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A Review of Digital Tools for Clinical Learning

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Abstract:

This study presents a comprehensive review of digital tools used in clinical learning at a time when clinical learning is moving from its core traditional format to digitalised tools. This transition has been hastened and made more imperative by the coronavirus disease 2019 pandemic. The review highlights the main digital tools used for clinical learning, the challenges, benefits and prospects of digital tools in clinical learning. These digital tools have made some gains and in this rapidly expanding digital age, and the onus rests on students, medical educators and training bodies to keep abreast with its scope and possibilities, as well as its challenges and limitations, for the best outcomes in the application of digital tools to clinical education.

Keywords:

Clinical learning, digital tools, e-learning, technology

Introduction

In recent years, learning in all sectors has moved from core traditional style to incorporate predominantly digital approaches due to technological evolution, as well as the coronavirus disease 2019 (COVID-19) pandemic.^[1] Clinical learning dates as far back as the ancient Greeks' method of rational inquiry, which introduced the practice of observation and reasoning regarding diseases. Rational interpretations and discussions led to the teaching and formation of schools such as that at Cos, where the Greek physician Hippocrates is said to have taught in the 5th century BC and originated the oath.^[1]

'Clinical' refers to the examination and treatment of patients while learning is referred to as the acquisition of knowledge or skills through study, experience or

being taught. Learning in a clinical context is prerequisite in the training of health professions; there is no alternative and there is also no comparison to the learning that comes from managing patients in real clinical scenarios.^[1] Clinical learning and thus patient management have become easier with the advent and use of digital tools in everyday clinical practice.

Clinical learning involves the application of knowledge and skills to patient care. It involves participation in supervised learning sessions in healthcare environments, which help the learners to apply what they have learnt in the classroom into practice. It can take place in different settings across the health sector and supervised by experienced practitioners and teachers who foster students' critical thinking and clinical skills safely. The future of medicine is changing based on advances in information and communication technology, and the current classroom model seems to have

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difficulties in fully preparing students for the future of medicine.^[2]

Today, technology is ubiquitous, and many individuals and firms adapt to it in their daily lives. Since the beginning of the 21st century, the world has seen significant technological advancements. The emergence of smartphones, the Internet, computers, social media and websites has paved the way for the development of digital tools that will enhance educational teaching and learning processes. There are more digital tools that are being adopted in education at present, and they have become the most important tools to help teachers and students improve their communication, collaboration and creativity skills.^[3]

This study aims to review the various digital tools for clinical learning, the benefits of these tools, particularly in the COVID-19 pandemic, the challenges associated with their use and their prospects in order to proffer recommendations on the use of digital tools for both students and medical educators.

Digital Tools for Clinical Learning

Digital learning includes teaching and learning that is enabled by information and communications technology, both inside and outside the classroom.^[4] The use of digital tools is the new trend in teaching and assessment methods.^[2] The digital technologies introduced in medical and dental education include Google Forms to collect students' answers, Zoom video conferencing, YouTube live streaming, Google art and culture (an online art museum) and choose-your-own-adventure as a story-telling technique.^[2]

Digital tools are programmes, websites or online resources that can make tasks easier to complete. Many digital tools can be accessed everywhere via web browsers that do not require downloading, and that are accessible anywhere. Digital tools, such as websites, applications (apps) and their extensions, offer interesting digital learning experiences.^[3] Digital tools provide a way to implement text, images, audio and video for an immersive experience. Frequently used digital classroom learning tools such as Chromebooks, Airtame (for wireless presentations) and tablets offer participatory and explorative digital learning for students.^[5]

COVID-19 fundamentally changed education, forcing hundreds of colleges, universities, schools, training centres and tutors to move physical teaching to virtual settings. While many institutions and public learning spaces are now reopening, hybrid forms of teaching are likely to continue for a while. The success of this model

entirely depends on the technology chosen for the job and how educators adapt to them.

There are virtual teaching tools out there for every different teaching approach for different age groups' needs and abilities. These tools cover over a wide range of things from colleague interaction, video classrooms, classrooms, to managing schedule and sticking to work hour.^[6]

Some digital tools are as follows:

Zoom

The COVID-19 pandemic popularised the Zoom platform. In addition to using Zoom to video call family members, it is a useful tool virtual classrooms and departmental meetings. This popular video conferencing platform allows more than 100 participants and helps create several breakout rooms, share screens and use group chats for smaller discussions during a lesson. It provides the opportunity to easily record lectures and for sharing meetings with colleagues who could not attend.^[6]

Google classroom

Learning management system software provides a single space for all organisations' administration, documentation, reporting and training needs, in addition to the tools to plan teaching, host virtual lessons and create assignments. Google Classroom brings together all its standard G Suite tools such as Docs, Sheets and Hangouts, to help seamlessly manage and deliver virtual teaching.^[6]

Computer-aided instruction (computer-assisted learning)

This learning method has the advantage of being able to easily visualise complex procedures, and its principal advantage may be excellent accessibility.^[7] Through the widespread use of the Internet and various electronic devices, clinical education, which conventionally could only be conducted in the school setting, and especially in practice rooms, can now be carried out at home, on the road and above all repeatedly at the pace of learning until the students are fully acquainted with the corresponding material. Wang conducted computer-aided training in pharmacology practice classes for Australian medical school students and then surveyed students to evaluate their understanding through a standardised questionnaire.^[8] In their study, 98.7% of students successfully achieved their learning goals with a positive result.^[8] This method has some limitations, as the content provided on some screens may be insufficient to replace in-person teaching and physical practice.^[8]

YouTube

YouTube is an online video platform wherein its users can upload videos worldwide.^[2] In addition,

there is a large volume of educational content on YouTube, thus it can be used as a digital tool for learning.^[2] Teachers can create a personal channel on YouTube and post educational materials for flipped learning so that students can watch the material before class. The biggest advantage of YouTube is that students can easily access YouTube on any device without even signing in, and they are already fully comfortable with how to use the platform. Another important feature of YouTube is the recommended playlists displayed on the top right. The YouTube algorithm automatically selects similar content and provides suggested videos alongside. Students can make connections with the original video and acquire profound insights related to materials by watching similar videos from different viewpoints. In addition, by using the basic streaming function of YouTube, it is possible to provide real-time interactive classes to remote students. However, YouTube live streaming clearly has the disadvantage of being unable to evaluate students' reactions face-to-face, although students can at least communicate through comments in real time. Fortunately, this technical limitation can be easily overcome by using various types of video conferencing tools, especially Zoom or Google Meet.^[5]

Cell phones

Smartphones are becoming more common in school because they offer a variety of benefits beyond calling/texting communications, quick answers and social media. Cell phones can be applied to educational uses, as demonstrated by a world scientific news study of 274 students (159 males, 115 females), in which 36.5% agreed that mobile phones assisted them in their learning.^[9] The students also posited that cell phones were an important means of international interactions between fellow students and educators. Despite some downsides to smartphones in the classroom, such as distractions, uptraining and failed multitasking attempts; the benefits of easy and mobile access to educational sources seem to outweigh the negatives.^[9]

Interactive whiteboard

Interactive whiteboards allow educators to take standard lessons and turn them into interactive activities. Interactive whiteboards like the Sharp Aquos Board are replacing overhead projectors in classrooms across the nation. Some advantages of interactive whiteboards are as follows:^[10]

Enhanced lessons

Educational contents are enhanced by interactive whiteboards which equip teachers with new, innovative ways to teach the same subject material. Because it offers students the ability to view, hear and touch, they (students) learn better and remember more.^[10]

Interactive learning

Interactive whiteboards allow students to interact with the learning material. The students become a part of the lessons, and they can also teach each other.^[10] With interactive whiteboards, students are able to provide immediate feedback, such that both learners and educators can ascertain the progress of the learning sessions.

Ease of use and access to sources of support

Interactive whiteboards are easy to use using a specialised pen; they are also easy to maintain.^[10] In addition, they are Internet enabled and offer access to various sources of support, educational information and online tools.

Electronic books

Electronic books (e-books) have become prevalent amongst the general population, as well as students, owing to their advantages over traditional books. Some schools have been able to integrate e-books into their classrooms, as shown in a South African study.^[11] In order to realise the potential of e-books and their associated devices within an academic context, where reading speed and comprehension are critical for academic performance and personal growth, the effectiveness of reading from a tablet screen should be evaluated.^[8] The results of this study indicate the majority of participants read faster on an iPad, which is in contrast to previous studies that have found reading from tablets to be slower.^[8] It was also found that comprehension scores did not differ significantly between the two media (tablets and iPad). In general, this shows that e-books can be introduced without concern that reading performance and comprehension will be hindered.^[11]

Podcasts

Podcasts have become the shorthand for audio-only media. It was originally synonymous with audio-only files shared on the Internet with the mediation of a radio station. Podcasts are cheap to produce compared to video content and allow for natural flows in the conversation between hosts and guests. Performers or experts use podcasts to cultivate an audience and make that audience feel part of a wider community.^[12] This has benefits for educators looking to create a feeling of belonging in distance education. Professional podcasting has proliferated since 2010. There is a growing trend of using freely available podcasts in teaching and learning, both as a trigger for discussion or to reinforce learning. With audio, students can listen anywhere, anytime, using mobile devices. As they are only an audio stream, they use very little mobile data.^[12]

Films

Films are particularly important in education because they help students to retain information for a longer time. Pictures and words are processed differently in

our brains, making the information stick longer than when reading print media. It helps students grasp information regarding different topics. Viewing the film in the classroom gives visual representation to abstract thoughts, and seems to aid better retention than reading texts alone.^[13] It helps students gain in-depth knowledge, develops critical interpretation and actively involved students in their studies.^[14] When teaching abstract material in multicultural academic colleges, it is especially important to create a classroom climate that encourages all students to bring their own authentic selves to the classroom. In such a climate, the instructor works hard to bring her or his whole self to the classroom. Watching films enable students to make the connection between theory and real-life situations.^[14]

Digital cameras

Digital cameras are used to enhance learning, provide motivation and as a convenient tool to empower both students and teachers. Cameras are becoming easier to use, smaller, cheaper and powerful. Teachers and students can now readily produce and use digital images with ease in any learning area.^[15] This is perhaps a justification for the inclusion of digital cameras in the curriculum.^[15]

Scanner

Scanning software is an electronic device that replicates the digital representation of an image, such as a photo or document for data input into a computer. A scanner optically generates digital images from printed texts and images, which are in paper format. In a school setup, many people can use the scanner as the scanning software is essential to office attendants, teachers and students.^[16] As a learning aid, a scanner benefits both the teacher and students in that it helps the teacher and students to replicate learning materials such as documents and images, capture and store images. It is easy to use, fast and convenient, especially for students above the elementary level. In a classroom, the scanning software is very powerful and invaluable if used together with a computer and a whiteboard. In class, a scanner would be very handy in reproducing all sorts of documents and images. To use a scanner as a learning aid, a teacher needs a document, text or photograph, a scanner and several networked computers that are functioning well.^[16]

Websites and applications: Online reference materials, games, blogs and search engines

Content websites and applications have been in use for clinical learning for some time; however, their widespread use has been facilitated by recent advances in technology and the recent COVID-19 pandemic.^[17]

1 Wong A, Ho S, Olusanya O, Antonini MV, Lyness D. The use of social media and online communications in times of pandemic COVID-19. *Journal of the Intensive Care Society*. 2021;22(3):255-260. doi:10.1177/1751143720966280

These have led to a massive shift from conventional face-to-face learning, teaching and assessment to that of an online interface. Some examples of these digital tools that have facilitated clinical learning include online reference materials, games, blogs and search engines.

The use of online reference materials and search engines, such as eMedicine, UpToDate, Medscape, Google Scholar, ResearchGate and Wikipedia, has shifted clinical learning to an unprecedented new height.^[17] The interface and resources available from these tools have immeasurable advantages and usefulness to the end-users as well as the facilitators. However, some studies conducted have shown the information contained in these tools and resources are not always authentic and accurate, as there are errors contained in them.^[17] Applications and game-based learning tools are also part of the curriculum of some schools in developed nations and are utilised as tools for clinical learning.

Social media

Social networks and virtual communities hold great value as a teaching learning tool.^[18] They may appear relatively novel or unfamiliar tools to some educators but not with the Internet-savvy students. Social media provide a user-generated and collaborative dimension of participatory learning.^[9] Social media enhance medical and clinical learning by facilitating engagements and self-reflections. They provide real-life learning experiences as students may be expected to tweet questions as lectures are ongoing.

Teleconferencing

Teleconferencing is used in continuing medical education courses, post-graduate medical education and telementoring.^[19-21]

Online medical applications

Numerous applications (Apps) assist health-care practitioners with many important tasks, such as clinical decision-making, medical education and training. Some of the popular medical applications include mHealth, Brainscape, AnkiMobile, Quizlet, MDCalc, prognosis, daily rounds, human anatomy atlas, Epocrates, Medscape, Micromedex and PEPID. They are designed to make clinical learning easier in this technological advanced world.^[22]

Some other online technological communication platforms identified that are changing clinical training include Hangout, Future learn, Teams, Google Classroom, Code Academy, Wevideo, Examus, Coursera, ClassDojo, Adobe Captivate, Classtime, Claswise, Neo, Articulate 360, Edmodo, Blackboard Learn, Docebo, Buncee, Bakpax, Elucidat, FeedbackFruits, FlipGrip, Flop, Gynzy, Goguardian, Kami, G Suite, Kialo Edu, Hapara, Edx,

Start.me, Ted-Ed, Pronto, Skillshare, Parlay, Udemy, WiziQ, Seesaw, Plurasight, Out and Lectura Inspire.^[23]

Benefits of Digital Tools for Clinical Learning

Traditional clinical learning has its advantages, including closer networking and heightened opportunities to read body language. Thus, a study by Dim *et al.* in Nigeria reported that some clinicians preferred physical to digital learning, possibly because of their belief that clinical learning was mainly taught physically in the country.^[24]

However, the requirement of being in the same physical space became increasingly difficult with rising transportation costs, border limitations, insecurity and recently the COVID-19 pandemic lockdowns. The need for digital tools to aid traditional clinical learning was conceptualised to address some of these limitations of traditional method of learning and has become an integral tool of clinical learning in undergraduate, post-graduate and medical residency programmes of many countries.

Digital learning has been shown to reduce the cost and time of traveling within and between countries. It assists in security by avoiding travel to insecure areas or during insecure periods. It also assists in the maintenance of social distancing – a key condition to limit the spread of COVID-19. Digital tools for clinical learning thus help overcome the distance, time, security and cost barriers to learning and improve the efficiency of training programmes by enabling sessions to be taken more frequently.^[25] Digital learning has indeed revolutionised learning by broadening the scope of learning, allowing learners to learn at different paces and by having a global reach.^[26]

Challenges of Digital Tools in Clinical Learning

Lack of technical skills, including insufficient computer and typing skills, is one of the barriers that can be met by educators when engaging with the development and implementation of online learning, and this can inhibit the educator's willingness or ability to engage in the delivery of clinical learning using digital tools.^[27]

Amongst medical educators, the pressure of time to allocate teaching, research and work–life balance might lead to minimal time left for mastery and development of digital materials.^[28] The negative attitude amongst educators in engaging with new technologies and tools can be seen as a barrier to the development and implementation of digital tools in clinical learning. Educators noted feeling overwhelmed with the entire

process of engaging with new tools and having little patience for navigating minor technical issues.^[28]

In addition, the lack of infrastructure, technological limitations and poor Internet in many low- and medium-income countries deter the adoption of digital clinical learning amongst both educators and students.^[4]

Prospects of Digital Learning

Innovation in digital technologies such as artificial intelligence, deep learning, machine learning, robotic surgery, telemedicine, big data and next-generation sequencing has led to ongoing development of computer-aided instruction (computer-assisted instruction), virtual reality (VR), augmented reality (AR) and human patient simulation (HPS).^[2,29,30]

Computer-aided instruction (computer-assisted learning)

Computer-assisted learning is the application of computers to aid or support the education or training of people. Other terms include computer-aided (or computer-assisted) instruction (CAI), computer-based learning and computer-managed instruction. They are a range of computer-based packages which focus on providing interactive instruction in a specific subject area.^[31] CAI has been applied in monitoring, surveillance, detection and prevention of COVID-19 in a study conducted on digital technology and COVID-19.^[32] Computer simulations and interactive interfaces have been tried in pharmacology, prediction of depth of cancer invasion, psychiatry and diagnostic procedures.^[33-37]

Virtual reality

VR is the immersion within a completely virtual environment, which is often or most easily achieved by taking over the entirety of a participant's peripheral field of view via a head-mounted display. Visual patients are being utilised in all medical specialities at present.^[38,39] A comparative study showed that a group trained with the VR simulator had an overall better performance than those trained conventionally.^[40] VR might also be used in robotic-assisted surgery and resident procedural trainings.

Augmented reality

Augmented Reality (AR) overlays digital interfaces upon physical surroundings, producing an environment that is both real and digital. This is unlike Virtual Reality (VR) which utilises technology that creates artificial environments through headsets that isolates users from their surroundings.^[41] These applications are software and/or hardware developed explicitly with AR functionality and have been applied to medical education

as anatomical teaching tools, classroom study aids, image training simulators and clinical skills interaction simulators.^[41]

Human patient simulation

Simulation is defined as a technique to replace or amplify real experiences with guided experiences that evoke or replicate substantial aspects of the real world in a fully interactive manner.^[42] It was first described in ancient times by both Confucius and Aristotle and more recently by Kolb.^[41] The use of human patient simulation cut across all medical specialities and training.^[39] At present, HPS, that is, high-fidelity mannikin use, has been incorporated into the doctor of pharmacy (PharmD) curricula across the United States.^[43]

Recommendations and Conclusion

It is recommended that workshops that allow faculty to learn this new skill and gain familiarity with digital tools be held frequently for medical educators. Adjustments and allocation of time to be spent in developing or implementing digital learning should also be made for educators. For both students and educators, there is a need for the provision of the necessary technology, tools and Internet for a smooth teaching and learning experience.

In conclusion, the explosion of digital tools for clinical learning demand improvements of digital skill sets of both educators and students, provision of the enabling environment and frequent assessments of the adequacy of these tools for efficient learning. By so doing, medical educators and students will be better prepared for the challenges of this digital age.

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