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The application of multidisciplinary team combined flipped classroom teaching model in oral general course for clinical undergraduates

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Abstract

Background Oral general course (OGC) is a basic subject of medical education. The implementation of multidisciplinary team (MDT) meets the individual needs of patients. Based on the concept of MDT, this study combined the theory and practice of flipped classroom teaching method to evaluate the teaching effect, so as to provide a basis and reference for the thinking transformation of medical students to clinicians.

Methods The participants of the study were 760 clinical undergraduates in OGC training in Hainan Medical University from 2021 to 2023. A total of 760 students were divided into a control group and an observation group of 380 cases, each using the random number table method. The control group used traditional teaching methods, the observation group adopted the MDT combined with flipped classroom teaching model and organized dental postgraduates team to participate in the teaching task. A unified assessment of the teaching outcomes was conducted after 1 semester study duration.

Results The basic theory, independent learning ability and case analysis scores of the observation group were higher than those in the control group, and the differences were statistically significant ($P < 0.05$). Except there was no statistically significant difference in literature searching ability between the two groups ($P > 0.05$), the other indicators of teaching satisfaction in the observation group were higher than those in the control group, and the difference was statistically significant ($P < 0.05$). The postgraduates team gave relatively good feedback to the MDT combined flipped classroom teaching model.

Conclusion MDT combined flipped classroom teaching model had outstanding effect in OGC, this student-centered teaching method was a beneficial supplement to their clinical thinking and practical ability, and worth further promotion.

Trial registration Not applicable.

Keywords Multidisciplinary team, Flipped classroom, Oral general course

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Background

In recent years, with the continuing advancement of medical technology, the connection between stomatology and other disciplines (such as internal medicine, surgery, pathology, imageology, etc.) has become increasingly closer [1]. Oral general course (OGC) is an elective course for clinical students. Similar courses carried out in the past have also achieved good results. The general education course of Oral Science significantly improved undergraduates' general knowledge of dentistry and effectively improved their oral hygiene behavior [2]. Science Popularization Education regarding Oral Health-General Health for Nonmedical Undergraduates has better teaching outcomes and is more likely to be accepted by college students [3]. In the past, case-based learning teaching method played a leading role in medical teaching, and it had significantly affected the cultivation of students' clinical thinking ability [4]. But it has the limitation of disciplinary division, it is not conducive to cultivating students' clinical system thinking, so that many studies have put forward the concept of multidisciplinary diagnosis and treatment (MDT). The proposal of MDT makes the modes of diagnosis and treatment tend to be individualized, precise, comprehensive and multi-disciplinary, which are more suitable for the individual patient, thereby effectively improving patient survival and quality of life [5, 6]. Several studies have shown positive effects of Flipped Class Model on promoting the personalized development of students' learning [7–9]. Therefor, this study combined MDT with flipped classroom to apply OGC for practical exploration, as reported below.

Methods

Study design

This was a prospective, randomized, controlled study (Fig. 1).

Participants

The participants of the study were 760 clinical undergraduates who participated in OGC in Hainan Medical University from 2021 to 2023. Random number table method was used to divide 760 students into control group and observation group with 380 students in each group. According to the questionnaire statistics (Questionnaire 1), there were 231 males and 149 females in the control group, aged 19–22(20.60 ± 1.10) years. The observation group consisted of 176 males and 204 females, aged 20–24(20.10 ± 3.50) years. The results before enrollment of the control group were (80.94 ± 9.86) and the observation group were (82.66 ± 7.62). All subjects signed an informed consent form. By comparing the general data and results before enrollment of the students in both groups, the results suggested no statistical significance ($P > 0.05$), Table 1.

Teaching content

Control group adopted the traditional teaching model

The students in the control group were randomly divided into subgroups, they consulted and discussed the data and literature of oral clinical cases published by the teachers collectively. After class, the groups summarized the diagnosis and differential diagnosis of the cases, proposed the next steps to improve imaging and other tests, treatment plans, etc., and made a slide of the discussion results for report. One team member was responsible for reporting, while the other members were responsible for adding. The teachers commented on the medical ethics, doctor-patient communication, medical history and clinical examination item collection, medical record writing, clinical problem solving steps, operation points, diagnosis and treatment results and existing problems. Students reviewed and summarized themselves after class. Duration: 1 semester.

Observation group adopted MDT combined flipped classroom teaching model

The first step: selected cases Patients with more than 3 kinds of oral diseases while intending to be clinically treated by MDT were selected as sample cases, and teachers related to the diseases were invited to participate in the explanation of these cases (Oral and maxillofacial surgery teachers were invited to participate in MDT for cases of tongue pain, tongue erosion, ulcer or mass; If the tooth had pain at night, the endodontic teachers were invited to participate in MDT).

The second step: constituted teaching team Tutor, 40 postgraduates assistants, teachers from related majors such as prosthodontic, periodontology, implantology, endodontics and other specialties were invited to form an MDT for teaching implement.

The third step: implemented teaching method 10 oral comprehensive cases were selected by the teachers and the team of dental postgraduates, and were placed on the Wisdom Tree platform three weeks before the course began (https://passport.zhihuishu.com/login?service=https://onlineservice-api.zhihuishu.com/gateway/f/v1/login/gologin), 4 of these cases were published for undergraduate students to study in advance. Students collaborated in groups to find relevant content from textbooks, literature, guidelines, and expert consensus. They summarized MDT consultation views, actively discussed and analyzed questions and diagnostic challenges, and identified unresolved problems. The postgraduates team estab-

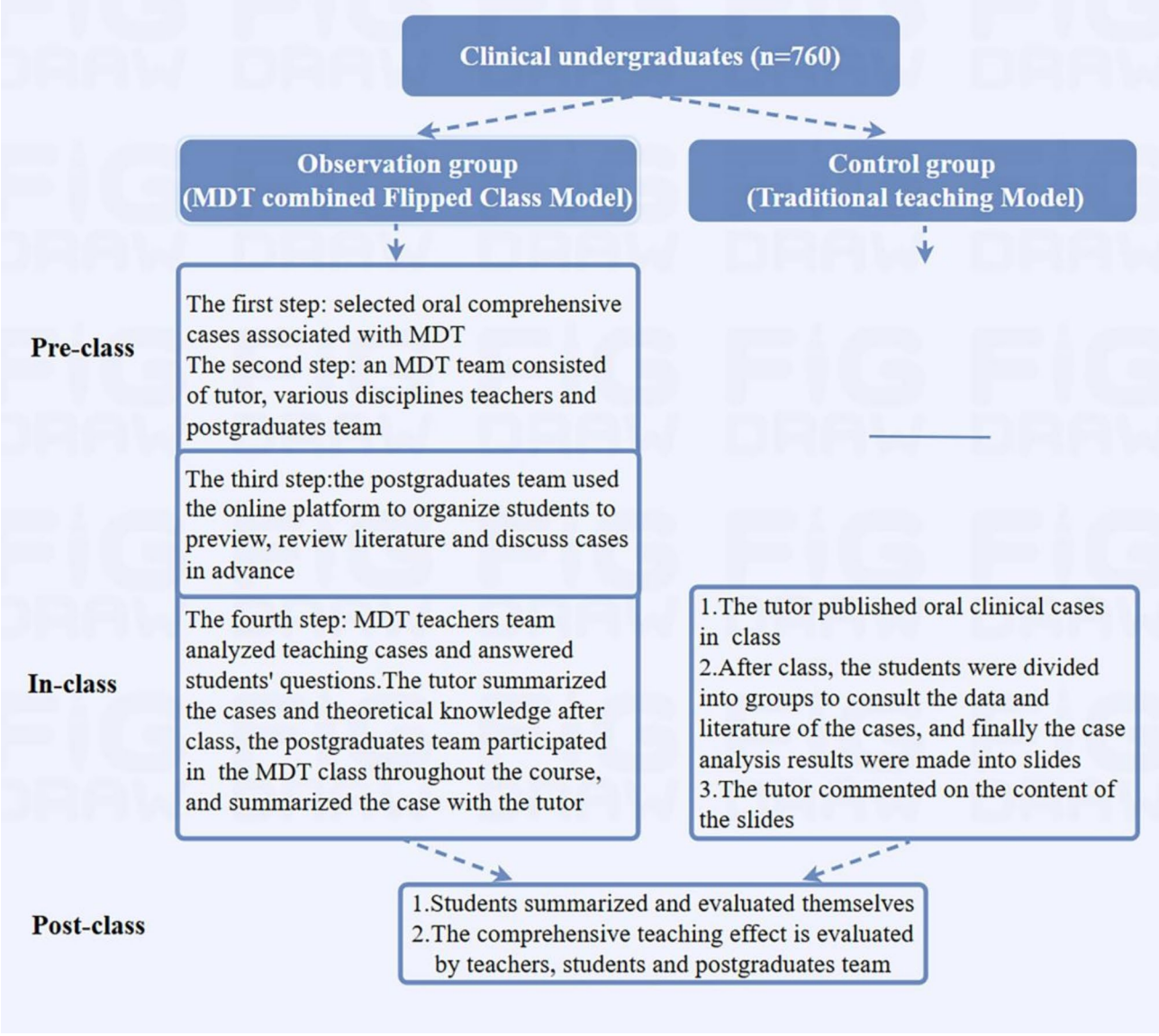

Fig. 1 Flow chart of student teaching process for two groups

Table 1 Comparison of general data between two groups of undergraduates

Group	Age	Results before enrollment
Observation group($n=380$)	(20.10 ± 3.50)	(82.66 ± 7.62)
Control group($n=380$)	(20.60 ± 1.10)	(80.94 ± 9.86)
t-value	1.927	1.952
P-value	> 0.05	> 0.05

lished a flipped classroom learning discussion group and sent out the proposed learn-related links. Undergraduates could give immediate feedback on any unclear content. The tutor and postgraduates team could log into the platform to keep track of students' self-study and problems, and actively guide and encourage undergraduates to find new problems. According to the feedback of undergraduates, further research and discussion were conducted. The postgraduates team summarized the collected data to come up with solutions, maximizing the leading role of undergraduates in the whole teaching process. Undergraduates made slides of their pre-class preparation for class presentation.

The fourth step: classroom interaction The undergraduates reported the case in groups, and the MDT put forward their own views and opinions about the case in class, such as the possibility and pros and cons of certain tooth retention, the ways of retention, the procedure, time and cost of treatment, and the key points of communication with patients. Then the teachers of each specialty analyzed the content of students' slides and pointed out the deficiencies of students' case analysis results. Finally, the teacher conducted a comprehensive case analysis and

theoretical knowledge summary, communicated with the students, and answered the questions encountered by the students. Students explained their learning experience after class to make up for the omissions in knowledge points. The postgraduates team audited the whole course and made records, and finally made a comprehensive summary and induction together with the tutor, and improved all the data of the cases and included them in the MDT database. Duration: 1 semester.

Teaching effect evaluation contents

Annual assessment results

The clinical systematic thinking ability of students was comprehensively investigated in the form of cases. Both groups of students were assessed together. The remaining 6 cases were selected. After reading the cases, the students made diagnosis and differential diagnosis according to the cases, gave the treatment plan and related treatment details, etc. Finally, the teachers scored them according to the scoring criteria. The scoring was divided into three parts: basic theory, independent learning ability and case analysis, with each part worth 100 points.

Teaching satisfaction

Questionnaire was used to evaluate the teaching effect and satisfaction of the two groups under different teaching models (Questionnaire 2). The first part included the mastery of theoretical knowledge, efficiency of course learning, effectiveness of teaching model, relevance of teaching course content to clinical needs, and the promotability of the teaching model. The second part evaluated the learning interest of oral courses, oral health thinking, doctor-patient communication ability, clinical thinking ability, comprehensive diagnosis and treatment ability, and literature consulting ability.

The postgraduates team feedback

The postgraduates team participated in the whole process of MDT combined flipped classroom teaching, listened to the explanation and analysis of oral comprehensive cases given by professional teachers, and collected the evaluation of their own gains after the teaching through questionnaires (Questionnaire 3).

Data analysis

SPSS 26.0 statistical software was used to analyze the data. Measurement data were expressed as ($\bar{x} \pm s$), and T-test was used for comparison between groups. Counting data were tested by x^2, and $P<0.05$ was considered statistically significant.

Table 2 Comparison of undergraduates assessment results

Group	Basic theory	Independent learning ability	Case analysis
Observation group ($n=380$)	(85.34 ± 5.45)	(88.38 ± 3.22)	(86.39 ± 7.62)
Control group ($n=380$)	(80.70 ± 7.81)	(86.93 ± 2.57)	(81.65 ± 8.64)
t-value	9.49	6.86	8.02
P-value	< 0.05	< 0.05	< 0.05

Table 3 Results of MANOVA

Group		F	*P*-value
Observation group	Basic theory	3.47	< 0.05
	Independent learning ability	3.76	< 0.05
	Case analysis	3.14	< 0.05
Control group	Basic theory	6.34	< 0.05
	Independent learning ability	7.53	< 0.05
	Case analysis	6.89	< 0.05
Observation group ×Control group	Basic theory	4.89	< 0.05
	Independent learning ability	5.19	< 0.05
	Case analysis	5.33	< 0.05

Results

Reliability and validity analysis of the questionnaire

The reliability and validity of the questionnaire was analyzed using SPSS 26.0 statistical software before analyzing the questionnaire data. The results of the reliability test showed that the Cronbach's α values of the questionnaires used in this study were all > 0.7, which meets the statistical requirements and has a certain degree of reliability. The KMO coefficient was 0.916,between 0.9 and 1.0 and the Sig. value of Bartlett's test of sphericity was 0,less than 0.05, which indicated that the validity of the questionnaire was good and the results of the questionnaire were scientifically valid.

Annual assessment results

The basic theory, independent learning ability and case analysis scores of the observation group were higher than those of the control group, with statistical significance ($P<0.05$), Tables 2 and 3.

Teaching satisfaction

Except there was no statistically significant difference in literature searching ability between the two groups ($P>0.05$), the other indicators of teaching satisfaction in the observation group were higher than the control group, and the difference was statistically significant ($P<0.05$), Table 4.

The postgraduates team feedback

The feedback from the postgraduates team was generally satisfied with the MDT combined flipped classroom teaching model, Table 5.

Table 4 Comparison of teaching satisfaction results of undergraduates

Indicators	Observation group ($n=380$)	Control group ($n=380$)	x^2	*P*
Part one				
Mastery of theoretical knowledge	335(88.15%)	309(81.31%)	6.87	< 0.05
The high efficiency of course learning	327(86.05%)	301(79.21%)	6.19	< 0.05
The reasonable teaching model	362(95.26%)	340(89.47%)	9.03	< 0.05
The course content meets the clinical needs	369(97.10%)	343(90.26%)	15.03	< 0.05
The teaching model is worth promoting	358(94.21%)	333(87.63%)	9.96	< 0.05
Part two				
The learning interest of oral courses	369(97.10%)	347(91.31%)	11.67	< 0.05
Oral health thinking	362(95.26%)	339(89.21%)	9.72	< 0.05
Doctor-patient communication ability	365(96.05%)	344(90.52%)	9.26	< 0.05
Clinical thinking ability	368(96.84%)	345(90.78%)	11.99	< 0.05
Comprehensive diagnosis and treatment ability	360(94.73%)	336(88.42%)	10.71	< 0.05
Literature consulting ability	369(97.10%)	358(94.21%)	3.83	> 0.05

Table 5 Feedback from the postgraduates team on the MDT combined flipped classroom teaching model

Questions		Frequency	Percent
Do you think MDT combined flipped classroom mode is interesting?	A. Interesting	33	82.50%
	B. Common	7	17.50%
	C. Boring	0	0.00%
Are you satisfied with the MDT combined flipped classroom teaching model?	A. Satisfied	37	92.50%
	B. Common	3	7.50%
	C. Dissatisfied	0	0.00%
Do you think MDT combined flipped classroom teaching model improve your clinical system thinking?	A. So much	33	82.50%
	B. A little	6	15.00%
	C. No sense	1	2.50%
Do you think participated in MDT combined flipped classroom teaching model will improve your teaching ability in the future?	A. So much	35	87.50%
	B. A little	3	7.50%
	C. No sense	2	5.00%
Do you think it is necessary to apply MDT combined flipped classroom teaching model in your professional assessment?	A. Necessary	34	85.00%
	B. Unnecessary	6	15.00%
	C. No sense	0	0.00%
Is it helpful for you to fully carry out MDT in clinical practice through MDT combined flipped classroom teaching model?	A. So much	36	90.00%
	B. A little	4	10.00%
	C. No sense	0	0.00%

Discussion

At present, teaching is mostly carried out in the form of special lectures, so that many students lack the ability to analyze clinical diseases in a holistic and comprehensive way, which affects clinical practice and medical quality [10]. Therefore, the cultivation of multidisciplinary diagnosis and treatment type of clinical thinking should be implemented gradually and carried out in the undergraduates training of medical students [11]. In view of the above requirements, under the guidance of teachers who are of various dental specialties, this study conducted simulated MDT training for clinical undergraduates based on the OGC.

As an emerging teaching model, the flipped classroom advocates a student-centered teaching method by means of network and information technology, which is carefully planned and designed according to specific teaching objectives and teaching contents [12]. The integration of the teaching design with the BOPPPS teaching model significantly improved the academic performance and critical thinking skills of students [13]. In order to further improve the service level of hospital medical quality and the medical experience of patients, the affiliated hospital of our university has established an MDT discussion mechanism. The implementation of MDT diagnosis and treatment model in the medical education stage can provide a good general medicine learning platform for medical student, and lay a good foundation for improving the efficiency of clinical disease diagnosis and treatment [14, 15]. The research shows that MDT model can improve the assessment results and the overall teaching satisfaction in teaching [16]. The combination of the MDT mode and flipped classroom teaching method can improve clinical teaching effects of internship students in terms of pediatric obstructive sleep apnea [17]. The complexity of diseases requires the development of MDT training

model during medical education, so as to improve the graduates' in-depth knowledge in the practice during the diagnosis and treatment of diseases [18]. The combination of flipped classroom and online learning could result in higher academic performance [19]. In addition, the design and implementation of the flipped classroom method significantly enhanced students' learning motivation, academic performance, and supported the achievement of curriculum objectives [20–22]. In this study, through the evaluation of outcomes from two teaching methods, the basic theory score (85.340 ± 5.45) of the observation group was higher than that of the control group (80.70 ± 7.81), independent learning ability (88.38 ± 3.22) of the observation group was slightly higher than that of the control group (86.93 ± 2.57), and the case analysis score (86.39 ± 7.62) of the observation group was significantly higher than that of the control group (81.65 ± 8.64), the results were all statistically significant ($P < 0.05$). Compared with traditional theoretical teaching, flipped classroom has a positive impact on students' motivation and strategies for deep learning, which is conducive to students' long-term development [23].

Standardized resident physician training is the first compulsory stage in the education of clinical medical students. The flipped classroom teaching method based on MDT teaching concept could be combined with the clinical teaching needs of standardized training for residents of various specialties and the actual situation at the present stage in order to establish standardized and personalized treatment concepts for students, and cultivate their all-round and multi-dimensional comprehensive clinical ability [15, 24]. In this study, the teaching satisfaction of the observation group was higher than that of the control group ($P < 0.05$), but there was no significant difference between the two groups of students in literature searching ability ($P > 0.05$), perhaps both groups of teaching models required students to consult literature to solve classroom tasks, and their ability to consult literature was exercised in this process. The transition between health care providers plays a crucial role, and interdisciplinary education can break down the disciplinary island [25–27]. Interdisciplinary curriculum is an important embodiment of interdisciplinary education, and the research of interdisciplinary education has been carried out in many disciplines, reflecting the importance and feasibility of this method [28, 29]. The implementation of OGC among clinical students could play an interdisciplinary role in education and achieve good results. The proportion of people interested in learning oral courses in the observation group (97.10%) was higher than that in the control group (91.31%), and the number of people with oral health thinking in the observation group (95.26%) was higher than that in the control group (89.21%), the differences were statistically significant ($P < 0.05$). Therefore, MDT combined flipped classroom concept will not only play a positive role in all aspects of disease prevention guidance and diagnosis and treatments, providing patients with a more "personalized" treatment plans, but also achieve better results in the design of interdisciplinary medical education.

The participation of the postgraduates team in MDT combined with flipped classroom teaching could not only improve their teaching competency, but also consolidate their clinical thinking and improve their expression ability in the teaching process [30]. Full participation in the multidisciplinary diagnosis and treatment class helps them extend beyond the thinking and diagnosis and treatment of oral diseases, laying a strong foundation for their future long-term careers [31]. Through the research and analysis, the postgraduates team had a good feedback on MDT combined with flipped classroom teaching mode 82.50% of the postgraduates thought the MDT combined with flipped classroom teaching model was interesting and 92.50% were satisfied with the teaching effect of the model. 82.50% and 87.50% respectively believed that this teaching mode had greatly improved their clinical system thinking and their own teaching ability, 85.00% thought that this teaching mode was necessary to be applied in their professional assessment, and 90.00% considered that it was helpful to fully carry out multidisciplinary diagnosis and treatment in clinical practice. Therefore, MDT combined flipped classroom teaching courses could improve students' comprehensive ability to deal with problems, fully analyze clinical cases, and enhanced the accuracy of disease diagnosis and treatment [32]。.

Hereafter the reform of OGC should consider multiple scenarios to provide medical or non-medical students with comprehensive and easy-to-understand dental health information. There are several limitations that must be acknowledged with this study. A pilot study at a single institution limits it's generalizability, there remains the possibility of subjectivity in students' choices during the research process, which may affect the identified themes. Future mixed methods studies should focus on the diversity of research units and reduce the subjectivity of students' choice in research design.

Conclusion

This study found that MDT combined flipped classroom teaching model has many advantages. Compared with traditional teaching methods, MDT combined flipped classroom teaching model could effectively improve students' basic theoretical knowledge reserve, independent learning ability and case analysis ability, and also improved students' oral knowledge acquisition and clinical comprehensive ability. In addition, it could also allow the postgraduates to get enough exercise and obtain

more comprehensive clinical knowledge in the process of teaching. Therefore, on the basis of traditional teaching mode, we are supposed to actively integrate new ideas and methods, give full play to the advantages of different teaching methods in order to continuously improve teaching efficiency and quality.

Abbreviations

OGC Oral general course
MDT Multidisciplinary team

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12909-024-06632-3.

Supplementary Material 1

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None.

Author contributions

Zhu-Ling Guo conceived and designed the review. Xue-Jing Lin and Qing Yuan collected the published articles. Zhu-Ling Guo acquired funding. Xue-Jing Lin and Diwas Sunchuri drafted the manuscript. Jie Zhou and Yu-Lei Dong contributed to analysed the data of the study. All authors have read and approved the manuscript.

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Data availability

Data is provided within the manuscript or supplementary information files.

Declarations

Ethics approval and consent to participate

Ethical approval for this study was obtained from the Ethics Committee of School Stomatology of Hainan Medical University. All methods were performed in accordance with the relevant guidelines and regulations. Informed consent was obtained from all subjects involved in this study. This study adhered to the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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