# Ethics behind technology-enhanced medical education and the effects of the COVID-19 pandemic

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## SUMMARY

This century has been marked by an ever-growing technology-dependent society. Medical education has not been exempt from this, with the integration of technological advancements into the classroom and laboratory. Research has been focused primarily on the impact of students' learning and perception, with limited data oriented towards the impact it will cause on future pedagogics and healthcare providers, as well as the ethical implications behind its integration in education. Although the benefits are evident, a bridge between technology-enhanced medicine and education with basic humanity should always be present. The human-centered educational experience cannot be lost. Educators must remain committed and be persistent in learning how to engage new technologies in order to prevent the loss of ethical principles and professionalism, as well as interpersonal relationships and mentoring, thus avoiding isolation, the production of incompetent healthcare professionals and unfit pedagogics. The COVID-19 pandemic forced remote teaching worldwide and will have a lasting effect on medical education. However, educational strategies need to constantly evolve alongside the integration of emerging technologies, and educators must be instructed and adequately trained for their use. As much as technology affords us enriched mediated interactions, face-to-face teaching is an important and ongoing necessity in the evolution of anatomy and medical education. Technology must be integrated purposefully in the design of learning and should complement and support the persistent need for interpersonal interaction, teamwork, and communication skills.

**Key words:** Medical education – Ethics – Technology – Technological advancements – COVID-19 – Anatomy

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## LIST OF ABBREVIATIONS:

AI: artificial intelligence

TEL: technology-enhanced learning

## INTRODUCTION

Technology has taken a strong foothold in all post-secondary classrooms —a reflection of an increasingly technology-savvy and technology-dependent society (Payne et al. 2012; Barry et al., 2016a; Stigmar, 2016; Altınay-Gazi and Altınay-Aksal, 2017; Salinas-Alvarez et al., 2020). The question now focuses on how technology is changing students' perceptions of the role of educators, the role of peer-to-peer interactions, and their own role as developing professionals (Koehler et al., 2012; George et al., 2013; Boruff and Storie 2014; Brooks and Pomerantz, 2017; Masters, 2017; Khamis et al., 2018). A proactive approach to the integration of technology, aware of the benefits and risks of technology, can build the pedagogical foundation to support a new generation that will have to bridge technology-enhanced medicine and education with the basic humanity of healthcare interactions (Granger, 2004; Alexander et al., 2009; Sugand et al., 2010; Cook et al., 2011; Barry et al., 2016b; Delgaty et al., 2017; Hennessy et al., 2019; Hildenbrandt, 2019).

The motivations to integrate technology into medical education are manifold and are at times at odds with more traditional approaches to the delivery of essential anatomy course content such as dissection. Whereas there has been ample discussion around the ethics of dissection and its role in professional identity formation (Sugand et al., 2010; Hasan, 2011; Miller and Lewis, 2016; Jones, 2018; Quiroga-Garza et al., 2017; Hildebrandt, 2019), this same discussion has been limited around the use of technology in the anatomy classroom. Most papers evaluate the impact on student learning as measured in summative assessments —and indeed, by that metric, dissection is not superior to other teaching modalities (Sugand et al., 2010; Barry et al., 2016a,b; Holland and Pawlikoska, 2019). However, body-based instruction has survived the curricular reforms. It arguably fortifies anatomy education, as a basic constructional principle of professionalism and compassion —and indeed, by that metric, anatomists affirm their preference and its benefits in the formation of future physicians (Elizondo-Omaña et al., 2005; Korf et al., 2008; Estai and Bunt, 2016; Kumar Ghosh and Kumar, 2019; Salinas-Alvarez et al., 2020).

There are many success stories of those who have implemented technology to change their curriculum. These successes need to be used as a foundation (Sugand et al., 2010; Drake et al., 2014; Barry et al., 2016a; Darras et al., 2019; Holland and Pawlikowska, 2019; Salinas-Alvarez et al., 2020). Advances in technology can support educators to enhance and reimagine more traditional course content to properly prepare students for future clinical challenges. Online and mobile access to platforms with learning modules, activities, and videos provide students with the tools to attain, understand, review, and apply knowledge that complements traditional forms of lecture-based delivery. (George et al., 2013; Krebs et al., 2014; Masters et al., 2015; Student et al., 2015; Barry et al., 2016a; Mordhurst et al., 2017; Holland and Pawlikowska, 2019; Maudsley et al., 2019). Alongside the integration of new technological platforms, the role of the educators also needs to change and adapt. How can educators continue to balance an authentic, human-centered educational experience while adapting the curriculum to take advantage of new technological developments and at the same time maintain that unique human spark and creativity? (Fig. 1).

## A PERSISTENT CHALLENGE IN MEDICAL EDUCATION

When interventions are well planned, technology can be integrated purposefully into achieving specific learning outcomes. The use of visual aids such as animations, can illustrate complex concepts and encourage innovation and creativity (Barry et al., 2016a,b; Miller and Lewis, 2016; Brooks and Pomerantz, 2017; Holland and Pawlikowska, 2019). These can be also controlled by the user/student for individual pacing and exploration of didactic content: by pausing a pre-recorded video, repeating any part of it, any day, any time, or fast-forwarding to support their own learning process. A direct access to remote content

removes the physical dependency of learning being contained to a classroom/laboratory (Alexander et al., 2009; Cook et al., 2011; Boruff and Storie, 2014; Altinay-Gazi and Altinay-Aksal, 2017; Brooks and Pomerantz, 2017). Purchasing larger volumes of a specific technology can reduce the overall cost for increased class sizes. Content can be distributed with other institutions, both locally and globally. Moderated forums allow easier participation, even for more introverted personalities. When technologies are evaluated by a multidisciplinary team, their integration can easily be improved from course to course (Elizondo-Omaña et al., 2005; Miller and Lewis, 2016; Mordhorst et al., 2017).

When not integrated within the learning ecosystem nor associated with specific learning outcomes, technology can be an impediment. The multitude of technological resources available and the lack of time result in educators' inability to keep a check on all content. This also makes it challenging to focus on what is critically important for students. Most learners build a personal relationship with their instructors, connecting the educator's passions and insights with the didactic content. This makes them care about what they are learning, which allows learners to remember the content better (Chopin, 2002; Gershenfeld, 2014; Vallée et al., 2020). Technology alone can be cold and lack human connection. These advantages can be easily ignored when technology is forced upon students and faculty, causing disengagement with the course. They can build social isolation/disconnection of the user by neglecting the need for interpersonal interactions (Huang, 2010; Rhim and Han, 2020). They can generate a social divide amongst those who lack the economic resources (Van Deursen and Helsper, 2015; Warschauer and Xu, 2018). The familiarity of accessing knowledge through various technologies may lead professionals to either overestimate or underestimate their competence (Kruger and Dunning, 1999; Abduallah, 2014). Without a commitment to persistently learning how to engage with new technologies, or when situated in a work environment that does not


**Fig. 1.-** Technology adaptations. (**A**) Balanced use of technology in anatomy education with interaction between educators, near-peers, and students in small groups. (**B**) Students in laboratory practice with face-to-face interaction. (**C**) Online teaching with video interaction and online material. (**D**) Online laboratory practice teaching students surgical knots.

have rapid access to technology, a professional's knowledge may soon be out of date. Excessive use of computers or smart-devices has also been correlated to ergonomic and health problems (Korpinen and Pääkkönen, 2011; Fuentes-Ramirez et al., 2020).

Current technological tools do not adapt in real-time or empathize with the user, although artificial intelligence (AI) may soon change that. AI will impact medical education with the application of adaptive learning, although evidence shows that it will primarily enhance the role of teachers, not replace them (Masters, 2017; Masters, 2019). The design of user experiences that respect universal design principles and are built on best practices for human-computer interactions is imperative in order to move the field forward. When not integrated, technology can increase a sense of alienation, exclude those with different abilities, and lead to social depersonalization and a loss of humanity in education.

## ETHICAL IMPLICATIONS OF TECHNOLOGY OVERUSE

Educator identities are tied to teaching and inspire learning. Behaviors from the classroom and laboratory are mimicked by students and teaching assistants, as professors become role models. (Chopin, 2002; Pawlina, 2006; Lachman et al., 2012; Gershenfeld, 2014; Masters, 2019; Guerrero-Mendivil et al., 2020). Friendlier and more accessible educators promote better learning (George et al., 2013; Hennessy et al., 2019).

The student/teacher relationship is the foundation for the physician/patient relationship. Human interaction with educators, peers, donors, set off a cascade of professionalism and understanding of medical ethics (Dyer and Thorndike, 2000; Pawlina, 2006; Englander et al., 2013; Jones, 2016; Hildebrandt, 2018; Kumar Ghosh and Kumar, 2019). These human interactions cannot be easily simulated with technology —the most extensive experiment with artificial intelligence (AI) was by Jill Watson, as an online teaching assistant, who has demonstrated the limitations of AI to date (Eicher, 2018). The overuse of technology may even cause dependence on technology in a clinical environment due to a developed habit that ensues other ethical and legal issues (Goodman, 2010; Jones, 2016; Barry, et al., 2016b; Miller and Lewis, 2016).

There is, of course, an evident need for technology in medicine: task management, data processing, and collection are some of the tasks facilitated by these tools, but how this information is managed also raises some ethical concerns. (Goodman, 2010; Tavani, 2011; Hennessy et al., 2019).

There is no formal pedagogic link between health and information technology (Goodman, 2010, Barry et al., 2016b; Estai and Bunt, 2016). One concern is the exponential growth of online resources. Many resources are user-generated and user-regulated and lack both peer review and validation. Some materials bring up the ethical boundaries within which modern anatomy programs operate —and the question of whether and how to present images of cadaveric dissections (Philip et al., 2008; George et al., 2013; Barry et al., 2016b; Miller and Lewis, 2016; Cornwall and Hildebrandt 2019; Hildebrandt, 2019). With a constant increase in student to staff ratio, time demands for research, and reduced course hours, educators must depend on the use of technology-enhanced learning (TEL) to uphold content standards (McGaghie et al., 2010; Sugand et al., 2010; Bleakley et al., 2011; Guze, 2015; Green and Whitburn, 2016; Delgaty et al., 2017; Hildebrandt, 2018).

There are risks to the use of TEL resources. If not addressed by their developers, conflict will be inevitable. Grunwald mentioned two branches to orient technology policy: the philosophical ethics implicated and technology assessment (Grunwald, 1999). Research has been primarily focused on the assessment and effectiveness of new tools, disregarding the ethics and implications of these. Social isolation, technology dependency and a lack of the natural mentoring formed by the student-teacher interaction may lead us to incompetent healthcare professionals, incapable of teaching, of developing inter-personal relations and of mentoring. Depersonalization and commodification will cause clinical detachment

(Jones, 2018; Hildebrandt, 2019) —as Sungand et al. stated: "weak and unfit pedagogics" (Sugand et al., 2010)

So, how to reconcile the integration of technology in teaching and learning experiences? There is no simple solution for medical educators when asked whether or not to include the latest tech in the classrooms (Frenk et al. 2010; Jones, 2018; Vallée et al., 2020). Educational strategies need to constantly evolve alongside the integration of emerging technologies. Within set time limits that are often imposed by administrators (Sugand et al., 2010; Drake et al., 2014; Estai and Bunt, 2016; Hildebrandt, 2019), educators are challenged to constantly upgrade skills so that they can efficiently interact with students and take full advantage of resources. Program administrators also need to ensure that they offer resources and support in order to instruct and adequately train their faculty to teach with the technologies that they want faculty to use (Salinas-Alvarez et al., 2020). For example, a balance must be defined by all stakeholders for blended learning to maintain and achieve efficient student learning outcomes (Barry et al., 2016a,b; Green and Whitburn, 2016; Miller and Lewis, 2016; Brooks and Pomerantz, 2017). As much as technology affords us enriched mediated interactions, face-to-face teaching is an important and ongoing necessity in the evolution of anatomy and medical education.

## SARS-COV-2 (COVID-19) PANDEMIC

Debating the overuse of technology was not an option for the year 2020. The outbreak of the SARS-COV-2 pandemic forced the closure of schools and the implementation of social distancing. This created a situation in which all educational programs had to transfer to a 100% remote and online education curriculum (Cheng et al., 2020; Gordon et al., 2020; Hodges et al., 2020; Pather et al., 2020). Schools with prior experience were able to migrate more easily to online platforms, with most challenges present in low- to middle-income countries (Cecilio-Fernandes et al., 2020; Muñoz-Leija et al., 2020). In many cases, educators were faced with a lack of technological resources, infrastructure and/or training, unclear instructions by administrations, blindness to student situation/capacity, and even complex home environments (Espino-Díaz et al., 2020; Rizun and Strzelecki, 2020). These created a stressful situation in which educators could have been exposed to anxiety and emotional exhaustion, in addition to the confinement imposed by the pandemic (Espino-Díaz et al., 2020).

Educators had to quickly adapt (Espino-Díaz et al., 2020; González-Calvo et al., 2020; Tejedor et al., 2020). Synchronous and asynchronous methods were implemented for remote learning (Gordon et al., 2020; Hilty et al., 2020). Once the lasting effects of the pandemic and undefined longevity of social distancing were assimilated, educators understood the need to innovate teaching methods to better engage students without face-to-face interaction (Gordon et al., 2020; Rhim and Han, 2020).

Several studies report student satisfaction and self-efficacy with online learning. The majority of students are comfortable with online and remote learning, however, the development of certain key competencies may be shown to be deficient in the future, with consequences for the professional development of physicians. In 2021 2$^{nd}$-year medical students will continue their education and will not have been face-to-face with their professor, not have been in a classroom or laboratory, not encountered an anatomical donor for dissection (in case of anatomy), or have been physically exposed to different academic scenarios. In many countries, an introduction to clinical environments was restricted due to the increased risk of COVID-19 transmission. The effects of social isolation, lack of interpersonal relationships, the exposure to anatomical donors/patients (development of values such as professionalism, respect, integrity, empathy, and humanity), the psychological effects, the level of student confidence, academic output: all need to be addressed if educators are to continue with remote learning (Chytas et al., 2020; Espino-Díaz et al., 2020; Gordon et al., 2020; Lozano-Díaz et al., 2020; Muñoz-Leija et al., 2020; Tejedor et al., 2020). Universities are facing an increase in burnout and dropout rates, as well as variability in student enrollment (Rizun and Strzelecki, 2020;

Tejedor et al., 2020; Zhan et al., 2020). Student academic misconduct during class and exams may also be present, which is increasingly challenging to detect, especially in large groups (Clark et al., 2020; Elizondo-Omaña et al., 2020; Gamage et al., 2020; Hylton et al., 2016). Multitasking during online sessions may also leave in question the lasting effects of learning (Rhim and Han, 2020). These are all issues that need to be kept in mind and addressed in the design and implementation of online and mixed asynchronous/synchronous educational offerings.

There is no doubt that the changes implemented during the pandemic will leave a lasting effect in medical education. Currently, there is an abundance of publications regarding remote teaching methods that we can draw from historically (Lynch and Dembo, 2004; Puzziferro, 2008; Barnard et al., 2009; Broadbent, 2017; Hodges et al., 2020). However, current publications detailing the impact of teaching medical education remotely during the time of Covid-19 are limited to short-term studies, and assertions are not readily generalizable across different teaching contexts. Subsequent research will be needed to determine the impact of these methods in the student's professional formation (Gordon et al., 2020; Hilty et al., 2020; Rhim and Han, 2020).

## CONCLUSIONS

The COVID-19 pandemic has caused a disruption in medical education and forced a transition of all courses to online platforms. Technology has been a fundamental solution to continue with academic curricula, with evident advantages and disadvantages. In order to have any lasting impact on the community of medical practitioners, technology must be integrated purposefully in the design of learning and should complement and support the persistent need for interpersonal interaction, teamwork and communication skills (Philips et al., 2008; Alexander et al., 2009; Englander et al., 2013; George et al., 2013; Barry et al., 2016b; Green and Whitburn, 2016; Jones, 2016; Miller and Lewis, 2016; Elizondo-Omaña et al., 2019). It must be organized, structured and curated to meet the objectives and competencies of the curriculum. Looking at the use of technology in terms of how it can enhance medical education and solve contemporary problems facing the community, educators are encouraged to resist the temptation to engage in a polar opinion as to whether technology is good or bad. Part of the research needs to continue to user-test technology in learning contexts. Disseminating those results will help others make more informed decisions as to the benefits of integrating emerging technologies and their impact on learning and the user.

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