As the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic spreads across the globe, academic institutions and hospitals are restricting nonessential gatherings. As such, medical education programs are faced with a difficult choice: should they cancel all academic activities unrelated to direct patient care or adapt?

Online learning uses digital platforms to connect and engage individuals across geographic boundaries. This is different from digital resources such as textbooks, websites, or podcasts that deliver information but do not allow individuals to actively engage with each other, with the material, or with experts. Online learning takes many forms, including but not limited to seminars, discussion groups, virtual patients, and large group presentations. The current generation of medical learners makes extensive use of these interactive online educational resources (1).

Online learning has existed since the world wide web was introduced to the public domain in 1991. From basic educational computer games to the first online courses, the internet has been a medium for education for three decades. Historically, uptake of online learning has been variable in medical education. With the potential to solve the issue of social distancing required during this current pandemic, can online learning strategies effectively substitute for traditional in-person instructional methods such as grand rounds, small-group sessions, tutorials, or journal clubs? This commentary examines the utility, theory, and evidence for extraclinical teaching (i.e., teaching unrelated to “bedside” teaching) via online methods.

**UTILITY OF ONLINE LEARNING**

There are four advantages to online learning: 1) scale, 2) asynchronous and tailored learning, 3) democratization of teaching voices, and 4) efficient renewal of resources. The biggest advantage of online learning is the ability to scale, so that one teacher reaches a greater cohort of students than possible via in-person teaching, irrespective of geographic boundaries. Second, online resources can be accessed in an asynchronous fashion; learners are able to process and review material at a tailored pace. Third, with the democratizing effect and reach of digital platforms, participation in medical education
design and instruction is no longer constrained to appointed faculty from traditional institutions. The free, open-access medical education movement has introduced new and diverse voices. Finally, online resources allow for regular updating of and near-instantaneous access to refined resources, ensuring up-to-date learning.

Despite its many advantages, online learning is not immune to educational challenges. First, building online learning resources is labor intensive, and even free platforms require significant amounts of preparatory work. Thus, appropriate technical skills to navigate new digital platforms and educational expertise to adapt resources to an online format are required. Second, not all learners have equitable access to computers and/or mobile devices with high-speed internet access, limiting the utility of digital platforms. Institutional acceptance is essential. Without strategies and support, some learners may be disadvantaged.

Third, spontaneity of conversation and etiquette of interaction can feel artificial and forced at times. Although this can be variable, one notable issue that can continue to hamper the quality of the interaction is the resistance of educators when engaging with new technology or tools.

EXAMINING THE EVIDENCE

A meta-analysis by Cook and colleagues found that internet-based instruction for health-profession learners is associated with large positive effects across different learners, learning contexts, clinical topics, and learning outcomes. When compared with traditional in-person learning, there was little difference, suggesting noninferiority for online learning. However, the pooled estimates favored internet-based instruction for that vast majority of outcomes.

Online learning, however, does not simply work by virtue of information availability on the internet. Cook and Steinert found that success is more likely when courses address a relevant need, facilitate communication and social interaction, and provide time to complete course activities. Opponents of online learning formats point to the effectiveness of traditional in-person learning, as students believe they have learned less in online courses and are treated with more respect in in-class courses.

However, the pooled analysis from a robust systematic review and meta-analysis found that digital problem-based learning was more effective at improving knowledge than traditional problem-based learning and was more effective than traditional learning in improving skills. Furthermore, with respect to student satisfaction, although the results are mixed, the majority of the included studies reported neutral or improved satisfaction scores.

More recent work by Richmond and colleagues looking at the effectiveness of online learning for licensed healthcare professionals found similar results compared with Cook and Steinert. Despite the low quality of evidence with respect to the included studies, the meta-analysis suggested that online education may be as effective as alternative methods for training healthcare professionals.

Finally, a third and more recent meta-analysis by Pei and Wu found that there is no evidence that in-person learning is superior for undergraduate medical education, with online learning leading to greater post hoc test and retention scores.

ONLINE LEARNING AND EDUCATION THEORY

There is nothing magical about a digital platform that can correct poor curricular
design or inattention to education theory. A digital platform is simply a platform. Effective online learning must attend to the necessary interaction between learner(s) and teacher(s) that facilitates learning. Vygotsky’s (11) sociocultural development theory stresses that social interaction is key to cognitive development. Online learning platforms must allow teachers to support learner development. Digital communication is essential to facilitate modeling, feedback, instructing, questioning, and cognitive structuring. The social learning theory of Bandura and Walters (12) postulates that people learn from their environment through observation, imitation, and modeling. Herein lies the responsibility of the learner and teacher to engage with both the material and the online community. The online-learning social environment is notably different from in-person learning in that observation can be challenging. New video and text technology can facilitate observation and create social interaction, but online educators must be attentive to the design. Peers influence changes in an online platform, but this can be used in an advantageous manner. For instance, social learning theory suggests that motivation can originate from being rewarded. Adding gamification principles to online learning is one way to drive learning (13). Online learning also presents a unique opportunity to create an online community of practice. A community of practice is defined as the collaborative, informal network that supports professional practitioners in their efforts to develop shared understandings and engage in work-relevant knowledge-building (14). The theory of sociomateriality emphasizes that the influence of the digital platform impacts how online communities engage with each other (15). Teachers should not assume that in-person communities of practice will be exactly replicated online. Nonetheless, working toward a common goal, facilitating varied and regular engagement by the community, and supporting a learning culture can all be achieved using digital platforms (2).

CONCLUSIONS

As medical education programs continue to migrate extracurricular teaching online, it is imperative that this transition is thoughtful and informed by evidence and best practice. Even after the SARS-CoV-2 pandemic has passed, online learning can continue to facilitate effective and efficient learning. As with all types of learning, online learning has many advantages and challenges. Effective implementation requires a firm grounding in educational theory with notable attention to social learning. Successful applications of online learning have yielded virtual conferences, journal clubs, and even in situ simulations (16–18). Medical education should continue to embrace innovation and lead from the front.

Author disclosures are available with the text of this article at www.atsjournals.org.

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