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Original Article

Using mobile multimedia platforms in teaching dental diagnosis

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الملخص

أهداف البحث: إن منصات الوسائط المتعددة المتنقلة هي أدوات خصبة يستخدمها الأفراد والشركات لمشاركة المحتوى. ومع ذلك، فقد أظهرت بعض الدراسات فاعلية منصات الوسائط المتعددة المتنقلة كأدوات تعليمية. الغرض من هذه الدراسة هو تقييم فاعلية منصات الوسائط المتعددة المتنقلة في تحسين مهارات التشخيص الأساسية لطب الأسنان. بالإضافة إلى ذلك، سجلنا ملاحظات الطلاب حول استخدام منصات الوسائط المتعددة المتنقلة في مناهج طب الأسنان.

طرق البحث: في هذه الدراسة التداخلية الطوعية على ٨٩ من طلاب طب الأسنان في السنوات الأخيرة. أنشأنا وحدات تعليمية رائدة من خلال منصات الوسائط المتعددة المتنقلة تسمى قصص انستغرام لتعليم تشخيص الأسنان. قمنا بتقييم فاعلية الوحدات من خلال الاختبارات التشخيصية التي أعطيت لطلاب طب الأسنان القريبين من التخرج.

النتائج: أظهر الطلاب زيادة كبيرة في درجات الاختبارات التشخيصية من ٤٩٪ إلى ٧٣٪ بعد استخدام منصات الوسائط المتعددة المتنقلة. علاوة على ذلك، أشارت تعليقات الطلاب على منصات الوسائط المتعددة المتنقلة إلى أن غالبية الطلاب وجدوا أنها سهلة وممتعة.

الاستنتاجات: تظهر بيانات دراستنا أن منصات الوسائط المتعددة المتنقلة قد تستخدم لتحسين التدريب على مهارات التشخيص الأساسية للأسنان ويمكن أن تكون بمثابة أداة تعليمية مساعدة. علاوة على ذلك، يمكن لوحدات منصات الوسائط المتعددة المتنقلة أن تثري التعليم المهني في البلدان النامية حيث يكون الوصول إلى الموارد التعليمية محدودا.

الكلمات المفتاحية: تعليم طب الأسنان؛ ردود الفعل؛ عالمي؛ منصات الوسائط المتعددة المتنقلة؛ وسائل التواصل الاجتماعي.

Abstract

Objective: Mobile Multimedia Platforms (MMPs) are prolific tools that can be used by individuals and corporations to share content. However, few studies have shown the effectiveness of MMPs as educational tools. Through this study, we aimed to evaluate the effectiveness of MMPs in improving basic dental diagnostic skills. In addition, we captured student feedback on the use of MMPs in a dental curriculum.

Method: In this voluntary interventional study on 89 senior dental students, we created pilot learning modules through an MMP called Instagram Stories to teach dental diagnosis. We evaluated the efficacy of the modules through diagnostic tests that were given to dental students who were close to graduating.

Results: The students showed a significant increase in diagnostic test scores from 49% to 73% ($p < 0.05$) after the use of an MMP. Furthermore, the students' feedback on the MMP indicated that most students found it easy and enjoyable to use.

Conclusion: Our study data show that MMPs may be used to improve training in basic dental diagnostic skills and can serve as an adjunct teaching tool. Moreover, MMP modules can potentially enrich professional education in developing countries where access to educational resources is limited.

Keywords: Dental education; Feedback; Global; Mobile multimedia platforms; Social media

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Introduction

Dental schools in many developing countries have limited educational resources and lack opportunities for chair-side teaching. Faculty at the School of Dentistry at Muhimbili University in Tanzania noted that shortages in teaching resources limited students' ability to learn didactic material and affected their performance in clinical exercises and patient care.[1] Dental students at the University of the Western Cape, South Africa, did not have much training in a clinical setting before becoming dentists themselves.[2] Consequently, many of these countries are finding ways to upgrade their dental education systems.[3] A study conducted in Vietnam showed that, after a three-hour global teaching initiative, students improved their surgical skills significantly.[4] Furthermore, there is a growing interest in helping dental students in developing countries improve their professional training. A study conducted with dental students in the US and Bulgaria showed that most students agreed that dental schools should have a moral obligation to improve oral health care worldwide.[5]

Much of dental diagnosis, which constitutes a significant portion of dental education, requires practice and experience to perfect, which is difficult given the time constraints in dental schools.[6] Traditionally, dental radiology is taught through lectures, which can be costly and time-consuming.[7] Moreover, the diagnosis of dental caries and pathology is highly visual by nature; therefore, teaching dental diagnostics in lecture format may not be effective for some learners. Experienced clinicians have the advantage of having seen thousands of radiographs and clinical cases.[8] Increasing the exposure of students to radiographic and clinical images may help improve their diagnostic skills.

In recent years, there has been a proliferation of blended education or the combination of traditional lectures with online instruction.[6] Online platforms can not only provide a new medium for delivering information but also motivate learning and create opportunities to make lecture materials more available and interactive. The use of mobile multimedia platforms (MMPs) may particularly help supplement learning from traditional lectures and equip students with the skills necessary to improve diagnostics. Mobile multimedia platforms (MMPs) are currently used by individuals and corporations to share user-generated content or serve as visual marketing tools. MMPs such as Instagram, Facebook, and Snapchat are used to consume social media content and have recently found a niche in delivering educational information. The generation born after the 1990s is particularly proficient in the use of these platforms and is exposed to extensive content from peers and companies.[9] The increased use of MMPs for educational purposes, coupled with their popularity among the current generation of students, creates opportunities for MMPs to serve as an alternative method of teaching.

There is minimal literature on the use of MMPs as an educational tool in health care professions, let alone in dentistry. More specifically, there is a gap in the literature in studies exploring the usefulness of MMPs in teaching dental diagnosis. However, the few studies that do examine MMPs as an educational tool may have implications for the use of social media in dental education. A 2018 study showed that, at a joint ADEE/ADEA workshop in London, social media were useful in training faculty to teach more effectively.[10] Another study showed that there was significant self-assessed progress in MEDP skills after Facebook was used as the teaching medium for a course taken by Syrian dental students on medical emergencies in dental practice (MEDP).[11] Student perceptions of the use of social media in education have also been largely positive. A 2018 study showed that most medical students preferred to use social media to learn pathology.[12] Another study conducted with dental students in central India showed that most students believed that they could benefit from incorporating social media into their professional course studies.[13] Twitter was used in an oral radiology course, and a study showed that students perceived the use of Twitter as helpful in increasing exposure to radiographic examples and access to the instructor.[14] Further, a study showed that most students perceived the use of social media—Facebook, WhatsApp, and Instagram—advantageous in learning infection prevention and control methods because the platforms were easily accessible, allowed information to be obtained quickly, and included images that enabled effective assimilation of information.[15] Another study detailed how the highly visual nature of Instagram was particularly well-suited to teaching surgical content.[16] Currently, there has been a decline in the use of Twitter and Facebook but a notable increase in the use of Instagram among students.[17] Approximately 90% of Instagram's over 150 million users are aged 35 years or younger.[18] Among students using Instagram, 82.8% were using social media for educational purposes.[12] In addition, more dental educators are starting to post online educational content on Instagram. In a study, Instagram accounts were audited, and 80 accounts were found to have a focus on medical and dental anatomy; these accounts had numbers of followers ranging from 513 to 2.1 million.[18] Based on research that has shown positive responses from students regarding social media use in dental curricula and increasing preference among students for platforms like Instagram, there appears to be an opportunity to explore the benefits and limitations of Instagram as a learning tool in teaching dental diagnostics. By creating dental learning modules that can be presented on an MMP, we may be able to connect students more efficiently to high-quality education at lower costs. This study may be useful in creating an inexpensive tool that educational institutions in developing countries can use to improve their dental curricula. Incorporating learning modules into a social media platform may help improve professional education in developing countries where access to educational resources is limited. In this study, we aim to evaluate whether MMPs can be used as an effective teaching tool for dental education.

Materials and Methods

This study was a voluntary interventional trial composed of senior dental students at Huế University of Medicine and Pharmacy. Students were given the option to participate in the study. All students received a brochure explaining the details of the study translated into Vietnamese (Appendix 1).

Students implied consent if they decided to participate in the study.

The MMP used to incorporate dental diagnostic learning modules was Instagram Stories. Five Instagram Stories modules were created based on the following topics: dental anatomy, caries diagnosis, periodontics, endodontics, and oral radiology.[12] These topics were chosen because they covered the breadth of what is generally taught to predoctoral dental students to prepare them for clinical practice.[19] Initially, Keynote®, a presentation software application, was used to draft the learning modules. The slides were mostly visual, with minimal text, and were consistent with the basic dental curriculum taught at the predoctoral level in dental schools in the US.[19] The images were taken from online open-access sources as well as lecture material from Harvard School of Dental Medicine. All slides were translated into Vietnamese by a translation service. The slides were subsequently uploaded as modules on Instagram Stories (Figure 1).[20] After the modules were published on Instagram, students were granted access to them and instructed to study the MMP modules. They could use the learning modules as many times as they liked and at any time during a four-day period on a mobile phone or internet-connected computer. A period duration of four days was chosen to give students enough time to study 280 slides when students would have otherwise attended a lecture consisting of about 70 slides each day. With this amount of exposure, it was thought that students would learn at the same pace as in a traditional lecture setting.

While working through the modules, students had two options. First, they could allow the story to run on its own. This resulted in each slide's image being displayed for 7 s before automatically advancing to the next, but the progression could be paused by the student at any time (Figure 1b). If a student selected this option, it would take approximately 30 min to view all the story content. Second, by clicking or touching the screen, students could advance the story before seven seconds had passed or skip slides that they were already familiar with, allowing them to control the content exposure rate.

The participating students were assigned random identification numbers used to label submitted documents. All data collected remained anonymous. Initially, students answered a baseline 35-question test on dental diagnosis and filled out a validated learning style questionnaire, as shown in Appendix 2. The students were given the examination in a lecture hall via an overhead projector. There was one question per slide, and the projector automatically advanced after 20 s. Students recorded their answers on a sheet of paper with their unique identification number. Once completed, the answer sheets and the learning style questionnaire were collected by the student representative and placed in an envelope.

After students finished taking the baseline test, the Instagram account name was displayed, granting students access to the MMP modules. This allowed students to view the account on their mobile devices and study the modules of the Instagram story. Four days later, students' diagnostic skills were tested (35 questions) using a test like the one used to determine the baseline. The test included the same images as the baseline, but they were presented in a different order with shuffled answers. Further, students filled out a feedback survey on how they felt about using the modules. The survey questions focused on student perception of learning through an MMP, student preferences for its implementation in the curriculum, and students' internet use and access prior to the study. Moreover, students reported on their prior use of mobile technology to facilitate their dental training (Appendix 3). The datasets, including students' test scores, learning style indexes, and session feedback, were entered into a Numbers® (Version 5.3) spreadsheet. The data were sorted using the students' unique identification numbers and analysed using Numbers®. One-tailed paired t-tests were used to compare the differences between sample sets. The statistical significance was set at a p-value of <0.05.

Results

There were 106 students who elected to join the study. Of this set, 17 students chose to drop out or were unable to complete all the exercises. Students who did not complete both tests were excluded from the analysis. The final number of students whose data were used for the analysis was 89.

Access and use of technology amongst dental students at Huế University of Medicine and Pharmacy before the study

Figure 1 shows a typical content slide from an MMP module. All 89 dental students who participated fully in the study reported that they owned a device that supported MMPs. Figure 2 shows that most students had access to laptops or computers (89%), and almost all owned either an iOS or Android-type smartphone (98%). Students primarily used Facebook and Instagram MMPs, and these platforms were used mainly for chatting with friends and sharing photos and videos. Eighty-two percent of the students were already using MMP technology for educational purposes, and most students used technology for 3 to 6 h a day. One student primarily accessed the internet while at school, whereas the rest
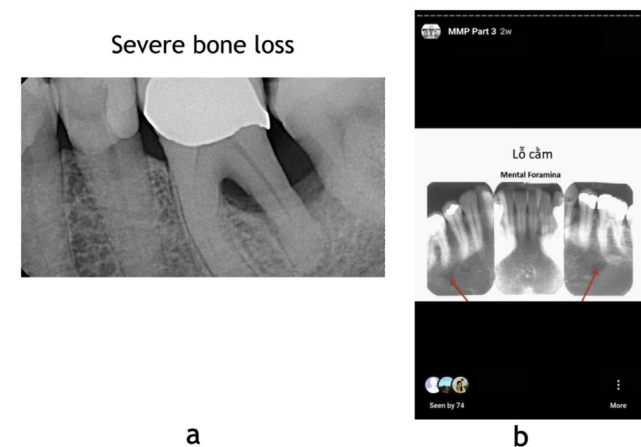

Figure 1: Sample slides from an MMP learning module: (a) a typical slide from one of the five Instagram Stories modules, (b) a radiographic image with an arrow pointing to the anatomic landmark of note and a label identifying the landmark in both English and Vietnamese.
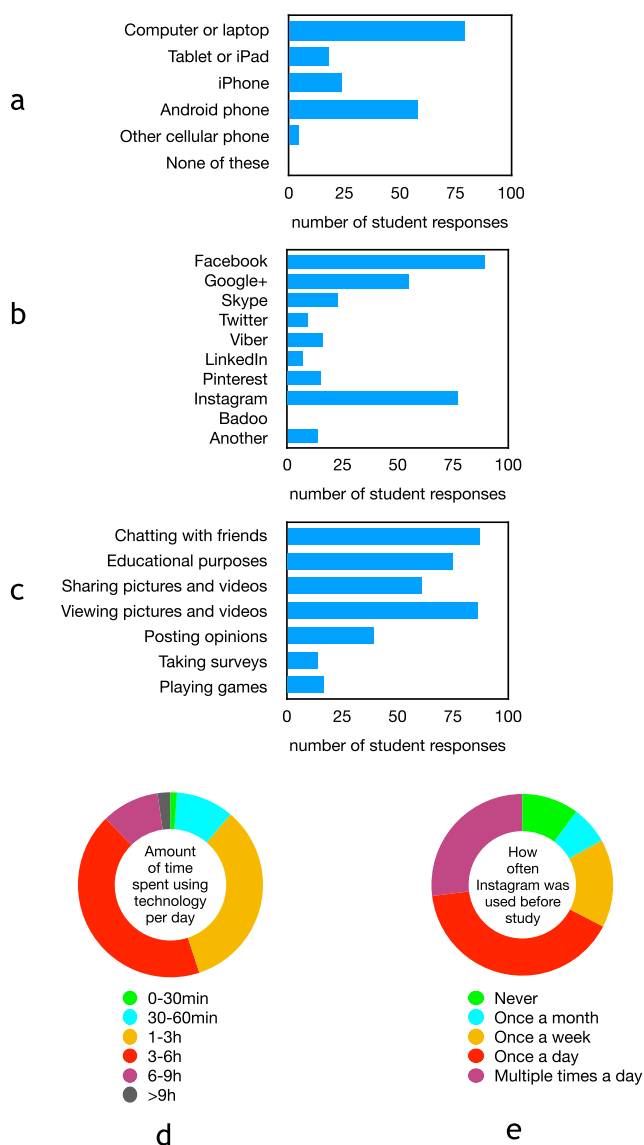
Figure 2: Pre-trial surveyed use of MMP technology: (a) shows the devices students had for accessing MMPs. Facebook and Instagram were used the most by students (b) to view pictures and videos, chat with friends, and learn for educational purposes (c). Most students spent 3−6 h a day using technology (d). Before the study, most students used Instagram at least once a day, and only 10% reported never having used it (e).

use reported by students. Forty percent of students used Instagram once a day (40%), while 10% reported never having used the platform before the study.

Effect of the intervention

After students were exposed to the MMP teaching modules, their diagnostic test scores increased significantly ($p < 0.05$) (Table 1). Those who reported using the modules for 15−30 min showed the greatest improvement in their diagnostic test scores (16%) (Table 2).

Use of MMP modules

The duration and frequency with which students accessed the MMP modules over the four-day period varied (Figure 3). Most accessed the MMP more than three times. A quarter of the students did not access it at all, another quarter accessed the MMP a single time, and half accessed the modules at least two times. Half of the students used the modules for 15 min, and over a third used them for more than 15 min.

Feedback on MMPs

The students overwhelmingly agreed that the Instagram Stories platform was easy to access and use for studying (Figure 3). Sixty-seven percent of the students preferred using the Instagram modules to traditional lectures to learn about oral diagnostics. Ninety-two percent of students wanted more of their dental curriculum to be taught using social media. All the students in the study wanted some social media incorporated into their dental curriculum.

Effect of MMPs on diagnostic skills

Table 3 shows how various learning styles may affect how well students can learn oral diagnostics from Instagram modules. We sorted score changes based on the learning styles of the 86 students who took the learning style survey. Those who identified themselves as moderate or strong visual learners had the greatest score change, with a 23% increase, whereas those who identified themselves as moderate or strong sequential learners had the lowest score change at 17% (not statistically significant).

of the cohort reported that they primarily accessed it at home. All students checked social media at least once a day, with 93% checking multiple times a day and 7% checking once a day. Figure 2 also shows the amount of pre-trial Instagram

Table 1: Students' diagnostic test scores before and after exposure to an MMP.

Baseline score	After MMP	t-test	n
49%	73%	<0.001	89

Table 2: Duration of reported time spent using MMP and effect on score change. The greatest score change was in the 15−30-minute group, and most students used the modules for fewer than 15 min.

Approximately how long did you spend using the Instagram modules?	n	Score change
None	10	6.1
0−15 min	46	8.7
15−30 min	18	16.3
1−2 h	11	9.8
2−4 h	2	7.0
9+ h	1	8.0

Figure 3: Student feedback on MMP use: most students spent 15 min on the modules (a) and accessed them more than three times (b). All students wanted at least 25% of their curriculum to be MMP-based, (c) most students found the modules easy to access (d) and study, (e) and most wanted more MMP lessons in the curriculum (f) and preferred them to traditional lectures (g).

Table 3: The effect of dental students' learning styles on diagnostic skill improvement via an MMP. The improvement percentage was the final test score minus the baseline test score. The improvement percentages were sorted by learning styles (if moderate or strong) from the Felder and Silverman 'index of learning styles' questionnaire.

Learning style	Activist	Reflective	Sensing	Intuitive	Visual	Verbal	Sequential	Global
Improvement percentage	7.21	6.43	7.91	Na	8.19	6.33	6.00	6.43
N	19	14	47	0	58	3	8	14

Source: Franzoni, A.L., Assar, S., Defude, B., & Rojas, J. Student Learning Styles Adaptation Method Based on Teaching Strategies and Electronic Media. In the 2008 Eighth IEEE International Conference on Advanced Learning Technologies 778−782 (2008).

Discussion

The use of technology in teaching is becoming more widespread. For example, more university students are choosing to purchase e-textbooks on their mobile devices instead of buying physical textbooks without detriment to their grades or cognitive learning.[21] Digital teaching applications are being built on new concepts such as virtual reality, augmented reality, and gamification.[22] Instant messaging (IM) is increasingly being incorporated into educational settings, primarily as a communication tool.[23] A study of first-year biomedical science students found that those who used Twitter as a means to communicate with staff and peers concerning course content received significantly higher semester grades than those who did not.[24] This study was conducted to explore the use of an MMP to learn oral diagnostics and provide an overview of students' perceptions regarding the desirability of incorporating an MMP into the dental curriculum.

In this study, four results should be noted: 1) most students had positive score changes on the tests administered after learning oral diagnostics through an MMP; 2) most students preferred learning oral diagnostics through Instagram modules compared to traditional lectures and wanted more of the dental curriculum to be taught using social media; 3) most students found accessing and studying the Instagram modules easy; and 4) students who had a visual learning style tended to experience the greatest score change, but all students experienced a positive score change regardless of their learning style. There was a general improvement in scores after students used the Instagram modules to learn oral diagnostics; this could have positive implications for the effectiveness of using MMPs to learn oral diagnostics. The largely positive response and feedback of the dental students at Huế University of Medicine and Pharmacy regarding the incorporation of Instagram modules into the dental curriculum and the fact that most students use social media daily suggest that dental students, in general, would find using MMPs to learn about oral diagnostics beneficial to their education. Finally, MMPs present information visually, and there seems to be a correlation between having a visual learning style and benefitting the most from learning through MMPs (not statistically significant). However, students with other learning styles most likely also benefited from using the MMP for educational purposes, as there was a positive change in test scores regardless of learning style. This could have implications for incorporating MMPs into an educational setting in which students have various learning styles.

In further studies, it might be helpful to introduce the long-term use of MMPs at dental schools in developing countries. We acknowledge that this study was conducted over a period of a single week. This may not have been enough time to fully investigate the effectiveness of teaching oral diagnostics through MMPs; however, it is evident that students effectively learned oral diagnostics through exposure to an MMP based on the positive score changes. Other variables, such as whether students can retain the information well long term through this mode of learning, were not included in this study. If MMPs were incorporated into the dental curriculum, students might approach the material presented in them more seriously, as it would be a part of their curriculum rather than for a one-time study. Requiring students to use MMPs throughout the academic year might also allow them to acquire strategies for how to best utilise MMPs to maximise their learning experience. Thus, it would be useful to increase the exposure time of students to MMPs (over weeks or even months). By collecting data on overall usage and test score results over a longer period, we could better assess the effectiveness of MMPs in helping students learn oral diagnostics throughout their dental school training.

We also acknowledge that this study was conducted with a single class of dental students and did not have a true control group. A crossover study would have been a more appropriate design; however, at the time of the study, most students at Hue University of Medicine and Pharmacy were already using Instagram. It would have been nearly impossible to release the Instagram story to only half the class without exposing the control group as well. Moreover, having an isolated control group might have provided an educational disadvantage to the students in it and was thus deemed unethical. Future studies might involve having tests administered to an entire class that has not been exposed to the traditional lecture-based dental curriculum or designing a crossover study with students from two isolated dental schools. This would allow a comparison between students who learned oral diagnostics through an MMP and those who learned oral diagnostics in a traditional classroom setting. A comprehensive collection of material in slide form is necessary to create learning modules. This can be a labour-intensive process but can have practical benefits, as such a collection can be used with subsequent classes of students and in multiple dental schools across the world if done well.

Limitations

This study's limitations include the fact that a single class of students from a single institution was recruited, which could affect the generalisability of the findings. However, the strength of the study lies in the high participation and survey response rate. The findings garnered from this study can be used to develop further studies assessing the perception and performance of students of multiple classes and institutions.

Another challenge involves concerns over the privacy of the technology. However, privacy issues were overcome in this study, as students could 'follow' the account where the learning modules had been posted without the learning account 'following' each student. Another limitation of the study is the short amount of time over which the study was conducted (a week). Future longitudinal studies should be performed over longer periods, preferably for an entire academic semester or year, to assess whether an MMP enables better learning of oral diagnostics. Further, it may be necessary to consider the perceptions of faculty towards incorporating an MMP into their teaching curricula.

In addition, the study measured students' diagnostic skills through didactic tests and did not involve testing students' skills in clinical practice. Despite this limitation, the study still showed that MMPs might be advantageous in an educational setting, particularly in resource-limited areas.

Conclusion

MMPs are widely used, can facilitate the distribution of large quantities of content, run on existing devices that are ubiquitous in developing countries, and provide a user-controlled experience. Further, they allow the teaching and learning process to occur at any time and place. This research could help bring high-quality, low-cost medical and dental education to developing countries and ultimately improve patient care. It may also have applications in the US, such as helping to lower the cost of dental and medical education.

Source of funding

Conflict of interest

The authors have no conflict of interest to declare.

Ethical approval

Ethics approval was received from the Harvard University area Institutional Review Board IRB 18-0994. Participation in this study was voluntary, and students implied consent if they decided to participate in the study. This study does not contain any individually identifiable data, as each student was assigned a random identification number used to label submitted documents. All data collected remained anonymous, and the data were sorted using students' unique identification numbers.

Authors contributions

RT, RHT, and YHN co-conceived the study design, created the research materials, and drafted the manuscript. CDBH constructed the MMP learning modules and translated them into Vietnamese. DMH collected, organised, and analysed the data and coordinated the intervention. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jtumed.2020.05.008.

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