



Study on the use of MOOC among Students of stomatology in Southwest of China During the Outbreak of COVID-19

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ABSTRACT

Abstract Objectives The project plans to investigate the situation of MOOC online teaching and use among stomatology students and faculty in Southwest China during the outbreak of COVID-19 epidemic to facilitate the application and improvement of oral related courses in the future.

Design online survey, examination papers.

Main outcome measures RE-AIM and Kirkpatrick models will be utilized by research group to evaluate the use of oral related courses, including pre-course knowledge mastery, post-course knowledge mastery, perceptions and purpose achievement, etc. All students will complete 5-month stomatology-related courses and receive research and interviews to obtain objective evaluation and subjective feelings. Feedback and advice on the course content related and how it can be improved.

Participants Senior undergraduates of School of Stomatology in medical university of Southwest China.

Results 420 students of stomatology schools across 5 medical universities responded. Degree of course completion and time spent on courses are the influencing factors of examination grades on behalf of objective performance. Overall evaluation of the MOOC was higher than expected and the effect was better than expected. The main advantages of MOOCs appeared to be the decrease of tripping outside (n=368), reduced risk of infection (n=326), resource diversity (n=246), ability of learning at their own paces (n=301). On the other hand, students stated that, lack of group discussion (n=324), the possibility of internet disconnection (n=287), anxiety (n=246), lack of clinical practice (n=143), unfamiliarity with MOOCs (n=175) are barriers to get MOOCs.

Conclusions During the outbreak of COVID-19 epidemic, stomatology students and teachers of universities in southwest China had high evaluation of MOOC usage, improved both objective and subjective learning results, and gave effective feedback. Definitely, MOOC provides more and more help to students of stomatology schools and plays a more important role than ever in the teaching process of teachers of stomatology schools.

1. Introduction

In December 2019, an outbreak of pneumonia caused by the novel coronavirus (2019-nCoV) occurred in Wuhan, Hubei Province, which was afterwards named COVID-19 (coronavirus disease) by the World Health Organization (WHO) (WHO, 2020). On 30th January, 2020, WHO issued a statement declaring it a public health emergency of global concern (FutureLearn, 2015). Due to the impact of the epidemic and the intense infectivity of the virus, universities across the country postponed the opening time of spring 2020, and universities in southwest China were compelled to adopt online teaching recording and live broadcasting (Ma, 2020). Therefore, some online course learning platforms played a key role in teaching methods of universities, especially MOOC courses (Lu, Liu, Zhu, & Zhang, 2020), which were widely used and involve courses suitable for stomatology students in universities around the world.

MOOCs (Massive Open Online Courses) are large-scale

network open courses (abbreviated with MOOC). MOOC is a new teaching model, brought in as the outcome of Internet technology and the era of big data. With the booming development of MOOC in China, a large number of local Chinese MOOC platforms have sprung up (Zhang, & Cheng, 2021), such as China University MOOC platform, School Online, Superstar Live Broadcast, Rain Class, Tencent, Ding Talk, WeChat, QQ and Blue Ink Cloud Class7. Prominent development of educational online platforms indicated that the impact of MOOC on universities around the world should not be underestimated. MOOCs are widely utilized in a variety of rapidly developing countries such as the US, Australia and Britain8. Coronavirus related medical MOOCs are now available in the UK 9, students spent an average of 4 to 6 hours per week using online teaching platforms, using a combination of video tutorials (27.71%).

Massive online medical healthcare education curriculum is

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now being popularized, content of stomatology teaching related to Oral Anatomy and Physiology, Oral Histopathology, Odontostomatology, Periodontology, Orthodontology, Prosthodontology and so on, are designed by well-known teachers from countries all over the world. Live courses, extracurricular group learning, tests and exams were made to ensure the course content quality and diversify the teaching style. Even online virtual patient scenario courses and online application of Root Canal Therapy have received positive feedback (Han, Wang, Shao, Ma, & Yang, 2021). Some students thought the main advantages of online teaching appeared to be that it saves students time on travelling (19.82%), provides flexibility (19.52%) and so on.

The courses applied in the research are all to be indispensable assessment contents of stomatology students in job hunting and further study (Jia, Ji, Liang, Liu, Lu, & Xing, 2021). We will discuss with teachers of medical universities in southwest China, according to the degree of knowledge coverage, suitability, credibility and novelty, in order to work out an appropriate course schedule, and provide sufficient learning resources, post-course tests and examination papers. Post-course tests and examination papers will be obtained from the local professional physician examination questions, the extracurricular learning resources and postgraduate examination questions of School of Stomatology, Sichuan University.

A five-month study will be implemented among the senior students. Before learning the series of courses, changes of objective and subjective knowledge mastery were evaluated. Objective investigations were comprised of exams of different subjects and surveys before using MOOC, while subjective investigations constituted of self-evaluation of knowledge mastery, in both of which the RE-AIM and Kirkpatrick models (commonly used to evaluate training courses and interventions) template were used. Immediately after the completion of the study, attendance and assignments accuracy were ought to be collected. After one month of taking these courses, the examination papers of each subject, post-course surveys, and the self-evaluation of the degree of knowledge mastery is to be examined. Post-course feedback and suggestions (immediate and 1-month follow-up) from the MOOC users were collected finally.

During the epidemic, demands for doctors increased dramatically, so necessity of refining education quality of medical students rose up (General Medical Council, 2020). MOOC provided a suitable online learning platform for medical students during the COVID-19 period, involving a large number of high-quality learning materials from famous universities at home and abroad to meet the learning needs of medical students at different degrees (Berman, Biguet, Sathakarou, westin-Hagglof, Jeding, McGrath, Zary, & Kononowicz, 2017). During the COVID-19, in order to ensure the safety of teachers and students and facilitate teaching procedures, online courses became a significant part of medical education, so as to stomatology. Surveys of MOOC courses using on stomatology in southwest China universities during COVID-19 were aimed to explore the impact and contribution of MOOC to stomatology students learning, and promotion of teaching efficiency. These surveys were designed to boost the development of MOOC, and improve the medical education quality.

2. Methods and analysis

2.1 MOOC development and delivery

The whole learning courses will be staged on the MOOC platform, comprising of live broadcasts online, recordings and playbacks, tutorial discussions, assignments, stomatology related basic medical theory, clinical practice and key questions will be integrated into the teaching courses by lecturers, for instance, Oral Anatomy and Physiology from Xi'an Jiaotong university, Oral Histopathology from Zhejiang university, Odontostomatology from Xi'an Jiaotong university, Periodontology from Shandong university, Orthodontology from Xi'an Jiaotong university, Prosthodontology from Peking university, and Implantodontics from Xi'an Jiaotong university. Teachers and lecturers are highly authoritative and

influential around the world. Details can be seen in the MOOC platform.

These learning courses, which are available to everyone on MOOC platform, required students to spend about 4 hours per day during weekdays. After each course, the teachers will distribute their personal assignments and the group presentations according to the courses content. Moreover, varieties of extracurriculum learning resources are provided, including short videos, relevant literature, clinical shared experience, etc. Students are able to ask questions in the chat areas of the live courses, and give feedbacks in the comment sections. An extra live broadcast ought to be in progress every week, in which students' questions would be pooled and answered, and feedback would be sorted out to improve the quality of courses.

2.2 Study design

Based on the research of Sian K Smith-Lickess et al (Sandhu, & de Wolf, 2020), we use a series of methods used in their articles for research and evaluation. We used part of RE-AIM and Kirkpatrick models' dimensions for the design of research and interview Q&A. RE-AIM includes Reach (participation rate within the target audience and participant characteristics), Efficacy (short-term impact of the intervention on key outcomes), Adoption (workplaces adopting the intervention), Implementation (extent to which the intervention is implemented in the real-world) and Maintenance (extent to which the program is sustained over time), in which Adoption and Implementation will not be used because of the certain irrelevances. Three dimensions from the Kirkpatrick model were used to evaluate the MOOC, which were reaction, learning and behavior. Details can be seen in Figure 1.

2.3 Study participants and recruitment procedure

In March, 2020, all 420 senior undergraduates of School of Stomatology in medical university of Southwest China were arranged to take courses, tests and exams by the teachers with excellent teaching experiences of surveyed teaching and research offices of Oral Anatomy and Physiology, Oral Histopathology, Stomatology, Orthodontics, Endodontics, Periodontology, Oral Mucousology, Oral Implant selected in digital teaching. After completion of MOOC courses, teaching resources could be learned by students on their own initiative without Q&A live broadcasts and the accumulations of learning duration. We chose the grade of participants in terms of the medical knowledge basis of senior students, because only senior students in medical universities of southwest China have accepted some required clinical medical courses (Vallee, 2017), including System Anatomy, Physiology, Biochemistry, before the corresponding training by MOOC courses. Senior students has established a certain medical knowledge foundation and formed relevant thinking system, facilitating the process of deepening the understanding of expertise in stomatology. Therefore, surveys were not applied to other grades of participants.

We will conduct corresponding questionnaires and interviews with 1,400 participants before, immediately after and 1 month after their use of MOOC, and collect their feedbacks and suggestions on stomatology-related courses.

2.4 Data collection

Figure 1 provides an overview of the different measures in accordance with the RE-AIM and Kirkpatrick models, and when they will be assessed (pre-MOOC, post-MOOC or 1-month post-MOOC). Subjective knowledge about stomatology was assessed using a multiple-choice test to acquire the changes in attitudes, confidence and capabilities, with a ranked scale of 5 (totally agree) to 1 (not agree). Objective knowledge about stomatology was estimated through exam papers, in which each question had five possible answers with one answer correct, in order to measure core knowledge and understanding of expertise in stomatology. The objective examination papers of knowledge evaluation are arranged and used

by the teachers of the major universities according to the examination questions of local occupational physician examinations,

the postgraduate examinations of School of Stomatology, Sichuan University and the extracurricular learning resources.

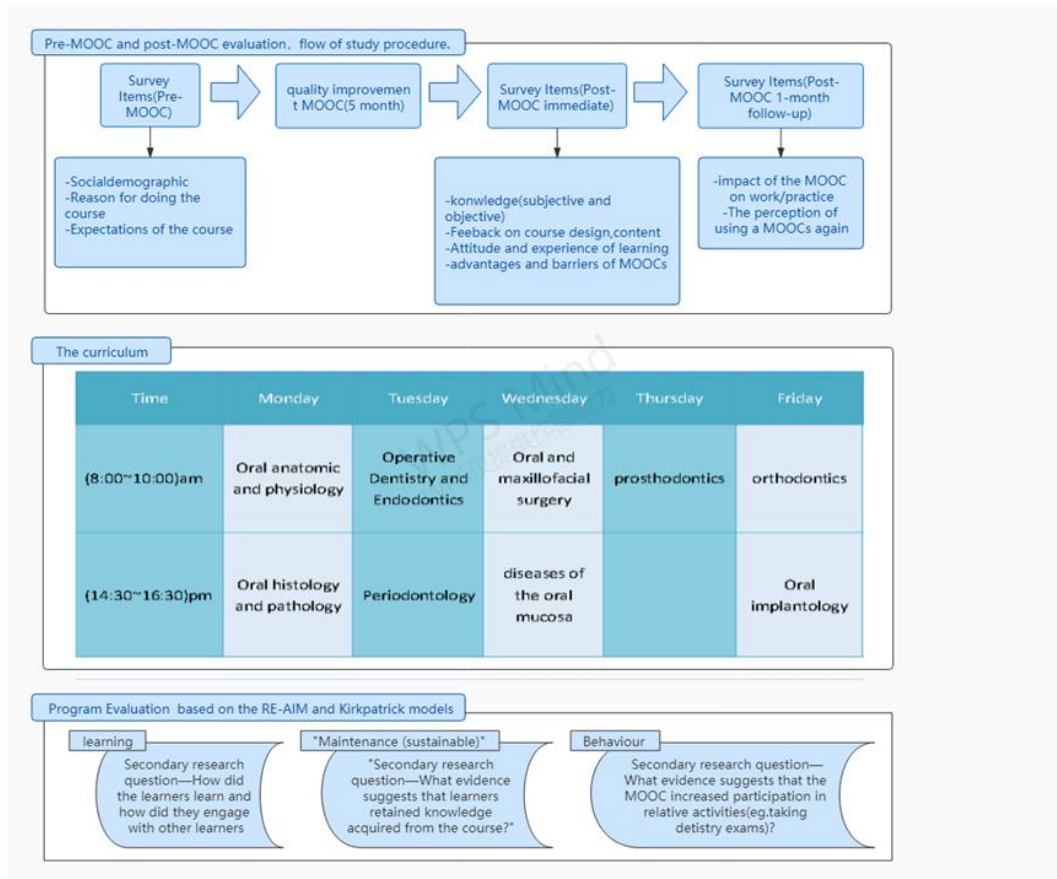


Fig. 1. A flow chart outlining the data collection procedures and items, curriculum

2.5 Data Analysis

Data was exported from Qualtrics to Microsoft Excel (Excel V.16.29, 2019). Both Qualtrics and GraphPad Prism (Prism V.8.2.1, 2019) were used to generate graphs and analyze descriptive statistics of survey responses. While Spss25,0 is used to generate data, and chi-square test is used to compare the relationship between objective performance and Course Completion level and average daily learning time. Paired t test and Spearman's rho correlations are used to describe the Pre - MOOC, Post - MOOC immediate and Post-MOOC 1-the month Follow-up: The difference and correlation of relevant responses at three time points.

Of the 420 responses collected, 48.1% (n=202) of respondents were men and 51.9% (n=218) were women. We collected responses from senior medical students of 5 medical schools in southwest China (Table 1). The response rates cannot be calculated because the survey distribution cannot be tracked. However, non-response bias was minimized by ensuring that a variety of medical students shared the survey across a variety of platforms.

Before students takes MOOC, students scored their experiences of online compared with face-to-face teaching to be lower, with an average of 2.71 scored for the question that whether they feel that online teaching is as effective as face-to-face teaching at pre-MOOC, and 3.617 for that at post-MOOC immediately.

From the perspective of learning, most of the participants

completed the course, and only a few did not (Table2). The objective scores of all the students who completed the course were high; on the contrary, the scores of those who did not complete the course were only around the pass line. Through chi-square test and Spearman's rho correlations ($\chi^2=166.126, P<0.001; rs=0.542, P<0.001$), it is concluded that the two are correlated, which is to say the degree of course completion is the influencing factor of objective performance. Moreover, with the improvement of the completion rates, the performance will also be promoted.

In terms of daily learning duration, the average daily learning duration of most students was 2-4h and 4-6h, and the scores of most participants were in the range of 70 to 90 (Table3). Chi-square test and Spearman's rho correlations ($\chi^2=241.089, P<0.001; rs=0.603, P<0.001$) showed that time spent on courses was also correlated with objective scores, and objective scores would increase with the increase of average daily learning duration.

As for the MOOC itself, before and after the using the MOOC, students' evaluation of the questions related to the MOOC was higher than before the use of the MOOC, indicating that the overall evaluation of the MOOC was higher than expected and the effect was better than expected (Table4). As for students' responses to follow-up questions such as application of clinical practice and whether to use MOOCs again, students' responses showed that MOOCs improvement had a stable effect on follow-up.

Table 1 A table outlining the demographics (Gender, Age and university) of students responding to the survey (n=420)

Demographic	Proportion of students,%(n)	
Gender	Male	48.1(202)

	Female	51.9(218)
Age	20years old	0.71(3)
	21 years old	5.48(23)
	22 years old	72.86(306)
	23 years old	20.95(88)
University	The Southwest Medical University	22.86(96)
	Sichuan university	21.91(92)
	Chongqing Medical University	18.57(78)
	Kunming Medical University	16.90(71)
	Guizhou Medical University	19.76(83)

Table 2 The relationship between Objective performance and Course Completion level

		Course Completion level/%				total
		100%	50%	<50%	0	
Objective performance/ point	90	43	2	0	0	45
	80~89	70	28	1	0	99
	70~79	59	59	9	0	127
	60~69	19	55	34	1	109
	60	7	10	5	18	40
	total	198	154	49	19	420

$\chi^2=166.126$, Spearman's rho correlations, $r_s=0.542$, $P<0.001$.

Table 3 The relationship between Objective performance and average daily learning time(weekdays)

		Average daily learning time(weekdays)/h				total
		>6h	4-6h	2-4h	<2h	
Objective performance/ point	90	22	20	3	0	45
	80~89	8	40	47	4	99
	70~79	7	56	49	15	127
	60~69	3	9	53	44	109
	60	0	0	11	29	40
	total	40	125	163	92	420

$\chi^2=241.089$, Spearman's rho correlations, $r_s=0.603$, $P<0.001$.

Table 4 A table displaying students' perceptions on their experiences of MOOCs, and A, B and C stand for pre-MOOC, post-MOOC immediate and post-MOOC 1-month follow-up, ranked on a Likert scale from 1 to 5, where 1=strongly disagree and 5=strongly agree. Likert scores have been shown as mean±SD and t(p)

Question	Mean			±SD			t(p)	
	A	B	C	A	B	C	A-B	B-C
I can get a great result from the exam.	2.85	3.519	2.624	1.357	1.181	1.306	10.228 ($p<0.001$)	15.09 ($p<0.001$)
I have the confidence to complete the courses.	3.083	2.671	-	1.253	1.113	-	6.302($p<0.001$)	-
I will be quite satisfied with the learning experience.	2.862	3.66	-	1.272	1.152	-	12.667 ($p<0.001$)	-
I think the courses will be quite useful.	2.895	3.769	3.757	1.247	1.125	1.12	13.347($p<0.001$)	0.620 ($p=0.530>0.5$)
I feel that online teaching is as effective as face-to-face teaching.	2.71	3.617	-	1.25	1.096	-	13.476 ($p<0.001$)	-
The teachers are well prepared for the teaching sessions.	2.681	3.581	-	1.262	1.097	-	13.186 ($p<0.001$)	-
I will enjoy the benefits brought by cooperative activities.	2.781	3.557	3.543	1.266	1.12	1.191	11.477	0.489 ($p=0.625>0.5$)
I have the confidence to get perfect results from future exams/design a perfect treatment plan for a patient.	-	3.633	3.629	-	1.092	1.148	-	0.165 ($p=0.869>0.5$)
I will use MOOC again when it is necessary.	-	3.559	3.538	-	1.099	1.213	-	0.479 ($p=0.632>0.5$)

The main advantages of MOOCs appeared to be the decrease of tripping outside (n=368), reduced risk of infection (n=326), resource diversity (n=246), ability of learning at their own paces (n=301) (figure 2A). A few people(n=85)also recommend that MOOC helps students use time efficiently, or allows more time for students to focus on preparing for clinical placements.

On the other hand, students stated that, lack of group discussion (n=324), the possibility of internet disconnection (n=287), anxiety (n=246), lack of clinical practice (n=143), unfamiliarity with MOOCs (n=175) are barriers to get MOOCs (figure 2B). Fewer students (n=58) believed lack of motivation, difficulty concentrating on courses as further limitations to the development of MOOC.

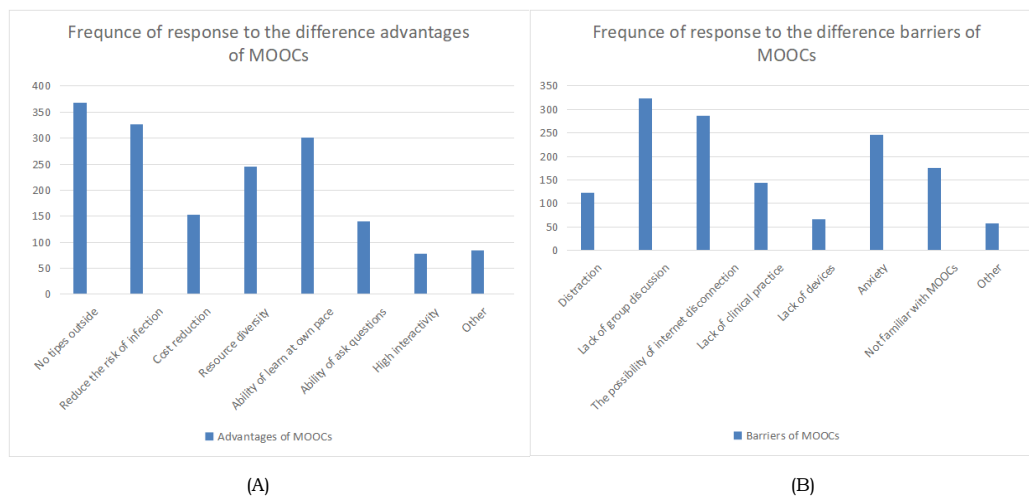


Fig. 2 A bar chart outlining the advantages and barriers of MOOCs. (A) Students were provided with a list of possible benefits of MOOCs and they were also given the options to input their own statements (n=420). (B) Students were provided with a list of potential barriers of MOOCs and they were also given the options to input their own statements (n=420).

3. DISCUSSION

3.1 Background

In the context of COVID-19, universities delayed the opening time to ensure the safety of teachers and students in universities across the country (Liu, Ding, Tian, Jing, Mao, Li, Yang, & Wang, 2020). However, professional medical education processes should not be affected adversely (Blakemore LM, Meek SEM, Marks LK. 2020). In order to keep the standards of stomatology undergraduate education and contribute to students' ambitions for further studies, professional doctor qualification as well as clinical career promotion, online network teaching has developed as an important class model, including MOOC used in all over the world, and enjoys a high reputation (Jia, Zhao, & Sun. 2021). The series of MOOC courses included in this survey are compulsory courses for students of stomatology department in medical universities in Southwest China (Rondon, Sassi, & Furquim de Andrade. 2013), which play a crucial role in the future career, and are conducive to pursuing advanced studies.

The research form was divided into three parts as different time points respectively (Table 4), which included pre-MOOCs, post-MOOC immediate and post-MOOC 1-month follow-up, referring to the relevant evaluation dimensions of RE-AIM and Kirkpatrick models. There were overlaps at different time points in the survey questions, and the participants made responses to the same or similar questions at different time points. Discrepancies were observed in results of participants' different responses to the same questions at different time points, indicating the changes of attitudes, ideas or capabilities of participants before and after receiving the MOOC courses. The other reason might be that the participants held new views on the applicability of the courses after a period of training by these courses.

When it was mentioned whether they were capable of acquiring good results from the tests designed by the research group, before the courses, a majority of the participants considered that they were unable to acquire excellent grades, which might be resulted from the high degree of professionalism of the test papers and the fact that the participants had not studied relevant courses. But immediately after learning, most of the participants were confident that it was more likely to acquire favorable grades for them, probably on the account that the participants had learned stomatology-related course systematically, watched the teachers' live courses, video recordings and extracurricular supplementary teaching resources and completed post-course assignments, which were conducive to better command of knowledge (Representatives of the STARSurg

Collaborative, EuroSurg Collaborative, and TASMAN Collaborative. 2020). One month after completion of MOOC, some participants became less confident about their capabilities, which may be related to their failure to continue reviewing these courses. It should be mentioned that one month after the courses completion, students' confidence was still at a higher level than that before taking the courses, proving that the efficiency of the MOOC courses has certain timeliness (Huddart, Hirniak, Sethi, Hayer, Dibblin, Meghna, Ehsaanuz, Jenkins, Hueso, & Sethi. 2020). As a consequence, students should be willing to learn on their own, to review in time and to consolidate knowledge when there is no curriculum arrangement.

When referred to whether the courses could be accomplished, most of the participants thought they could make it before the beginning of MOOC, reflecting the participants' trust in MOOC platform and the affirmation of their own learning attitudes (Rose. 2020). After the completion of MOOC, the number of participants actually finishing the course was less than expected, but there was still a majority of them accomplishing the MOOC courses, which indicated that some deficiencies were found in MOOC or participants were reluctant to continue to complete these courses for variable reasons, such as having acquired a better learning platform, being unfamiliar with online teaching (Longhurst, Stone, Duloherly, Scully, Campbell, & Smith. 2020), other occupations or dissatisfaction with teaching content (Kearney, Premaraj, Smith, Olson, Williamson, & Romanos. 2016).

When asked about the question that whether students were satisfied with MOOC, before taking MOOC courses, some participants thought that the MOOC courses were great, yet a considerable number of students thought that MOOC learning were not satisfying. Immediately after the completion of the courses, more participants showed their satisfaction with the courses, indicating that the designs of stomatology-related courses were beyond expectations, and the participants were more comfortable with the online courses than expected. It is proved that MOOC stomatology-related courses will be helpful for senior students of stomatology schools in universities to obtain professional courses during COVID-19.

For the question about the practicality of the MOOC, most students thought that MOOC would be beneficial to their further studies or career promotion before taking these courses, possibly because of their trust in courses quality on MOOC. Immediately after the completion of the MOOC, more participants believed that the course content of MOOC is easy to be put into practice. MOOC courses contain some key points in examination of postgraduates and medical dental practitioners [25], and integrate shared clinical experiences (Kusno, Villalta-Gil, Michaels, Joosten, Israel, Epelbaum,

Lee, Frakes, Cunningham-Erves, Mayers, Stallings, Giuse, Harris, & Wilkins. 2021). One month after the completion of the course, most subjects still thought that the course was practical; indicating that through practical application and inspection, the courses content is still considered to have strong clinical and exam applicability.

When it comes to the teaching method of taking online course, before the start of MOOC, most of students thought that face-to-face offline courses would be better than online courses. However, due to the epidemic, they were only permitted to stay at home to the ease the risk of infection. After taking courses on MOOC, most people still thought that face-to-face was better, but those who liked online courses also increased slightly, indicating the incremental familiarity of participants with the online teaching method. Before the MOOC, some students thought the teacher would not be adequately prepared for courses. On the contrary, after these courses, most participants changed the opinions and felt that teachers were mostly well prepared, perhaps it was that our courses were carefully selected by authoritative teachers, with various learning resources and assignments focused on key points, as well as regular online questions (Hendriks, PGM, WF, 2020), ensuring the quality of online courses.

When it comes to online teamwork, a considerable number of people did not like online teamwork before the MOOC began. After MOOC, through online group discussion and team presentations, more students tended to prefer online team works, and held the opinion that they could acquire more out of cooperation. A month after MOOC, most students still believed that teamwork could bring them a lot of benefits, which proved that the online activities in favor of the development of participants and was a project worthy of promotion and development (Gao, Yang, Zou J, Fan, 2021).

When mentioning the subject's knowledge application capability and knowledge integration ability, immediately after taking MOOC courses, a considerable number of participants argued that if faced with a patient, they would take the case into account at all aspects and work out a comprehensive therapeutic schedule, they were able to systematically organize knowledge, held a clear knowledge framework, find the common ground between different subjects and memorize it. MOOC has a great many irreplaceable advantages such as improving students' understanding of the material and practical ability, which is conducive to their learning as a whole (Meinert, Alturkistani, Brindley, Carter, Wells, & Car. 2018)

When referring to the whether the students would use MOOC again, most participants thought they would use them again as a kind of useful learning resources. Immediately after the accomplishment of these courses and a month later, most students expressed that they would certainly recommend MOOC to others. It was indicated that the students were highly satisfied with MOOC and stomatology-related professional courses deserved to be highly evaluated.

In a nutshell, it is concluded that the practicability needs to be improved through optimizing teaching methods and varying internal learning resources, so that the efficiency and educational quality of stomatology on MOOC will greatly enhanced during the COVID-19 epidemic.

The effect of MOOC online dental courses analyzed from an objective perspective

Immediately after the completion of the MOOC, the research group conducted the same exam papers for all participants and collected the grades as the objective analysis basis data of the project. The research group analyzed the relations between the number of courses finished and objective knowledge (grades), the difference (card square =) was statistically significant, indicating that the degree of course completion is a influencing factor of command of objective knowledge. It is likely that the broader the knowledge coverage students possess, the less unfamiliar questions they will be confronted with (Sneddon, Barlow, Bradley, Brink, Chandy, & Nathwani. 2018). At the same time, the research group analyzed the subjects' study time and test results, and the difference (card square =) had statistical significance, indicating that the study time is a influencing factor of the exams results. The possible reason might

be that students who spend more time on learning new things from courses as well as reviewing timely will better master the theories of courses and easier to perform well in the exams (Wong, Lee, Tam, Lau, Yu, Lui, Chan, Li, Bresee, & Sung, 2004). The levels of objective examination results is not only related to the difficulties of MOOC courses, but also to the participants' learning habits and learning attitude. If students can complete the MOOC courses, and continuously reviewing courses in time with diligence, they will be capable of pursuing outstanding learning achievement.

3.2 Benefits and barriers of online teaching

There are advantages of online stomatology-related courses training, the first of which is that it can reduce the risk of COVID-19 infection (Dost, Hossain, Shehab, Abdelwahed, & Al-Nusair. 2020), enabling teachers to teach knowledge without going outside. Furthermore, various learning resources serve as references, including live courses, recorded courses, short videos, mind maps and online virtual operations. In addition, discussions about clinical cases and group presentations have been added to MOOC, which can greatly enhance students' understanding of knowledge and strengthen their confidence in applying knowledge. For teachers, scores and attendance rates are more easy to be estimated online (EHJ, & Goh. 2016), and the courses arrangements can be appropriately adjusted according to the feed backs from students at any time.

However, there are also shortcomings in online courses, such as certain devices and electronic equipment required for the network, higher requirements for students' ability of voluntary learning and self-discipline, as well as the surroundings while taking courses. The research group will propose a series of solutions to improve the future application of MOOC and dedicate to its development in medical education field.

3.3 Future direction of online teaching

During the COVID-19, a large number of medical learning platforms have been constantly developed and applied to teaching, and many online teaching programs were also constantly updated. The first method is to give the case that the students ask questions and answers to. This can be incorporated into an effective learning method such as problem-based learning (PBL) (Jin, & Bridges. 2014) or team-based learning (TBL) which have been shown to improve learning outcomes, Both student motivation and understanding. Both PBL and TBL learning methods increase students' understanding of knowledge, their ability to comprehensively think about cases, and their confidence in applying knowledge to practice.

Another way is to make online clinical operation assessment applications (Clark. 2006), such as stomatology online crown preparation process of dental prosthodontics, so that students can click and slide on the line to operate. By clicking some options, scores will be recorded, so that students are able to practice clinical operations before internship without going outside during COVID-19. Students using these virtual practices can experience the process of clinical operations in advance and check the precautions of clinical operations. Although this method is not as effective as the actual clinical practice, it can also play a certain effect and establish foundation for senior students who are about to go into internship.

3.4 Limitations and future work.

The surveys, from the objective and subjective perspective of MOOC stomatology-courses for senior undergraduates of universities in southwest China, showed that during the COVID-19 outbreak, MOOC can play a certain positive role in medical education, improving students' learning ability and deepening the understanding of knowledge. It will be better if MOOC is applied in the medical education for the future examination and clinical practice. However, the surveys were still restricted in one major of stomatology in medical universities of southwest China, and range

of participants was not extensive enough. It is unclear that whether MOOC affects students of other majors in the same way. In the future, the range of participants will be expanded to students in a wider region of China. Students of different majors and grades will be selected in order to understand more accurately whether MOOC will have different effects in different majors. In the later research,

we will exclude other possible interference factors, for example, whether the student was trained by same courses in the research period, whether he studied relevant courses on other platforms, etc., to ensure the accuracy of the research results, and thus bring up more precise conclusions.

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