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REVIEW ARTICLE

ESSENTIAL ONLINE TOOLS AND LEARNING SITES IN DENTISTRY: A CO-CREATED REVIEW

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ABSTRACT

Background: The Internet and the connectivity it offers have become the hallmark of modern-day living. After the COVID-19 pandemic, the use of the Internet has grown exponentially and become a routine part of daily life. Rapid advancements in digital technology have led to the development of various digital tools in dentistry, enhancing both learning and clinical practice.

Objectives: This review aims to highlight the role of different online learning platforms, simulation and interactive tools, and patient education platforms in dentistry. It also seeks to summarize their advantages and key features that support dental education, diagnosis, treatment planning, clinical improvement, and research.

Results: The review identifies several essential e-learning and digital tools that provide interactive and simulation-based learning experiences. These platforms facilitate theoretical understanding, practical skill development, patient communication, and research advancement in dentistry.

Conclusion: Digital tools and e-learning platforms play a crucial role in modern dental education and practice. Their systematic adoption by educators and clinicians can enhance teaching, learning, and clinical outcomes, ensuring preparedness for the demands of contemporary dental practice.

***Keywords*: Dental education, online learning, e learning platforms, interactive learning tools, simulation tools, tele dentistry**

INTRODUCTION

Internet usage and literacy are growing at a rapid pace among the world population. A majority of dentists, dental students and dental healthcare workers use internet for scientific purposes, including for education, reviewing literature, using and adapting to newer digital tools and for continuous professional development.[1,2,3–5] The integration of online learning in the realm of dentistry has also gained significance during the COVID-19 pandemic, which necessitated a shift in traditional teaching formats to digital. Advancement of digital technology and its use lead to development and enhanced use of teledentistry across the board. Further, newer tools have also been integrated into the diagnosis and patient information arena. The use of digital technology provides increased access to information thereby enhancing knowledge and experience. Furthermore, it also promotes cooperation among different dental professionals, including research teams, doctors, dental

laboratories, and students. Increased professional cooperation results in the strengthening of professional, research and community service capabilities. Hence, this comprehensive review focuses on different key online tools and learning resources that are emerging as valuable and indispensable tools in modern, day-to-day learning and practice of dentistry.

1. E-Learning Platforms:

Numerous online platforms have established themselves as essential resources for dental education and knowledge dissemination. These platforms offer extensive online courses that cater to a wide range of topics, from theoretical concepts to practical skills that can be implemented in clinics. These tools provide platforms with innovative ways for the learner to engage in the subject matter by offering diverse modalities of learning such as videos, virtual simulations and live interactive sessions.[6,7] Coursera and eDX are example of notable e-learning platforms.

Coursera is an e-learning platform offering wide variety of courses. The platform partners with reputable universities like Stanford, Princeton and technical giants like IBM and Google worldwide to provide high-quality educational resources. Evidence shows that professional developmental courses in dentistry provided by coursera have contributed positively to dental education and oral health.[8]

edX is an another online learning platform for universities to provide specialised courses in health and dentistry, often free of charge.[9] However, it is important to acknowledge the e-learning paradigm's drawbacks and challenges.[10] Research indicates that although students like the flexibility of online learning environments, they lack the social interactions and real-world experiences that traditional classroom settings provide.[11] There is a definite desire for a hybrid paradigm that employs e-learning to supplement instructional content while keeping the essential hands-on training, according to research on dental students' experiences during the epidemic.[12,13] This balance reflects the need for education and professional development to keep pace with the changing educational landscape while also meeting the expectations of dental professionals for both academic and practical training.

2. Interactive Learning Tools:

In dental education, participation and engagement are of paramount importance. Interactive learning tools are designed to foster participation and enhance understanding:

Quizlet: It is a widely popular innovative learning platform which enables users to create flashcards and quizzes, which can be particularly useful for memorising dental terminology and concepts.

Kahoot!: It is an engaging and interactive game-based platform that allows instructors to create fun quizzes and polls, contributing to a dynamic classroom experience.

Epuzzle: It is an interactive platform that primarily helps educators create video content. A recent pilot study by Lopez et al demonstrated that using the Edpuzzle platform can improve students' proficiency in paediatric dental practices.[14]

Moodle: It is an open-source, customizable learning management software that can be used by educators and learners.[15,16]

Peer-to-peer Learning Platforms: Sites like DentalTown and Dentalxp offer forums and discussion groups along with lectures, publications and presentations where dental professionals can share insights, case studies, and best practices.

3. Simulation Tools:

Simulations offer a hands-on approach to complex dental procedures. Dentistry requires coordinated motor skills and adequate knowledge for effective treatment plans. Although cadavers are still used in traditional pre-clinical teaching, pre-clinical training has shifted to simulation due to budgetary, moral, and supervisory constraints. As haptic technology, like as robots, gains traction for improved communication and simulation in healthcare settings, computer-aided learning, augmented reality, and virtual reality are being utilised more and more in simulation to augment dental learning.[17,18] Moreover, Healthcare practitioners can also employ virtual reality (VR) distraction as a useful strategy to assist patients in dealing with uncomfortable treatments. In a recent study by Ghobadi et al, it was found that VR successfully decreased pain and anxiety when compared to no VR. Moreover, the physiological data also correlated with the questionnaire results. The authors concluded that VR technology can be used by dentists to manage patients' pain and anxiety.[19]

Augmented reality(AR) Simulations and Virtual Reality (VR) Simulations: Simodont® Dental Trainer, HVRS Simodont, Oculus Quest 2 are some of the systems employed for teaching dental students. While commercially available VR sets including Samsung, LG, VR box and Oculus Quest 2 have been employed in anxious patients for distraction with much success.[20–22] Such technology allows dental students to practice procedures like dental cavity preparation, suturing, root canal or crown placement without risk to actual patients.

CAD/CAM Technologies: Tools like CEREC (Chairside Economical Restoration of Esthetic Ceramics) are a revolutionary dental technology that enables the design and fabrication of custom ceramic restorations digitally directly within a dental practice. Thereby enhancing the knowledge of digital workflows, reducing the treatment time, and getting the practice to a contemporary level.[23]

4. Patient Education Tools:

Patients may learn a lot about oral health-related issues from a variety of websites, and patient education is just as important as teaching professionals. Websites like **MouthHealthy.org**, which is managed by the American Dental Association, raise public awareness of dental health by providing patients with a vast amount of information on subjects including cavity prevention and oral cleanliness.[24]

5. **Tele-Dentistry Applications:**

Teledentistry has shown promise in improving access to dental care, particularly in rural and isolated areas, and its use has accelerated by the COVID-19 pandemic.[25,26] Applications such as **Teledentix** is designed to facilitate remote consultations, allowing practitioners to evaluate patients without an in-person visit. Dental chat, Sesame, denteractive, dentulu and toothpic are some of the other commonly used teledentistry platforms.

6. Continuing Education (CE) Websites

Continuous education is not essential not only for obtaining the professional licensure but also for the professional development. Different continuous education online platform are available:

The CE Center of the American Dental Association (ADA): For professionals looking to improve their knowledge and abilities on a range of dentistry-related subjects, it provides a large number of training programs and courses.

Spears Schooling: Its main goal is to give dental professionals advanced training via live lectures and online courses.

DentalCare.com: This website offers continuing education materials on subjects including clinical practice and preventative care that are especially tailored for dental professionals. .[27] Additionally, it offers patient education materials in many languages.

Dentalxp.com: Launched in 2006, Dentalxp.com is a prominent online resource for dental professionals, including webinars, on-demand courses, educational resources, videos, articles, and forums to improve their skills and knowledge.[28] Dental practitioners may improve patient care, expedite processes, and improve clinical results by using the training and e-learning tools offered by the Institute of Digital Dentistry (IoDD), an educational platform that uses digital technology to improve dentistry.[29]

CAPP Dental Academy: It stands as an institution dedicated to advancing dental education through innovative training programs and continuing professional development. It offers online continuing dental education courses, live webinars, professional onsite training programs as well as university integrated courses.

7. Online Dental Tools:

http://ebhnow.com/wp/applications/ It is an online, evidence-based tool that provides access to evidence-based literature on dental restorations. It provides the current evidence-based literature in a highly consumable format for clinicians and thus helps circumvent the cumbersome process of literature searches and reviews.[30]

www.perio-tools.com/ It consists of a comprehensive plethora of periodontal tools which can be employed in the diagnosis and treatment of periodontal diseases.

Periodontal Risk assessment is a way of examining risks so that they may be avoided, reduced, or managed.[31] Risk assessment is defined as "the process by which qualitative or quantitative assessments are made of the likelihood for adverse events to occur as a result of exposure to specified health hazards or by the absence of beneficial influences."[32] The periodontal risk assessment model was put forth by Lang and Tonetti in 2003. Six vectors based on six criteria (clinical, systemic, and environmental aspects) make up the functional design. When determining a person's risk of periodontal disease progression, all of these factors are equally weighted.[33,34] It is available for no cost at **www.perio-tools.com/PRA** . It is a helpful tool in periodontal disease management, providing online personalized periodontal risk assessment in multiple languages.

Supportive periodontal therapy(SPT) normally follows active periodontal therapy to aid in preventing periodontal disease recurrence and the maintenance of treatment results by maintaining good oral hygiene. The need and success of SPT have been elucidated in multiple long-term studies.[35] The following link **https://www.perio-tools.com/spt/uk/** offers individualised evidence-based suggestions for scheduling supportive periodontal therapy based on the patient's risk profile.

Further, this link **https://www.periodontal-health.com/** provides periodontal disease information. While this link **https://www.oralhygiene-instruction.com/en/** provides a visual aid of oral hygiene procedures and has multimedia resources available in a simple and digestible manner.

Digital tools are not just limited for use in assessment of natural dentition but have also been evolved for use in assessment of dental implants. Peri-implantitis is a severe disease which affects peri-implant hard and soft tissues, leading to their loss. It has a high prevalence of up to 56% and there exists a need to assess, monitor and prevent any inflammatory process in the vicinity of dental implants.[36,37] Thus, **https://www.perio-tools.com/idra/en/** is a valuable online tool for estimating the risk of dental implant diseases.

Each year, millions of dental implants are placed globally.

Sometimes during retreatments, it becomes difficult to identify the implants that have been placed, especially with types and brands that are older and discontinued or with those not available regionally. The following sites offer comprehensive help in identifying the dental implants that our patients have: **https://whatimplantisthat.com/** and **https://www.spotimplant.com**

Treatment plan tools are helpful tools in planning dental treatment and visualising planned dental treatment. They can help in diagnosis and can help simplify interaction with the patients. The following is an online tool that can be of real benefit in treatment planning: **https://www.makemeclear.com/en_US/**

periodontalchart-online.com/uk/ is an innovative digital platform designed for those specialising in periodontics. It provides an interface for recording and analysing periodontal examination findings efficiently.

These online resources have significant implications for both practitioners and patients. The accessibility to these comprehensive tools and evidence-based guidelines improves diagnostic accuracy and treatment efficacy and enhances patient outcomes. The online educational multimedia available in easily digestible modules also helps heighten awareness about oral diseases and the available treatment options. These resources help encourage preventive measures, lead to informed decisions and improve compliance with oral hygiene and dental treatment plans.

8. Research and Journals:

The access to current research is vital for informed practice. The following sites are very helpful in accessing scientific research and keeping oneself updated.

PubMed: is a free online resource run by the US National Library of Medicine's National Centre for Biotechnology Information. It gives users access to a huge collection of dental literature, which includes reviews, research papers, and clinical trials.

ScienceDirect: Numerous full-text scientific papers and book chapters, including several on dentistry, are available on ScienceDirect.

CONCLUSION

By virtue of the effectiveness and accessibility of online resources and learning environments, the digital revolution in dentistry is growing day by day. These resources range from interactive tools and extensive e-learning platforms to tele-dentistry software and simulation technology and are revolutionizing dental education and practice. These online websites and tools serve as invaluable online resources for dental professionals and healthcare workers. They offer diverse diagnostic tools, treatment protocols, treatment planning tools and educational resources for dentists. To improve patient care and enhance professional development, educators, students, and other dental professionals must adopt these innovations. As the various digital platforms evolve, these resources will increasingly play an essential role in shaping modern dentistry. The future of dental education, patient care and communication is undoubtedly interconnected with technology, promising a more accessible, intriguing and enriched environment for all stakeholders.

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