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Original Article

Effect of online learning for dental education in asia during the pandemic of COVID-19



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Abstract *Background/purpose:* Online learning has been utilized in the world to continue educational activities in dentistry, which was severely affected by the pandemic of coronavirus disease 2019 (COVID-19). The purpose of this study was aimed to evaluate the effect of online learning during the pandemic of COVID-19 in different dental schools of different countries in Asia by the questionnaire survey.

Materials and methods: Mantel-Haenszel chi-square tests were used to analyze the difference between dental schools with and without shutdown. A questionnaire-based online survey was used to evaluate the online learning effect on undergraduate students in 13 dental schools of 7 Asia countries and regions.

Results: For the question that blended learning class has better learning efficiency, the agreement rate was significantly higher in the students (80.3%) from the dental schools that did not suspend face-to-face education activities than in the students (50.3%) from the dental school that was shut down.

Conclusion: Within the limitation of this study, it is concluded that a combination of physical and online classes in terms of blended learning courses will be the future trend for dental education.

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Introduction

The pandemic of coronavirus disease 2019 (COVID-19) is a highly infectious disease that has a great impact not only on health but also violates economics and social activities global wide.^{1,2} The route of spreading the virus is not only by means of direct contact but also can be transmitted by air droplets.^{1,3,4} This leads to an embarrassing situation for the government to make a last resort policy in terms of lockdown or isolation to limit the infection.^{5,6} It becomes the best choice of strategy to prevent the wide spread of the pandemic.⁷ By means of lockdown or isolation, the social distance can be kept to prevent direct contact or aerosol contamination of human beings, thus the pandemic can be inhibited. But this strategy also possesses some adverse effects to limit social activities.^{8,9}

Dental education is composed mainly of three components: Lectures/tutorials and problem based learning (PBL) interactions, simulated training courses, and clinical skills training.⁵ These three components, especially for simulated training courses and clinical skills training require close contact of human beings in which social distance cannot be always maintained during the process of these three components.^{6,8} According to the experience and suggestion from the School of Stomatology at the Wuhan University, China, to ensure the protection of the students' health not only by reinforcing infection control protocols in the clinical practice but distance learnings in terms of online learning or e-learning are recommended to avoid crowding and spreading of the pandemic.^{6,9}

Online learning is defined as learning that use of information and communication technologies (ICTs). It has been utilized as an auxiliary teaching method for distance dental education since 1990.¹⁰ The incorporation of technologies has transformed teaching and learning process, by using online learning, the learning process can be conducted regardless of time and place.^{11–13} Thus, the social distance which is the most important part during the pandemic can be maintained without hesitating the learning progress. Even though the main advantage of online learning during the pandemic is to maintain the learning process without violating the social distance, but it is high equipment, facility, and technique-dependent learning mode.^{14,15} The pieces of equipment and facility needed to conduct the learning process include laptops of both teacher and student, internet system, and technique to manipulate those digital devices. All of these factors can be influenced by the social-economic condition of the country and budget of the dental school and other factors like the motivation of both teacher and student.^{16,17}

Since the global outbreak of the novel coronavirus, the social lifestyle has been changed a lot. Many Dental Schools have shutdown the face-to-face education activities, and switched their education to online or blended learning mode to keep on the learning progress for those dental students.⁵ The learning efficiency of the online learning from the students' end can be influenced by some objective factors like equipment and facility of the online teaching and learning, technique to manipulate those digital facilities, and so on.^{18–21} This is the first experiment for dental school to bring most of the education by online, and there

are still many unanswered concerns about the teaching effectiveness. However, this information is very important to ensure and improve the quality of dental education in the new normal society. The purpose of this survey is aimed to study the effect of online learning during the pandemic of COVID-19 in different dental schools of different countries in Asia. And additionally, to evaluate the differences in responses of students in dental schools that with and without shutdown of face-to-face education activities during the pandemic of COVID-19. The meaning of the shutdown of face-to-face education activities was based on the previous study.⁵

Materials and methods

A questionnaire-based online survey (Google form) was used to evaluate the online learning effect of undergraduate dental students in 13 dental schools of 7 Asia countries and regions ie: Hong Kong (China), China, Indonesia, Japan, Korea, Malaysia, Taiwan, and Thailand. It is composed of 23 structured questions and one open question regarding the comments of online learning. Elements of the questionnaire are illustrated in Table 1. The survey was approved by the Ethics Committee Tohoku University Graduate School of Dentistry, Japan (No. 2020-3-31) as the representative institution.

The link of questionnaire was mailed to 13 dental schools which were interested in the survey, then distributed to the students. The students can decide whether to participate in this survey of their own will. The name and other personal information of the participants were protected. All the questionnaire's design obligated the participants to answer all the questions to make sure that the returned electronic forms were all complete. Mantel-Haenszel chi-square tests were used to analyze the difference between dental schools with and without shut down. The statistical significance level was determined at $p < 0.05$ (two-tailed).

Results

Effect of online learning during the pandemic of COVID-19

A total 510 students from 13 dental schools of 7 Asia countries and regions responded to the survey. The valid response was obtained from 495 students, and these were analyzed as the final data. Among them, 60.8% are female, while 39.2% are male. The grades of students were distributed from 1st to 6th year. Most of the students are 4th (20.4%) and 5th (33.1%) grade students. The results indicated that the 94.5% of the dental schools were conducted the educational activities by online classes during the COVID-19 pandemic. For those online classes, 50.5% were live classes, while 34.9% were pre-recorded online classes. 65.2% of the students answered that they will prepare in advance before an online class. 53.0% of the students were willing to accept the majority of courses were conducted online mode. 65.7% of the students are willing to raise questions during an online class. 67.1% of the students accept a test by using an internet block system in terms of a

Table 1 Questionnaires.

| Questionnaires | Statistical analysis between dental schools with and without shut down |
|--|--|
| 1 The name of the school | |
| 2 What grade are you in? | |
| 3 Gender | |
| 4 How many years of undergraduate education for dentistry do you have? | |
| 5 What is the percentage of classroom (lecture/tutorials and PBL interaction) in undergraduate education? | |
| 6 What is the percentage of simulation training in undergraduate education? | |
| 7 What is the percentage of clinical skill training in undergraduate education? | |
| 8 Does your school offer the online classes during the COVID-19 pandemic? | Y |
| 9 What would be the type(s) of online classes provided by your institute? | Y |
| 10 Do you make lecture materials preparation before an online class? | Y |
| 11 In your opinion, what is the percentages of online classes in each semester is acceptable during your learning process? | N |
| 12 Are you willing to raise question(s) during an online class? | N |
| 13 Will you accept a test by using an internet block system after an online class? | Y |
| 14 For an online class, one must be familiar with computer operation. Do you think that you have enough knowledge of computer operation to support your online learning? | N |
| 15 What will be the shortcoming, if all the learning courses are limited to be online class because of some inevitable reason (ex: pandemic)?Please list in the following | |
| 16 Do you prefer physical class or online class? | Y |
| 17 Do you think which class has better learning efficiency? | Y |
| 18 For the person who chose hybrid type for question 17, what percentage of online class to be effective for a hybrid type course? | N |
| 19 Which mode of class has higher tendency to distract you? | Y |
| 20 For those simulation training courses do you prefer an Online class or Physical class? | Y |
| 21 For those simulation training courses, do you think it will be helpful if students can view the procedure in Online after or before a Physical class? | N |
| 22 During the pandemic, many countries shut down the dental clinic and internship learning in teaching hospital. Do you think it will induce adverse effect on clinical skill training course? | Y |
| 23 During a pandemic do you think the clinical skill training course should be? | Y |

Y: statistical significant difference ($p < 0.05$).

N: no statistical significant difference ($p > 0.05$).

lockdown browser for an online examination. 78.7% of the students think they have enough knowledge for computer operation to support their online learning. 62.2% of the students prefer blended learning which is a combination of physical and online classes while the rest of 23.4% prefer physical class and 14.4% prefer online courses. 57.2% of the students think the blended learning method has better learning efficiency, 27.7% think the physical class has better learning efficiency while 15.1% think online classes have better learning efficiency. Among those students who chose the blended learning method to have better learning efficiency, 25.8% think if the percentage of the online class is 50% will be effective while 18.4% can accept more than 50% of the on-line class in a blended learning mode. 68.4% of the students think the online class has a higher tendency to distract them while 31.6% think they are easier to be distracted by physical class. For those simulation training courses, 69.5% of the students prefer the physical class,

while 23.4% prefer the blended learning. Only 7.1% of the students prefer the simulation training course to be conducted in online mode. 54.3% of the students think it will be helpful if students can view the procedure online before and after a physical simulation class. The rest of 33.5% of the students prefer to view it online before the physical simulation class. 92.7% of the students think the pandemic has an adverse effect on the clinical training in terms of internship. 79.2% of the students think the clinical skill training should be carried on with personal protective equipment (PPE) during the pandemic.

Differences in responses of students in dental schools that with and without shutdown

Of the 13 dental schools, only one school was continuing face-to-face education activities, while the rest had

shutdown face-to-face education activities. There were fewer online classes in the dental school that without shutdown of face-to-face education activities during the pandemic of COVID-19 (73.3%) than those dental schools with shutdown (98.0%). The difference was statistically significant ($p < 0.05$) (Table 1). The pre-recorded classes (55.6%) were significantly more than live courses (39.5%) in the types of online classes offered by dental schools that without shutdown of face-to-face education activities ($p < 0.05$) (Table 1). It showed the exact opposite result (53.1% live courses and 34.7% pre-recorded classes) in the dental school that with shutdown of face-to-face education activities ($p < 0.05$) (Table 1).

It found that students from dental school that suspended face-to-face education activities (70.0%) prepared more in advance for online lecture than students from dental school that had not suspended face-to-face education activities (32.8%). There are significantly more percentage (78.7%) of the students from the dental schools without shut down than that of the students (68.1%) from dental schools with shut down, will accept a test by using an internet block system ($p < 0.05$) (Table 1). The percentage of students who prefer blended learning classes were highest in dental schools without shut down (86.9%) than that with shut down (56.9%) ($p < 0.05$) (Table 1).

The percentage of students from dental school who answered that blended learning class has better learning efficiency was significantly higher in the dental school that without shut down (80.3%) than in the dental school that with shut down (50.3%) ($p < 0.05$) (Table 1). The percentage of students from dental schools that with shut down (69.6%) was highest than students from dental schools without shut down (49.2%), think the on-line course has a higher tendency to be distracted ($p < 0.05$) (Table 1). The most of student from both dental school that with (63.7%) and without (62.3%) shutdown answered that prefer a physical class for simulation training.

There are highest percentage of students from dental schools without shut down (100%) than with shut down (91.7%), think the strategy of shut down will induce an adverse effect on the clinical skill training course ($p < 0.05$) (Table 1). The 76.7% of the students from dental schools with shutdown think the clinical skill training course should be carried on with PPE, and 96.7% of students from dental schools without shutdown think clinical skill training course should be carried on with PPE. There is a statistically significant difference ($p < 0.05$) (Table 1).

The free comments from the students for the question of No. 15 can be summarized as 1. Difficult to raise questions in an online class. 2. Lack of clinical skill training course. 3. Lower down the learning motivation. 4. Lack of interaction among students. 5. The quality to connect internet is not always stable.

Discussion

The pandemic of COVID-19 has become a major public health challenge around the world.^{22–24} The World Health Organization announced that the outbreaks of the novel coronavirus have constituted a public health emergency of international concern.^{2,9} It becomes an infectious disease

without boundaries among different countries.^{25–28} Not only the health, mental, economics have suffered from this novel coronavirus but also the mode of social activities have been restricted due to its highly infectious character.^{29–33} Dental education which has been performed for many decades globally wide requires close contact with the human being in the past time.^{22,23} Due to the characteristics of dental education, the risk of cross infection may be high between teachers and students as well as among students.^{28,34} The mode of dental education should be revised to fit the requirement of epidemic prevention in terms of social distance. Online learning which has been advocated since 1990 becomes a proper method to fit the rigorous demand of social distance for dental education.^{35–37} But there is not a simple solution to a complicated problem in terms of a silver bullet solution to solve all these complicated demands for dental education. Thus it is worthwhile to study the effect of online learning in dental education to formulate a novel form of dental education in the New Normal Society.

This survey was organized by the Association for Dental Education, Asia Pacific, with Tohoku University (Japan) as the representative school to perform in 13 dental schools from 7 Asia countries and regions that are interesting to participate in this survey during the pandemic of COVID-19. All those students who participated in this survey were voluntary. More than half of the 495 valid responses were from 4th and 5th grade year students. The percentage of females (60.8%) was higher than males (39.2%). This may be due to there are more females' dental students nowadays in dental schools.³⁸

Most of those schools have experienced shutdown the educational activities during the pandemic of COVID-19 except dental schools in Taiwan.⁵ All the dental schools that participate this study, regardless of whether they were shut down or not, offered online course. While there are several papers related to online learning during the pandemic of COVID-19,^{6–8} there is no previous study to evaluate the various effects of online courses from the student side for those dental schools with and without shut down during the COVID-19 pandemic. In particular, there are no multinational studies.

There were more online classes offered by dental schools with shut down than that without shut down. This may be due to physical classes can be proceeded only in dental school without shut down.⁵ For those online courses in dental schools with shutting down, more courses were conducted live (51.7%) than pre-recorded courses (36.2%). This may be due to the shutdown strategy of some of the dental schools that were announced by the government unexpectedly. Online courses of dental education were not popular in Asia before the pandemic, and also pre-record courses may need more time to prepare. With the sudden onset of the pandemic, the demand for on-line courses become increasing due to the shutdown of dental schools, but it takes time for the dental school to prepare for those. Furthermore, the faculty may believe that live courses are more effective.

With or without shutdowns, both dental school students were found to have sufficient computer knowledge to support online learning, to be prepared for the online course, and actively asking questions during the online

classes. Additionally, they also think the percentage of online classes in a blended learning dental education can be up to 50%. This indicates competence and readiness on the part of the students to take online learning for dental education. And this also indicated that the dental students are accepted the online courses. However, the study of Amir et al. showed that more students felt lower learning satisfaction and more difficult communication either with instructors or with peer students in doing online learning. This means that internal factors of student readiness, time management, and difficulty to stay focused for a long online learning duration were highlighted as challenges.³⁹ Therefore, what percentage of online courses is appropriate and what percentage is appropriate for blended learning courses needs further research.

The students from dental schools with shut down are more likely accept exams using the internet block system, with results indicating that a higher percentage can accept more than 50% of the online class. However, many students reported that online classes have a higher tendency to distract them, therefore, the effectiveness of online classes and online exams must be thoroughly reviewed and clarified if they are to be used in the future.

With or without shutdowns, both dental school students prefer the blended learning of dental education which is composed of physical and online classes and think the blended learning method has better learning efficiency. Moreover, for those students from dental school without shut down, the percentage to distract students in the online class (49.2%) and physical class (50.9%) are almost equal. These results can be considered as an indication of the importance of physical classes (face-to-face classes). Due to the characteristics of dental education, face-to-face classes are mandatory. Especially in simulated training and clinical skill training, it is still difficult to switch to online with the current technology. This point also supported by the results of question 22, with many students answering that physical classes are preferred for simulated training courses. Having said that, it seems that a blended learning of learning may be the future trend, but the efficiency of the blended learning of dental education requires further study to prove its efficiency. For those simulated training courses, students from both dental schools with and without shut down think it will be helpful for learning if they can view the procedure online before and after a physical class. This is a good example of blended learning for simulated training courses in dental education. Based on this, to view the procedure online before and after the physical class is highly recommended for a simulated training course.

Most of the students think if internship clinical training is ceased during the pandemic, it will induce an adverse effect on dental education. But there are more percentage of students from dental schools without shut down than those with shutting down think clinical training course should be carried on with PPE. There are 22.9% of the students from dental school with shut down think the clinical skill training course should be shut down during the pandemic. This emphasized the importance to ensure the protection of students' health by reinforcing infection control protocols in the clinical skill training setting.⁹ It also revealed the real-world situation that PPE might be a

shortage in some dental schools during the pandemic. Otherwise, clinical skill training courses should be proceeded with PPE, to reduce the adverse effect of dental education during the pandemic. In order to continue dental education under the pandemic, COVID-19 guidelines are very important and useful that safely facilitate dental educational activities during the current pandemic.²¹

Online learning is highly dependent on the information technologies which includes the facility, personal laptop, and stable internet system and skill for students to conduct on-line learning.^{7,11,12} The results showed that most of the students are satisfied with their skill of computer manipulation. With the experience of online learning during the pandemic, it will promote the computer skill for the students. With the change of learning mode from the classroom to online, students can adapt it more quickly than senior teachers since students are more familiar with those computer productions. But the change may be difficult for those senior staff to adapt.⁵

The experiences of this COVID-19 pandemic, it has emphasized the importance of improving the skill of computer science not only for students but also for teaching staff to enhance the facility of information technology for each institution of dental education. And the performance of instructors/teaching staff in charge of online learning also very important in stimulating students' attention. Special skills to communicate with students are essential since lack of personal contact may affect the communication between teacher and students. It is also mandatory to prepare in advance for this pandemic COVID-19 and a similar crisis that may occur in the future. We, as dental educator, researcher and dental professionals, must create a novel system to address the new normal society. There is a lot of work to be done, such as build and online lecture system, develop VR devices for online simulated training, create a blended learning education system, and develop an online exam system, etc to maintain the quality of education during and after the pandemic of COVID-19.

The survey was performed in 13 dental schools in 7 Asia countries and regions, with an amount of 495 dental students participated in this survey. This is the limitation of the study. To view the whole pictures of the effect more participants and more dental schools from more countries are needed for further study.

Within the limitation of this study, it is concluded that online classes have proceeded in all those dental schools that participated in this survey. Students are ready to take online classes. A combination of physical and online classes in terms of blended learning courses will be the future trend for dental education. However, the most important thing is to ensure the quality of education in order to meet the minimum requirements of universities and national accreditation authorities, no matter what method is used.

Declaration of competing interest

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

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