The Effectiveness of Online Course about Pain Management and Local Anesthesia Methods for Undergraduate Dental Students

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ABSTRACT

Local anesthesia (LA) is the most commonly method for pain control during dental procedures. Dentists should have the knowledge, skills and attitude about LA. Therefore, this study aimed at evaluating online course about dental pain management and local anesthesia methods used in dentistry. A total of fifty-four dental students who accepted to participate in this study were included. An online course composed of six-module was developed. Students' knowledge was assessed by comparing their learning before and after their participation using identical pre and post-test. According to Chi-Square statistics, significant difference at $P < 0.05$ was found between the correct answers of participants in pre-tests and post-tests which indicates that the level of learning was significantly higher after the participation of the online course. The use of online educational course is effective in developing dental students' knowledge of dental pain management and the local anesthesia methods used in dentistry.

1. Introduction

There is no doubt that we live in the era of information and communication technology revolution, and people have currently greater possibilities to access information resources via the internet every day [1]. With the spread of smart phones and other smart devices, the popularity of social media increased, as did the number of its users, which led to increasing information exchange through it as well [2]. As a result, e-learning has become an essential component of many educational systems due to its ability to meet student needs that were previously difficult for colleges and universities to achieve using traditional education. E-learning is defined as education that takes place using the computer and the internet in any form, so that the learner receives the scientific material electronically when needed [3]. One of the most important advantages of e-learning is that students benefit from the possibility of learning in their own time and at their own pace, in the place they prefer or feel comfortable at [4].

The field of dentistry is one of the most important educational fields in which reliance on e-learning has increased to support traditional teaching and learning methods in various forms [5]. Like other disciplines, dental education has faced many challenges during the COVID-19 pandemic, when educational authorities were forced to find alternative solutions to complete the educational process, especially that most dental courses require contact with patients, which increases the risk of infection. As a result, the biggest challenge for dental school educators is to reduce the risk of COVID-19 infection while ensuring the quality of this education.

On the other hand, the pursuit of adopting an e-learning system was desirable by many universities even before the emergence of the Corona pandemic for several reasons. Most important reasons are that e-learning saves time, reduces costs, offers different learning styles, and allows students to learn in any place at any time outside the classroom, overcomes the shortage of faculty members, and helps transform the educational process from teacher-centered to learner-centered learning [6]. An example of colleges that embraced the principle of e-learning before having to resort to it in the era of Corona is the study conducted by Asiry [7] to determine the extent to which dental students at King Saud University are prepared for online education. The researcher concluded that there is a general consensus among students regarding their acceptance of online learning and its ease of use. The students considered it as an aid to their education, but not a substitute for traditional teaching methods. Similarly, researchers at the School of Dentistry in New York University conducted a study [8] to determine the extent to which dental students use social media, online applications, databases, and their interest in integrating e-learning as one of the teaching methods among the courses they study. The results indicate that e-learning may be used successfully in dental college curricula to enhance students' perceptions of key concepts and enable students to apply this knowledge to clinical cases.

Some studies have compared the effectiveness of traditional learning and e-learning in dental education. One of these studies is the one conducted by Hakami [9] concluded that virtual learning can be used as an alternative to traditional face-to-face education in communicating the necessary knowledge and skills to students in an orthodontic course. Another study was conducted to compare the effectiveness of two teaching methods (virtual versus traditional) on dental students' learning of rotary preparation of root canals systems [10]. Investigators concluded that virtual learning is feasible and will lead to more effective teaching compared to traditional lectures. However, more studies are needed to generalize the results of this study.

One of the most important courses that dental students study during their undergraduate years and which is largely reflected in their clinical practice is anesthesia, as local anesthetics are the most widely used drug in dentistry, and although they are considered effective and safe in controlling pain during dental procedures, but the occurrence of complications when using it is inevitable, which can be avoided with the correct knowledge of local anesthesia procedures, and how to prevent the occurrence of these complications. It has been noted that although dentists routinely use local anesthetics during therapeutic procedures, some dentists may be unaware of the dose calculations required to perform anesthesia, and the safe and effective maximum dose of the drug [11- 14].

It becomes clear to us the importance of the need to conduct educational programs to address the areas in which dental students suffer from a lack of information or have a need to update their previous information, and to benefit from e-learning in this field to facilitate access to these students and make it more flexible, and the possibility of their receiving this educational program at the place and time they find convenient.

2. Materials and Methods

After obtaining the ethical approval from the Syrian Virtual University SVU committee (2339/0, 15/12/2021) participants who were in the fifth year of their undergraduate study in Syrian universities, who completed the head and neck anatomy course, passed the pharmacology course and have a computer and appropriate internet connection, were invited to participate in this study. A total of fifty-four dental students (males = 12, females = 42) who accepted to be part in this study were included.

The names of the participating students, their phone numbers and e-mail addresses were collected and sent to the program coordinator, where accounts for the participating students were created on the learning management system of the SVU, which was used to give the course. After creating the accounts, the students were instructed on how to use the platform and the software required to attend the modules by the researcher, and set the date for the start of the online course. The content has been divided into 6 modules, so that at the end of each module, a set of objectives that the student should master is achieved.

The modules were recorded using the VSDC Free Screen Recorder program, and the average duration of each module was approximately forty minutes. Modules were uploaded to the learning management system of the Syrian Virtual University so that the students participating in the research could download them to their computers and listen to them at the appropriate time and place for them.

Pre-test and post-test were applied to all modules to assess the level of knowledge students have before listening to the module, and whether it had improved or not after listening to it. The pre-tests consisted of thirty questions divided into six tests, each test containing five questions, and the students answered each pre-test before listening to the corresponding module using a Google form link. The post-tests also consisted of the same thirty questions with the same distribution, and the students answered them immediately after each module using another Google form link.

After all the students participating in the study completed the online course, their answers recorded in both pre-tests and post-tests were collected and analyzed using SPSS program via Chi-Square test at the significance level $P < 0.05$ in order to determine whether there was a statistically significant difference between their knowledge level before and after the course. The analysis was carried out at three levels: at the level of the questions (each question separately), at the level of modules (each module separately), at the level of the course.

At the end of the course, the participating students made a general and comprehensive evaluation of the course, by answering the questions sent to them through a questionnaire made on Google form in order to provide feedback on their experience in attending the course, and the extent to which they benefited from this experience, after completing all modules. The questionnaire was designed using the five-point Likert scale; 1= poor, 2= acceptable, 3= good, 4= very good, and 5= excellent, and it was divided into four sections as shown in (Table 1). Cronbach's Alpha was used to measure the internal consistency of the survey items.

Table 1: Items of course evaluation

1. Course Structure
1.1. Clarity of the course objectives
1.2. Adequacy of course modules to achieve its goals
1.3. Integrity and fluency of language used in the modules
1.4. The usefulness of the program's content and its relevance to the topic
1.5. Quantity and depth of information provided to cover the topic

1.6. Organization of the course content
1.7. The novelty of the scientific material
1.8. The ability of the course to address the lack of knowledge related to dental pain management and local anaesthesia in dentistry.
2. Course environment
2.1. Suggested program duration (based on the number and length of modules)
2.2. The platform used to give the course
2.3. Clarity of sound display
3. Lecturer
3.1. Familiarity of the lecturer with the topics of the training course
3.2. The ability of the lecturer to present and organize information
3.3. The extent of the lecturer's cooperation with the participating students
3.4. The ability to communicate ideas and link them to practical
4. General evaluation
4.1 Overall, how satisfied are you with the course?
4.2. How likely are you to be nominated for this course by a colleague?

An analysis of the final evaluation of the course was also conducted to calculate the degree of satisfaction of the students who underwent the study with course offered to them. The fifty-four students participating in the course evaluated it, and the mean was calculated for each of the evaluation questions out of 5, and the mean was calculated for each section of the evaluation. Mean values and ranges were also used to provide verbal interpretation for the mean responses as demonstrated in (Table 2).

Table 2: Verbal interpretation of Likert scale

Mean value	Verbal interpretation
1.00 – 1.79	Poor
1.80 – 2.59	Acceptable
2.60 – 3.39	Good
3.40 – 4.19	Very good
4.20 – 5.00	Excellent

3. Results

3.1 Descriptive analysis of the sample
The sample of this study consisted of fifty-four undergraduate dental students (males=12, females=42). All participants were fifth year students of Syrian universities; 64.8% (35) are studying in private universities where the English language is used in teaching the curriculum, while 35.2% (19) are studying in governmental universities that teach in Arabic language.

3.2 Statistical analysis of the sample
Results indicates that 41% of the questions in the pre-tests were answered correctly. On the other hand, 98.1% of the questions in the post-tests were answered correctly, and a significant difference at $P < 0.05$ was found as indicated by Chi-Square statistics.

When comparing the effectiveness of the online course according to the gender, there were no significant statistical differences between male and female students ($P = 0.134$). No significant statistical differences were also found when comparing between students who studied dentistry in Arabic or in English language ($P = 0.317$).

3.3 Statistical analysis of course evaluation
The overall evaluation of the course was excellent as shown in (Table 3). In the suggestions section,

participants suggested adding a practical part to the course, organizing another course that is not recorded to provide an opportunity for questions and explanation on certain points, increasing the number of lectures so that their duration is shorter, using WhatsApp or Telegram to download lectures, and reduce the duration of the lecture.

Table 3: Statistical analysis of course evaluation

	A. Questions evaluation	
Question	Mean	Interpretation
1.1	4.67	Excellent
1.2	4.56	Excellent
1.3	4.78	Excellent
1.4	4.78	Excellent
1.5	4.67	Excellent
1.6	4.67	Excellent
1.7	4.67	Excellent
1.8	4.78	Excellent
2.1	4.22	Excellent
2.2	3.89	Very good
2.3	4.78	Excellent
3.1	4.78	Excellent
3.2	4.78	Excellent
3.3	4.78	Excellent
3.4	4.78	Excellent
4.1	4.44	Excellent
4.2	4.44	Excellent
	B. Sections evaluation	
Section	Mean	Interpretation
1	4.69	Excellent
2	4.3	Excellent
3	4.7	Excellent
4	4.4	Excellent

4. Discussion

The concept of e-learning is not newly developed, it has been adopted by many countries and governments decades ago, since the beginning of the information revolution [5]. Although this educational system was not recent, it was not widespread, and traditional face-to-face education remained dominant in the educational system. At the end of 2019, when the COVID-19 virus swept the world, governments faced many challenges at all levels, including the continuity of the education process in light of the rapid spread of infection with this disease that killed large numbers of people, and forced people to stay in their homes and become socially isolated in order to avoid infection. Since it is not known how long the world will need to control this disease and return life back to normal, the role of distance education has emerged as an alternative solution for the continuation of the educational process. The educational bodies that were afraid of the idea of moving from traditional education to distance education, especially since this transition was abrupt, and neither the teaching staff nor the students were prepared for this type of education, they found that it is possible to benefit from e-learning even after life returns to normal before the pandemic, especially that this type of education has great benefits and some advantages that may outperform traditional education whether it was delivered synchronously or asynchronously. However, to what extent can this type of education be effective, specifically in courses and disciplines that have a practical aspect. Applying this kind of education may be practical in theoretical courses, but the mission is not that easy for practical and clinical ones. An example of these specialties is dentistry. During the pandemic period, educational institutions were forced to find alternative solutions for teaching dental courses, especially since infection

with the COVID-19 is transmitted through droplets generated from dental treatments [15], which may expose dental students to the risk of infection when treating a patient infected with the virus. E-learning was used to teach theoretical part of these courses, but to cover the practical part, videos were used, clinical cases were studied and discussed, simulation systems were used if they were available at universities, and others of the methods of distance learning, but the experience of clinical practice is still indispensable to complete the educational process in this field [16].

From the foregoing, it was found that it is possible to benefit from the advantages of e-learning in covering the theoretical scientific material, by dispensing with traditional lectures and using various e-learning methods. It can also be used to address the shortcomings of some students, as it is not necessary to be completely relied upon as a teaching method in the field of dentistry, but it can be used when the student needs more information on a subject, especially if it is available at any time and be used anywhere.

In a review of previous studies [11- 14], it was noted that some dental students and recent graduates lack knowledge of the theoretical aspect of the mechanism of action of local anesthetics and methods of dental pain management, and how to calculate the maximum dose of local anesthetics, which may cause complications during dental treatment, and may threaten the patient's life. In this study, the researcher designed online course about dental pain management and local anesthesia methods used in dentistry with the aim of helping undergraduate dental students to strengthen their knowledge in this aspect, and to be a reference for them to refer to if they need any information in this regard. Therefore, this course was designed to cover the theoretical part of this topic and is provided to students participating in the study in a recorded form so that they can listen to it in the place and time for each student according to his/her will, and can listen to it again whenever they want. A total of fifty-four fifth-year dental students from Syrian universities participated in the research, and the participating students were required to have completed the study of the head and neck anatomy and pharmacology courses, in order to have sufficient background to understand the mechanism of action of local anesthesia drugs and its techniques. It also required that the participating students are still undergraduates, and have fast internet and a computer to be able to download the course modules and take pre-tests and post-tests designed to assess their knowledge before and after each module.

When analyzing the results of this study, it was found that this course was effective in increasing the students' knowledge of dental pain management and the methods of local anesthesia used in dentistry. This effectiveness was measured through the results of the fifty-four students participating in the study in both the pre and post-tests of the modules. The results showed that there was a noticeable difference between the results of the students before and after they were subject to the course, with a statistically significant difference of $P < 0.001$. This result is consistent with the studies conducted with the aim of evaluating the effectiveness of online courses in different specialties of dentistry [9], [10]. This result also agreed with another study conducted to evaluate the effectiveness of an electronic module on gastroenterology, evaluating students' satisfaction with the e-learning experience, improving their self-confidence, and their awareness of the experience's obstacles. The authors found that e-learning plays an important role in improving the level of knowledge, with no difference between the use of synchronous and asynchronous education [17]. Most of the questions that the students could not answer correctly in the pre-test revolved around purely theoretical information about the composition of local anesthetics and theories of their action and how dental pain is transmitted. As for the questions related to local anesthesia techniques, local anesthesia armamentarium, and possible complications of local anesthesia, they were among the questions that the students were able to answer more correctly. This may be explained as participants were familiar with the tools and techniques of local anesthesia in their previous years of study, especially that dental

students start to take local anesthesia courses since the fourth academic year according to most Syrian dental schools' curriculum.

There was only one question that no student participating in the study was able to answer correctly in the pre-test, which is the vasoconstriction contraindicated in pregnant women, as the correct answer is felypressin, but this answer was not chosen by any of the students in the pre-test of the module, indicating the importance of developing dental students' knowledge of the indications for vasoconstrictors used in combination with local anesthetics. No significant statistical differences were found nor when comparing according to gender nor according to language of study. However, the students who studied in Arabic answered more correct questions in the per-test than students who studied in English. This can be explained by the fact that these students were more familiar with Arabic dental terms as the online course is delivered in Arabic language.

Course evaluation results indicated the satisfaction of the students participating in the study in terms of the course's scientific structure, the training environment, the lecturer, and the overall evaluation of the course. But when comparing each section separately, it was noted that the training environment section got the lowest rating among the sections, where the rate of satisfaction with the training environment was 4.3 out of 5, where the ease of use the online platform used to give the course received the lowest rating. This can be explained because students may have faced some difficulties in learning how to deal with the platform and how to use it, especially since it requires the installation of certain programs, although there is a detailed guide on the Syrian Virtual University website on how to install these programs and access the platform, and the researcher directed the students participating in the study on how to use the university's learning management system, some students preferred to resort to applications available on smartphones, such as WhatsApp and Telegram as described in the suggestions mentioned at the end of the course evaluation. One of the participants also suggested adding a practical part to the program, and this indicates to the importance of the practical aspect of studying dentistry, and that it cannot be separated from the theoretical aspect, and that electronic learning methods should be developed to include this aspect, in order to complete the electronic educational experience.

On the other hand, there were some limitations that this study faced, the most important of which is the failure to evaluate the effectiveness of this program after a period of time (for example, two months) in order to measure the extent of information retention of the student who underwent this course. Another limitation is that it cannot be ascertained that the student has actually answered the questions of the post-test after listening to the modules without looking at the modules or referring to them. It is not possible to know whether the student relied only on the acquired knowledge and answered honestly and truthfully or not as the tests can't be controlled by the investigator.

5. Conclusion
Based on the results of the previously presented study, it was concluded that the electronic training program designed on dental pain management and local anesthesia methods used in dentistry for undergraduate students was effective with a statistically significant difference. Findings of this study indicates that E-learning can be used to improve dental students' knowledge about local anesthesia. In addition, E-learning can be used to address cognitive deficiencies in some areas of dental students and newly graduated dentists. In conclusion, E-learning can be used in conjunction with traditional education in the field of dentistry.

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