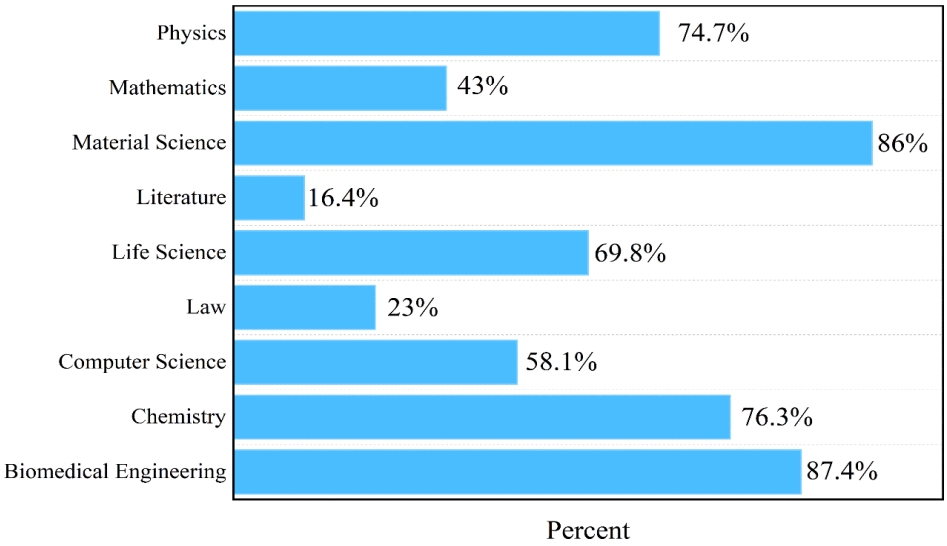

Figure 2. Intersection of the dental profession with other disciplines

3.2 Cross-disciplinary Settings in Training Programs

Among the students who responded to the survey, 85.6% thought that their undergraduate training programmes involved cross-disciplinary courses. Specific to the academic discipline, physics (88.6%, 342/386), chemistry (84.7%, 327/386), mathematics (78.5%, 303/386), materials science (35.5%, 137/386), computer science (26.9%, 104/386), and life science (25.6%, 99/386) were added to cross-disciplinary courses in their undergraduate training programs. In addition to the required courses in the training program, some students learned other cross-disciplinary courses as auditors (12.0%) or students in course selection (6.0%).

3.3 Mastery of Cross-disciplinary Knowledge and Study Motivation

As shown in Figure 3, 268 (59.4%) of the interviewees rated their knowledge of cross-disciplinary themes as average, 116 (25.7%) rated it as good, and only 23 (5.1%) believed it to be very good. As shown in Figure 4, most respondents (95.1%) indicated that they were willing (60.7%) or extremely willing (34.4%) to learn more cross-disciplinary knowledge related to their own disciplines, and 4.9% indicated the opposite. These results indicated that the majority of students strongly desired to study cross-disciplinary subjects. The respondents wanted to enrich cross-disciplinary knowledge in fields such as biomedical engineering, materials science and computer science. In terms of learning forms, respondents wished to learn related knowledge through research training (70%), theoretical courses (70%), lectures (45.2%) or on their own (18.6%). For the future direction of development, 49.7% of the respondents planned to conduct scientific research, whereas 50.3% claimed that they had no such intention. For the 387 undergraduates who responded to the survey, 82 (21.2%) students indicated that they would be extremely willing to attend graduate school in a field other than their own, 179 (46.3%) students would be somewhat willing, and 126 (32.6%) people would not be willing to do so.

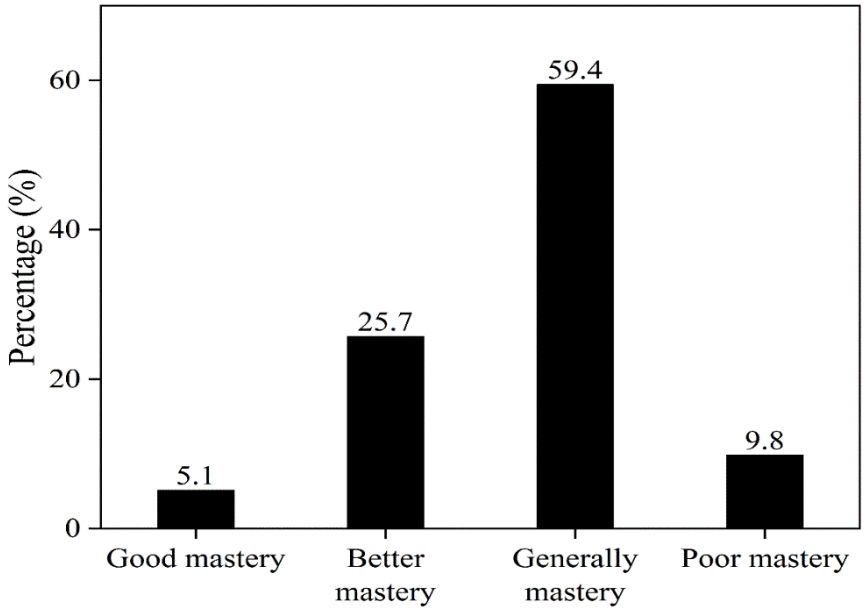

Figure 3. Respondents' mastery of cross-disciplinary knowledge

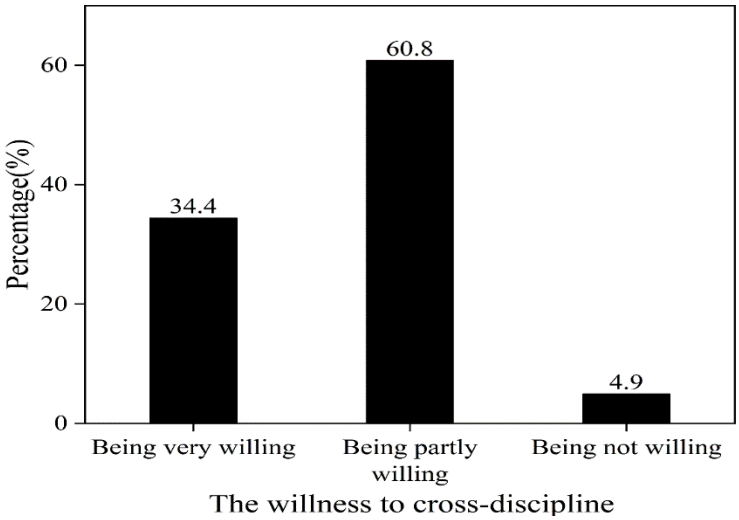

Figure 4. Respondents' willingness to learn cross-disciplinary knowledge

3.4 Recent Advances in Cross-disciplinary Training Worldwide

The American medical education system is characterized mainly by postundergraduate education and elite education via an eight-year training model. The practical skill training of students is carried out through the medical education process, which specifically emphasizes the development of clinical and scientific research abilities. The University of Oklahoma College of Dentistry has scheduled a "Student Science Day" for 41 years. The School of Dentistry at the University of California, Los Angeles (UCLA), launched the Student Independent Research Program in 1994 and held the Fifth Student Research Postter Competition in 1998. They arranged the first Research Day in October 2008, where students brought their posters on "Oral/Head and Neck Cancer Research" to the competition. In addition, participation in research projects is an integral part of the undergraduate dental curriculum in Sweden and other European countries. In 2000, the European Dental Education Project identified autonomous learning programs and mandatory research projects and regularly organized student research conferences to enhance dental practice education. The program required students to manage a small research project, present their findings to the group or class in oral presentations, and encourage them to present research results at conferences(Guven & Uysal, 2011; Ramachandra, 2020).

Foreign higher-stomatology education is generally recognized as elite education. In the 21st century, the traditional curriculum system, which is based on separate subjects, is no longer adequate for the transfer of new knowledge. A flexible curriculum model has been constructed for foreign stomatology education that includes cross-fertilized basic science and medical and dental knowledge both horizontally and vertically (Wang, Zhao, & Tan, 2017; Wu, Zhang, Jiang, & Guo, 2010). To improve innovation, Duke University developed a novel curriculum model based on integrated interdisciplinary innovation named the "Foundation of Excellence" in 2004. In this model, the process of curriculum reform determines the core content that is incorporated into the curriculum, which currently includes medical, humanities, ethics, legal, and academic aspects. In addition to curriculum reform, several foundational areas, such as assessment, guidance and coordination, educational technology, logistics and resources, educational methods and student life, also needed reform in Duke(O'Connor Grochowski, Halperin, & Buckley, 2007). The Baylor College of Medicine and Cleveland Clinic of Medicine are committed to strengthening the training of medical scientists, especially those with the ability to carry out scientific research and transformation. Other institutions advocate for the training of physicians, who can contribute to improvements in American public health as well as the health care system at most American University Schools of Medicine. For example, the University of California, San Francisco, focuses on community health and health differences, health systems and health policies, and social and behavioral sciences. Traditional academic content typically includes lectures at research conferences, manuscripts of peer-reviewed publications or project proposals. However, natural science projects involving other academic areas or interdisciplinary research may require the following considerations: 1) the design of new subject elements; 2) the submission of critical essays for publication; 3) the development of bioengineering tools; 4) the creation of important original articles; 5) the artworks of health sciences; and 6) the completion of public health projects(Green et al., 2010). Stanford University launched Project 2025 in 2013, led by the Stanford University School of Design, which is an open education innovation project focused on open-loop universities, paced education, axes flip and purpose learning. It breaks the bondage of objects, methods, goals and assessment methods of traditional education and gives students a scientific and comprehensive perspective on the puzzle

“why should I learn professional knowledge? ”. The implementation of this project accelerated worldwide intersectional medical talent training(S. University, Debuted in May 2014).

The Communist Party of the China Central Committee and the State Council formulated the blueprint for Healthy China 2030, which will guide the development of medicine, including stomatology, in China during the 14th Five-Year Plan period (2021--2025) and in the future (T. C. P. s. G. o. t. P. s. R. o. China, October 25th, 2016; Jinping, 26 Sept. 2021). The development of stomatology must be high enough to meet the growing needs for oral and physical health. In 2018, the Chinese Education Department and Ministry of Public Health of China implemented a “Physician education and training program of excellence” project 2.0. The guidelines indicate that medical education reform has aimed mainly to meet the requirements of national medical innovation and international competition for high-level medical talent, change the formalization of long-term clinical medical education and cultivate a number of high-level, internationalized medical top-notch innovative talents (M. o. E. o. t. P. s. R. o. China, May 7th, 2012). The Chinese government always highlights the great importance of medical talent training through education reform.

During the undergraduate stage, interdisciplinarity is popularly cited as an important way to cultivate top innovative talent. Lyall et al. summarized the factors affecting interdisciplinary projects, including interdisciplinary orientation, catalytic action, visionary leadership, active management, learning and persistence(Lyall, Bruce, Marsden, & Meagher, 2011). At present, major colleges and universities across China are also actively carrying out relevant exploration and practice. (S. C. N. University, December 8, 2021). To promote the cultivation of interdisciplinary talent, Peking University has also carried out a series of explorations and practices in terms of mechanisms and systems, including the following: 1) Thought leader: cultural soil and conceptual foundation for interdisciplinary talent cultivation; 2) Organizational support: diverse carriers and governance systems for interdisciplinary talent cultivation; and 3) Institutional guarantee: supporting support and management regulations for interdisciplinary talent training(Gong Qihuang, 2023). In 2007, they established Yuanpei College to reform undergraduate education, in which students can freely choose courses and majors throughout the university and carry out interdisciplinary project education. Tsinghua University has also made efforts to achieve innovation by providing interdisciplinary platforms and integrating multiple discipline resources. They established a leading group for interdisciplinary research and a management office for interdisciplinary research institutions at the university level and set up a special fund to promote interdisciplinary research to attract the world's top scholars and produce major international frontier academic achievements (T. University, December 16, 2017). In 2000, Zhejiang University established Zhu Kezhen College to cultivate top innovative talent following the "4+4" training model. After completing the first four years of nonmedical education, undergraduate studies will enter the next four years of medical doctor training. This “Medicine + other discipline (X)” multidisciplinary cross-composite pattern inspires students' diversified and innovative thinking with a broad academic vision, showing great potential as a clinical medical scientist in the future.

Interdisciplinary research is popular in current scientific research development and plays an important role in training innovative medical talent. We collected data on the class schedule of undergraduate stomatology at 12 universities, including Peking University, Wuhan University, Chongqing Medical University, Tongji University, Zhejiang University, Shanghai Jiao Tong University, Sichuan University, Sun Yat-sen University, Xi'an Jiaotong University, Capital Medical University, Zhengzhou University, and Qingdao University. All of them have established science subjects such as physics, chemistry, and mathematics and provide interdisciplinary subjects among majors such as psychology, computer science, evidence-based medicine, and statistics. The integration of scientific research achievements in undergraduate teaching will surely accelerate the quality of medical talent training (Abu-Zaid & Alkattan, 2013). The innovation class at Sichuan University relies on a state-level scientific research base and cross-disciplinary model to cultivate innovative undergraduate research talent. They select well-rounded research talent to set up courses with cross-disciplinary characteristics, implement a laboratory rotation project by assigning scientific research mentors, and carry out abundant academic exchange activities to cultivate research ability (X. W. Wei & Xiang, 2022). The “2+X undergraduate teaching and training” and “academic education” programs at Fudan University involve multiple development directions, including professional advancement, innovation and entrepreneurship, and interdisciplinary development (Z. Wei, 2021). Kuang Yaming College at Nanjing University has a major science education model that relies on key disciplines and connects undergraduate and graduate education, aiming to cultivate top talent with a good scientific spirit, high humanistic quality, a broad discipline foundation, and outstanding innovation ability. In the first and second academic years, students receive general education and basic science education and then choose their major in the third year to study professional courses. Tianjin University and Tianjin Medical University jointly set up an innovative talent training platform on the basis of global major medical needs, which involves the concept of deep integration of medical science engineering-related disciplines and integrates medical foundations and intelligent technology. Its goal is to cultivate medical engineering composite high-end talent with a deep mathematical foundation, comprehensive medical background knowledge, and solid clinical practice ability. Zhiyuan College of Shanghai Jiao Tong University also used a Frontier Exploration

Experiment Course to promote the independent learning ability of undergraduate students through multidisciplinary cooperation, communication and knowledge integration and discussed problems in the fields of science and engineering worldwide(Chen, 2022).

4. Discussion

4.1 Practical Necessity and Feasibility of Interdisciplinarity for Undergraduate Education

Interdisciplinary education has proven to be a powerful motivator for developing top-notch undergraduate innovators who can awaken the creativity of students and stimulate their interest in innovation. The National 14th Five-Year Plan also takes the promotion of interdisciplinary fertilization as crucial content in strengthening the development of national science and technology strategies. To promote interdisciplinary research, multidisciplinary research is widely carried out to promote the development of human society or solve the major problems that hinder the development of science. These problems often cannot be solved by a single discipline. It is necessary to apply the strengths of different disciplines to jointly solve key problems (Norton, Gerber, Fontaine, Hohner, & Koman, 2022). However, if education is limited by disciplinary classification, teaching will be limited by professional confinements, and research will be limited by disciplinary barriers. There will be a lack of cooperation and communication between teachers in different disciplines. As a result, trained students are often unable to adapt to the interdisciplinary employment environment and meet the requirements of the rapid development of emerging disciplines. In addition, it will also hamper subsequent sustainable development. The development of interdisciplinary education has advantages in overcoming professional barriers with expanded horizons and deepened knowledge, allowing them to form a sound theoretical knowledge system that combines with other disciplines in a comprehensive way of thinking. Therefore, the Ministry has cooperated with the National Health Commission to implement excellent education and training programs for physicians. The goals include adapting to the latest developments in medicine, accelerating the reform and upgrading of existing medical specialties, and optimizing the knowledge and ability structure of medical talent training. In addition, cross-integration among medicine and other disciplines, such as engineering and science, should be promoted to prospectively plan the development of emerging medicine or medical-related disciplines(T. C. P. s. G. o. t. P. s. R. o. China, September 17th, 2018).

Providing interdisciplinary education at the undergraduate level exposes students to multidisciplinary knowledge from an early age and enables them to find an appropriate study method to follow the direction for scientific research(Turner, Cotton, Morrison, & Kneale, 2022). In dentistry, the development of oral and maxillofacial surgery is a typical example of interdisciplinary development. In the 1940s, the combination of maxillofacial and oral surgery in clinical medicine produced oral and maxillofacial surgery(Lee & Chuang, 2021). In foreign countries, individuals engaging in oral and maxillofacial surgery must obtain two degrees: Doctorate of Dental Medicine (D.M. or D.D.) and Doctor of Clinical Medicine (M.D.). In recent years, scholars have also proposed emerging interdisciplinary neurostomatology, which is undoubtedly a comprehensive display of the interdisciplinary interaction of dentistry and biology. In addition, there are similar examples in the application of regenerative medicine technology, such as 1) regeneration of bone and periodontal tissue around teeth, 2) the application of 3D printing technology in the preparation of oral prostheses, 3) the utilization of new biomaterials such as bioceramics and nanomaterials in dentistry, and 4) the increasing number of emerging disciplines such as bone immunology and augmentation wisdom in dental clinical practice. All these successful cases of multidisciplinary integration have contributed significantly to the development of dentistry(Wen, Ding, & Jiang, 2024).

4.2 Analysis of the Current Status and Development Strategies for the Cross-Cultivation of Undergraduate Disciplines at the School of Stomatology of Lanzhou University

According to Qiu Weiliu, an academician of the Chinese Academy of Engineering, the development and achievements of stomatology in China are the result of the crossover and promotion of various disciplines, which is especially reflected in oral and maxillofacial surgery. The statistical results revealed that among the nearly 10,000 existing natural disciplines, more than 5,500 are more mature, 46.8% of which are interdisciplinary. Oral and maxillofacial surgery is a typical interdisciplinary discipline(Lee & Chuang, 2021). Currently, to cultivate innovative medical talent, the Ninth People's Hospital affiliated with Shanghai Jiaotong University School of Medicine focuses on basic disciplines represented by basic medical sciences and life sciences; frontier disciplines represented by precision medicine, regenerative medicine, and translational medicine; and applied science represented by stomatology and clinical medicine. On this basis, interdisciplines have been developed to promote interdisciplinary integration between basic medical sciences and clinical medicine, medical and engineering(Weiliu, 2022).

As a comprehensive university with the advantages of a large number of disciplines, including chemistry, physics, materials science and medicine, Lanzhou University has a solid foundation for the development of interdisciplinary majors and the cultivation of interdisciplinary talent. Therefore, we launched a questionnaire on interdisciplinary applications for the education of 451 undergraduate students at the School of Stomatology of Lanzhou University. The results revealed that 83.6% of the respondents believed that stomatology had a large intersection with other majors.

Moreover, 85.6% of the respondents considered that their undergraduate training programs incorporated interdisciplinary courses. Physics, chemistry, mathematics, materials science, computer science, life sciences and other disciplines were interdisciplinary courses related to stomatology that they thought had been incorporated into their undergraduate training programs. At present, although Lanzhou University has carried out active reform and exploration of the interdisciplinary training of undergraduate students, there are still a series of problems, mainly manifested in the lack of interdisciplinary majors and interdisciplinary courses, the insufficiency of interdisciplinary innovation and cooperation platforms, and the shortage of interdisciplinary faculty. In this regard, the following improvements are proposed.

Continuing to improve the arrangement of the curriculum and course selection system is needed. For example, Gillis et al reviewed 26 Canadian universities that together enroll just over 71% of all Canadian undergraduate and graduate students. Each of these universities offers interdisciplinary programs. However, many interdisciplinary undergraduate programs focus on a single broad domain or a combination of up to three domains. In these cases, students learn about each domain separately through siloed courses or longer two-semester courses that cover objectives from two disciplinary courses. Most of the graduate programs reviewed allow students to choose their own learning path, taking courses from different disciplines without additional scaffolding for synthesizing what they have learned. Such synthesis may occur while students work on their own research projects, but instructional support related to this synthesis is typically not included in graduate curricula(Gillis et al., 2017). Therefore, we need to provide basic courses for interdisciplinary education in the context of the development of disciplines, help students understand the history and prospects of interdisciplinary development, clarify the development of interdisciplinary intersections between stomatology and other disciplines, and provide help and guidance for students in the further study of interdisciplinary knowledge. In addition, on the basis of the understanding of the interdisciplinary disciplines of students, elective courses with certain credits can be arranged to enable students to study interdisciplinary knowledge in their own disciplinary fields of interest, broaden their horizons and lay a good foundation for future research in interdisciplinary fields.

The establishment of interdisciplinary cooperation is based on the faculty level and at different stages of education. Due to the limitations of the medical education system, only undergraduates or junior college students who have received medical education can become dentists after the clinical practice required by the state and obtain a qualification certificate. Moreover, medical academic colleges not only want to cultivate qualified clinicians but also have a demand for scientific research. Most current research-oriented graduate students are also clinicians, which limits the training of medical research and innovation talent. At present, there is a consensus among education and health departments that five years of medical education, coupled with three years of standardized residency training or standardized general practitioner training, will become the mainstream model for medical personnel training. Therefore, other basic disciplines should be introduced into undergraduate education, while the postgraduate training stage strengthens the connection between the School of Stomatology and several faculties, such as the School of Physical Science, the School of Technology, the School of Information Science and Engineering, the School of Chemistry and Chemical Engineering, the School of Life Science, and the School of Basic Medicine, to jointly establish a cooperative platform. On this platform, through multidisciplinary academic exchange activities, scientific research project cooperation and the establishment of interdisciplinary guidance groups are used to help dentistry students understand the basic knowledge of multiple disciplines, integrate what they have learned and improve their ability to solve problems in a multidisciplinary manner.

Interdisciplinary research provides a knowledge base for interdisciplinary education, and interdisciplinary research also requires interdisciplinary education to provide comprehensive and innovative talent. Explore interdisciplinary cooperation models at the faculty level and at different educational stages. Higher education around the world attaches importance to interdisciplinary learning, and the forms of interdisciplinary education are diverse. From 2020--2021, NUS established two interdisciplinary undergraduate colleges to provide more accessible, flexible and systematic interdisciplinary education for undergraduates. This talent development model reform has reconfigured the goals of undergraduate education, promoted the connection between interdisciplinary research and interdisciplinary education, and facilitated the integration of liberal and professional education(Singapore, 27August ,2021). Therefore, in five-year undergraduate stomatology education, the teaching mode should not be limited to traditional teaching methods but should involve interdisciplinary education. Interdisciplinary integration can overcome the constraints of the teaching system, adopt organic linkages and cross-integrate different disciplines, and require teachers of relevant majors to take lectures and truly achieve interdisciplinary teaching. Moreover, the relationship between knowledge and clinical practice should also be emphasized. The long academic system proposed by Tianjin Medical University shortens the gap between classrooms and practice, specifies the content and requirements of internships, and overcomes the drawbacks of the traditional subspecialty model, which is not conducive to cultivating students' ability to think comprehensively and analyze comprehensively(Yingchun Sun 2012).

Finally, the depth and breadth of professional theories for teachers must be enhanced due to the rapid development and renewal of interdisciplinary fields. Therefore, we should actively explore interdisciplinary research, strengthen the

training of excellent teachers, and promote the common development of scientific research and teaching. Moreover, the following requirements are proposed for teachers. 1) Teachers need to constantly learn and actively explore to improve their knowledge structure. 2) Pay attention to the latest research results and development trends in relevant fields and broaden your professional perspective. On the basis of these factors, teachers, especially young teachers, should be encouraged to actively participate in interdisciplinary research and relevant research projects to promote the common progress of interdisciplinary research and teaching.

5. Conclusions

The majority of the respondents thought that there was substantial crossover between dentistry and other majors, which mainly included literature, mathematics, law, materials science, biomedical engineering, chemistry, physics, life science, and computer science. Nearly all respondents believe that interdisciplinary knowledge is beneficial in the scientific study of their discipline, and they strongly desire to study cross-disciplinary subjects. Most of the students thought that their undergraduate training programmes involved cross-disciplinary courses. To build modern educational power, China's Ministry of Education launched the "Double First-class" talent training construction project. Promoting the cross-fertilization of disciplines, developing cross-disciplines, and cultivating complex talent are the development goals of building first-class universities. In the undergraduate education stage of dentistry, a cross-disciplinary integration education program is carried out to cultivate cross-disciplinary innovative talent in dentistry to meet the needs of social development—comprehensive and technical talent. Cross-disciplinary research is highly important for talent cultivation, and it is important to explore cross-disciplinary dental talent cultivation at home and abroad to create a system program for cultivating comprehensive talent. The effective use of relevant resources and the active implementation of the exploration of the resulting program are the top priorities.

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Authors contributions

PZ and RZ contributed to the design of the study and critically revised the manuscript; PZ and ZJG contributed to the draft of the manuscript; and ZJG, RST and YL designed and collected the questionnaires. CGW conducted the questionnaire; ZJG, HXH, YLW and TM contributed to performing the statistical analysis and interpreting the results. All the authors have read and approved the article and have done their due diligence to ensure the integrity of the manuscript.

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Competing interests

Not applicable.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Redfame Publishing.

The journal’s policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

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The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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