



Back to the Future: Maximizing Student Learning and Wellbeing in the Virtual Age

Andrea N. Belovich¹ · Ingrid Bahner² · Giulia Bonaminio³ · Anthony Brenneman⁴ · William S. Brooks⁵ · Cassie Chinn⁶ · Nehad El-Sawi⁷ · Shafik Habal⁸ · Michele Haight⁹ · Sandra B. Haudek¹⁰ · Uzoma Ikonne¹¹ · Robert J. McAuley¹² · Douglas McKell¹³ · Rebecca Rowe¹⁴ · Tracey A. H. Taylor¹² · Thomas Thesen¹⁵ · Richard C. Vari¹⁶

Accepted: 21 January 2022 / Published online: 10 February 2022

© The Author(s) under exclusive licence to International Association of Medical Science Educators 2022

Abstract

The virtual age of learning is no longer a concern of the future. It is here. The Fall 2021 Webinar Audio Series (WAS) of the International Association of Medical Science Educators (IAMSE), titled “Back to the Future: Maximizing Student Learning and Wellbeing in the Virtual Age,” was designed to help health science educators equip themselves with tools to teach the next generation of health care professionals successfully. From September 2, 2021 to September 30, 2021, the Fall 2021 Series was broadcast live to audiences at academic institutions worldwide in five weekly webinars. This five-part webinar series explored theories and best practices in delivering content over virtual and online media while simultaneously promoting a positive learning environment and enhanced student wellbeing.

Developing Faculty for the Future of Health Professions Education

Presenter: Theresa Chan of McMaster University, Hamilton, Ontario, Canada

Dr. Chan opened the series with a webinar designed to empower the audience to effectively anticipate and navigate

the future of medical education and its uncertainties. She began by sharing the principles of futurism, a framework used in the business world to provide strategic foresight to businesses and institutions. When faced with a problem, professional futurists first frame the problem and determine its scope, identifying its limits and domain, as researchers would frame a research question or hypothesis. Next, futurists engage in “scanning,” which explores signals and

✉ Andrea N. Belovich
abelovich@idahocom.org

¹ Idaho College of Osteopathic Medicine, Meridian, ID, USA

² Morsani College of Medicine, University of South Florida, Tampa, FL, USA

³ School of Medicine, University of Kansas, Kansas City, KS, USA

⁴ University of Iowa Carver College of Medicine, Iowa City, IA, USA

⁵ University of Alabama at Birmingham Heersink School of Medicine, Birmingham, AL, USA

⁶ International Association of Medical Science Educators, Huntington, WV, USA

⁷ Des Moines University Medicine & Health Sciences, Des Moines, IA, USA

⁸ Philadelphia College of Osteopathic Medicine, Philadelphia, PA, USA

⁹ Sam Houston State University College of Medicine, Huntsville, TX, USA

¹⁰ Baylor College of Medicine, Houston, TX, USA

¹¹ Eastern Virginia Medical School, Norfolk, VA, USA

¹² Oakland University William Beaumont School of Medicine, Rochester, MI, USA

¹³ School of Nursing College of Our Lady of the Elms, Chicopee, MA, USA

¹⁴ University of New England College of Osteopathic Medicine, Biddeford, ME, USA

¹⁵ University of Houston College of Medicine, Houston, TX, USA

¹⁶ Virginia Tech Carilion School of Medicine, Roanoke, VA, USA

indicators from fast-moving, innovative industries (such as technology) to learn how others adapt to rapidly emerging problems and to the changing environment. The next step is “futuring,” which uses both convergent and divergent thinking to identify the baseline parameters of a current situation and projects alternatives about how the situation is likely to evolve. Once the possibilities are identified, the “visioning” step allows an organization to choose and then develop the version of the future that will ultimately best fit its needs. Once the “ideal future” is identified, an organization can implement it by prototyping. Finally, during the “adapting” stage, the organization strategizes and develops contingency plans.

Dr. Chan then discussed how this framework can be applied to a disruption (such as the SARS-CoV-2 pandemic) and how medical educators can use disruption to implement a plan. To illustrate, Dr. Chan discussed the digitization of faculty development resources at her home institution, McMaster University. She observed that while this process began in 2014, the challenges and changes brought about by the pandemic served as a catalyst, as distance learning and remote work became necessary. Dr. Chan then described how McMaster University navigated the changing landscape using principles of futurism to digitally transform its faculty development program. She shared with the audience four significant lessons learned: (1) the digital transformation of medical education and health professions education is achievable and desirable for many, (2) leaders must fold growth orientation into every aspect of our organizations, (3) social connection and networks are how we interface with the world, and (4) change is required, and educators must be ready to make and lead change. While sharing these lessons, Dr. Chan also provided examples of the tools and resources McMaster University created to support faculty development during a rapidly changing world. As most of these resources are open access and available to the public, Dr. Chan extended a cordial invitation to audience members to investigate and utilize these resources by visiting McMaster University’s Program for Faculty Development Team website [1].

Creating Learning Entities: Augmentation in Health Professions Education

Presenter: Rachel Ellaway of the University of Calgary, Calgary, Alberta, Canada

In the second webinar of the series, Dr. Ellaway guided the audience through a series of thought experiments to explore the phenomenon of augmentation and understand its implications for the practices and philosophies of health professions education. Augmentation, Dr. Ellaway explained, is the

tendency of humans to enhance our intrinsic abilities to help us engage more effectively with our environment. Examples include clothing and functional accessories, technologies that enable remote communication and/or extended cognitive abilities, and even professional organizations and communities that expand an individual’s influence and access to resources. To help the audience engage with this concept, Dr. Ellaway shared the framework of the human capabilities approach, which defines “capability” as the ability of an individual combined with the opportunity to use that ability. In this context, augmentation alters a person’s *capabilities* by changing one’s abilities, opportunities, or both. Dr. Ellaway stressed that augmentation is not limited to the addition of factors to help a person improve their capability, but also includes the removal of obstacles. Augmentation applies neatly to education, as educators rarely improve the intrinsic abilities of learners but instead add factors (tasks, structure, curriculum) and remove others (distractions, complications, unnecessary details) to allow learners opportunities to utilize their abilities. To further illustrate the concept, Dr. Ellaway discussed how an augmentation could be observed by its removal or change, either voluntarily or involuntarily. Involuntary changes such as sickness, luck, theft, travel impediments, or other external circumstances beyond our control can undoubtedly alter our abilities. Events such as the SARS-CoV-2 pandemic can diminish or remove access to augmentations such as travel, communication, and relationships that individuals previously took for granted. In this way, the pandemic provided another framework (absence) as a way to engage with the concept of augmentation.

Dr. Ellaway next demonstrated how augmentation applies to healthcare profession education by introducing the idea of *entities*. Entities emerge when a person or persons experience different states of augmentation which can each produce a distinct profile of capabilities. For example, Dr. Ellaway asked the audience to consider a physician practicing in three different environments, each with differing augmentations: a multi-professional hospital system, a rural medical clinic, and a wilderness backpacking trip. The physician has similar intrinsic abilities in each setting but possesses different capabilities based on access to resources and the surrounding environment (augmentations). Therefore, we should think of the physician as three distinct entities depending on the level of augmentations. Translated to clinical practice, patients and their families expect healthcare professionals to switch between entities and adapt to the presence/absence of a variety of augmentations in practice. Dr. Ellaway questioned whether our educational programs are training learners to do this, especially in context of admission and assessment practices. For example, when considering applicants for admission to healthcare education programs, reviewers should consider variance amongst applicants’ access to augmentations and

their subsequent entities. Medical educators must consider entities when assessing a learner's abilities: if a learner's capability changes between a strictly proctored examination environment and a clinical setting where augmentations such as technologies, information databases, and colleagues' consultation are available, how accurately does the proctored examination assess the learner's true abilities? As educators, we must consider entities created by socioeconomic status and any entities that we ourselves may create for our learners.

With the creation of augmented entities, moral and ethical dilemmas also arise. Which augmentations confer too much advantage? What do we consider "too much" advantage and how do we define "normal" advantage? Should we create situations that raise individuals from "below normal" to "above normal," and should we require individuals who naturally operate at above normal to reduce their intrinsic state to "normal?" Dr. Ellaway emphasized that while humans recognize that some augmentation is acceptable and too much augmentation is unfair, it is difficult to define a standard, acceptable, and tacit set of morals on the subject. Dr. Ellaway concluded by encouraging more deliberate and reflective uses of augmentations, along with a more critical approach to the consequences of augmentation on learners and learning, teachers and teaching, and education and practice as a whole.

Reminders, Refocusing and Rethinking: Med Ed After COVID

Presenters: Andrew Binks of the Virginia Tech Carilion School of Medicine, Roanoke, Virginia, USA; Adam Weinstein of the Netter School of Medicine Quinnipiac University, North Haven, Connecticut, USA

The third webinar of the series began by discussing how teaching and learning strategies in preclinical medical education underwent significant changes prompted by the SARS-CoV-2 pandemic and the rapid transition to a virtual environment. This transition from the in-person learning environment to a virtual one caused anxiety, frustration, and social isolation for all persons involved. Due to the rapid transition, faculty and students were underprepared for the new teaching/learning environment. However, within the new virtual format, increased student autonomy in small group learning environments resulted in positive outcomes, such as a higher student engagement, increased intrinsic motivation, and increased responsibility for learning. Ultimately, these attributes contributed to students' overall successful learning. Declining attendance at

large group lectures also provided an opportunity to apply the principles of autonomy to the large group learning environment. Strategies for application included (1) providing independent time for learning the basics, (2) allowing students to test out of specific courses, (3) decreasing time in the classroom, (4) increasing the overall value of classroom time, and (5) employing specifications grading.

Establishing a social presence online is essential to enhance social and collaborative learning practices, as interaction with peers promotes exposure to diverse experiences and perspectives. Peer interaction also increases individual accountability and positive interdependence. This underscores the necessity of expanding the use of small-group learning methods in the virtual learning space and using these opportunities to develop novel approaches to small-group learning. The importance of creating heterogeneity of views, knowledge, and experience necessitated the increased accessibility of medical school through a more holistic acceptance process for applicants.

In addition to preclinical medical education, the in-person learning environments of clinical preceptorships, clerkships, and subinternships (Sub-Is) transitioned to the virtual learning environment, using modalities such as small group video-conferencing sessions and asynchronous modules due to the pandemic. While these sessions were valuable, they were not optimal for developing communication, clinical reasoning, and discussion skills. Additionally, teaching physical exam skills in the virtual environment proved to be challenging, and many medical students sought out their own service-learning opportunities. However, fourth-year Sub-I challenges brought about positive equity changes in the residency application process, and clinical learners demonstrated autonomous, self-directed, and asynchronous learning approaches. Clinical faculty served in multiple support roles for medical students and became developers and innovators of alternative clinical teaching approaches.

While clinical bedside learning remains an essential component for medical student training, medical students must train to become clinically proficient in both the virtual and in-person environments, especially with the surge of telemedicine. During the pandemic, the increased use of telemedicine created a much-needed bridge between medical students and the ability to provide direct patient care. As a platform for teaching and learning, telemedicine is excellent for teaching observation and inspection skills through deliberate practice and meaningful feedback. However, an important caveat to consider with telemedicine's rise to preeminence during the pandemic is proficiency in using technology does not directly translate into proficiency in conducting a telemedicine visit.

Hybrid Healthcare Education: Innovating for the Future and Rethinking Student Support

Presenter: Kendra Gagnon of Baylor University, Waco, Texas, USA

In the fourth seminar of the series, Dr. Gagnon showcased examples of recommended practices for promoting collaborative hybrid and online learning as applied in Baylor University's Doctor of Physical Therapy (DPT) program [2]. As one of the first fully hybrid DPT programs in the USA, Baylor University (BU) had implemented many innovative online and distance learning strategies before the changes induced by the SARS-CoV-2 pandemic. From this perspective, Dr. Gagnon challenged the audience to consider which elements of pre-pandemic teaching and learning should be retained by health professions education programs in a post-pandemic world and which elements could (or should) be changed as we seek to return to normal.

Dr. Gagnon began by defining hybrid learning as a delivery method that uses online and face-to-face learning strategies to maximize both learning environments. She then discussed hybrid learning in the community of inquiry framework, highlighting the importance of establishing teaching presence, cognitive presence, and social presence when teaching online [3]. Teaching presence, or the structuring of learning to help students understand what information they are learning and where they need to get that information, is built online by constructing syllabi and organizing curriculum into a learning management system (LMS). Dr. Gagnon shared several critical features of BU's accelerated, 2-year hybrid DPT program, including its unique curriculum structure (utilizing several online mini-semesters interspersed with in-person labs and clinical experiences), its use of a consistent virtual "classroom," and the techniques and software used to facilitate interactive online and hybrid learning. In particular, the use of video assignment platforms, such as Bongo, allows students to record and demonstrate learned skills for assessment. Platforms such as Flipgrid allow students to replace text-based discussion boards with personalized video responses.

Dr. Gagnon also shared the Substitution Augmentation Modification Redefinition (SAMR) framework to help the audience think more intentionally about using technology to build teaching presence in online learning. Technologies that serve as a direct replacement for in-person learning with no added functionality (substitution) do not offer any possibility of improvement, whereas technologies with a functional improvement (augmentation) do. In this context, technologies can be transformative by including the

possibility of significant task redesign (modification), and/or the creation of new tasks that were previously impossible (redefinition).

Next, Dr. Gagnon shared examples of how BU promoted cognitive presence online. Cognitive presence refers to students' ability to construct knowledge and collaboratively create meaning from the information they are learning. To illustrate how cognitive presence can be promoted in a virtual learning environment, Dr. Gagnon shared an example of how she transitioned her pediatrics physical therapy lab from in-person to online during the SARS-CoV-2 pandemic. She used the online platform Padlet, which enabled each lab competency to be visually grouped with its associated materials, activities, and assignments to simulate the "feel" of a lab experience. BU implemented group video assignments and activities to help students create a learning community. Software such as Flipgrid allowed students to upload skills-demonstration videos during lockdowns and receive video feedback from faculty on their performance. Finally, the group-focused nature of the pediatrics physical therapy lab also supported the development of social presence, which involves the humanization of learning and is essential for students to feel like they are part of a community of learning.

A critical outcome of the online pediatrics physical therapy lab was the confirmation that professional identity formation is still possible through online learning. Dr. Gagnon showcased a student's reflection video from a Telehealth final exam with a patient family over Zoom. This student's reflection included commentary on how the activity helped her develop confidence in her skills and her professional identity as a physical therapist. To further emphasize the value of intentionally structuring online learning, Dr. Gagnon shared data showing high levels of student engagement achieved by this approach to asynchronous learning.

Dr. Gagnon then expanded upon creating community online when an entire program is hybrid. Students in the Baylor accelerated DPT program are located across the country, making building community a challenge. To compensate, the Baylor DPT program uses group activities during orientation (such as creating a map of students' locations) and academic teams with assigned faculty coaches to promote a sense of community amongst participants. Students take emotional intelligence and strengths finder assessments and are intentionally grouped into teams with diverse abilities. Students are given resources to promote a culture of reflection, and faculty coaches receive training to help build a shared understanding of roles and values in the teams. In addition, several non-academic and institutional support resources are also available to help students. These virtual resources and support systems were strengthened during the SARS-CoV-2 pandemic, which represented a

positive example of change that will, hopefully, persist in a post-pandemic world.

Finally, Dr. Gagnon shared preliminary outcomes of the Baylor DPT program, which matched or exceeded the average outcomes of other accredited DPT programs. Measured outcomes included graduation rate, licensure pass rate, and 1-year employment rate. However, the Baylor DPT program has a much higher percentage of minority students, both enrolled and graduated, than the national average. Based on student feedback, Dr. Gagnon suggested that the accessibility of the program helps remove barriers to minority and first-generation students and may promote increased diversity amongst students in the program. Dr. Gagnon also shared advantages of hybrid education for the healthcare professions, including scalability, flexibility, the ability to use time as a resource, the promotion of a diverse student body, and a greater ability to recruit faculty across the country. However, she also acknowledged that cost is a challenge due to the technologies, online program managers, and faculty travel for in-person lab teaching. Student workload and workflow must be appropriately managed, faculty development must be intentionally implemented, and faculty/student issues must be intentionally managed from a distance. Integrating experimental and community-based learning and service can also be a challenge. To conclude the webinar, Dr. Gagnon provided the audience with a wide variety of resources and references for more information about successful online teaching and learning.

How COVID-19 Transformed Online Teaching and Learning: or Did It?

Presenters: Jonathan Wisco of Boston University School of Medicine, Boston, MA, USA; Olivia Coiado and Jaya Yodh of the Carle Illinois College of Medicine, Champaign, Illinois, USA; Luke Read of the Norwich Medical School at University of East Anglia, Norwich, UK

Delivered by a panel of medical educators, the fifth and final session of the series relayed examples of how the speakers' respective programs adapted to the online learning environment during the SARS-Cov-2 pandemic. Dr. Wisco began by sharing how the Anatomy course at the Boston University School of Medicine (BUSM) was adapted from the traditional dissection format into a blended learning experience with a greater online learning component. Before the pandemic, the 9-week BUSM Anatomy course involved 3 weekly lectures, a weekly 2-h dissection for each student within a larger group, along with continuing dissection/recitation events in the afternoon. Students relied on the ability to access the anatomy lab to finish dissections and study from their cadaver donors outside of scheduled classes.

However, BUSM's pandemic response reduced in-person contact to 2 h each week and eliminated student access to the anatomy lab outside of class.

To meet the challenge of translating the traditional dissection course to a safe, online learning experience with minimal student-educator contact, Dr. Wisco and his team changed the BUSM anatomy course to an entirely prosection-based paradigm. Fourth-year medical students prosected all cadaver donors and set up study materials, while afternoon recitations and reviews were delivered virtually using Zoom. To help students prepare for labs, Dr. Wisco utilized flipped learning, and a detailed structure guide for medical students was created by graduate students in the Boston University Masters of Anatomical Sciences Educator Pathway. During in-person lab sessions, students were divided into smaller groups (Pods) that rotated between 6 cadaver donor stations, with 2–3 students receiving instruction from station prosectors at a time. To assess learning, the BUSM Anatomy course did not administer practical exams using cadaver donors, but instead utilized images to create hotspot questions using ExamSoft and utilized formative assessments such as in-lab quizzes.

Dr. Wisco then shared data regarding the effectiveness of each learning resource provided to students, as evaluated using a Likert-scale questionnaire, a grounded theory thematic analysis of student free-response questions (collected from 80/160 students), and a focus group of 16 students. Students indicated that the pre-lab guides were useful but were primarily used as post-lab reviews. Surprising to Dr. Wisco was the value students placed on the Zoom recitation sessions, stating that the feedback received was imperative to students' success in the course. On average, students scored 10% higher on all exams administered compared to the previous year's traditional dissection course. Based on these results, the BUSM Anatomy course will retain the use of Zoom-mediated lab recitations in future courses. Dr. Wisco concluded by emphasizing the importance of establishing a culture of trust with clear objectives and expectations as well as activities that help students learn and perform well on exams. He also shared the importance of ensuring that assessments reflect students' learning activities. He further shared the observation that faculty are no longer the primary source of information. Still, the ability of faculty to provide formative and timely feedback to students is more important for student success. Finally, by involving students as partners in the feedback process, curriculum transformation can be better informed.

Dr. Coiado continued the webinar by discussing how problem-based learning (PBL) was transitioned to an online setting at the beginning of the SARS-Cov-2 pandemic at the Carle Illinois College of Medicine (CICM). Before the pandemic, in-person PBL at CICM was conducted with

groups of 5–10 students working on a case together. Each student was assigned a unique role in the group (e.g., scribe and information searcher) and a faculty facilitator present to guide the activity. Groups were assigned to individual classrooms with a single table, a physical whiteboard, and one computer/projector. As PBL was moved online, Zoom replaced the physical classroom, and Google Docs, Excel, or PowerPoint replaced the physical whiteboard. Dr. Coiado emphasized the published highlights of this transition for the audience [4]. PBL sessions ran slower in an online setting than in-person and often involved greater periods of silence. There was also greater risk for distraction, although faculty can leverage the chat feature of Zoom to communicate directly with individual students. Zoom increased accessibility for students, especially given difficulties such as quarantining. Regarding the challenges of conducting PBL using Zoom, Dr. Coiado commented that it was much more difficult for facilitators to observe body language, assess student engagement, and engage more quiet and reserved students. Students also felt isolated and experienced loss of community, and Dr. Coiado acknowledged the burnout and feelings of fatigue often experienced in an online setting. Overall, important lessons learned while transitioning PBL to an online setting include the observation that PBL is still fun for students and remains a student-centered approach.

Next, Dr. Yodh discussed the online impacts on PBL that have emerged over the past year, sharing preliminary findings from an in-progress study comparing online and in-person PBL at CICM. These data suggest that online PBL has been impacted by changes in computer access by group members, student engagement, and student learning and learning outcomes. Regarding computer access, in-person PBL at CICM previously involved only one student having access to a computer, with only one group member conducting searches and gathering information. Other group members were able to identify learning issues and apply the information to the case. During online PBL, all student members have computer access, so the role of “searcher” expands to the rest of the group. Although this ubiquitous searching ability benefits individual learning synthesis, it also leads to a more passive learning environment with less team engagement and problem-solving. Dr. Yodh’s data also suggest that students may be intimidated by the transition back into in-person PBL if they no longer have the ability to individually search for information. Despite the differences in team building and team roles, the learning issues students identify during PBL remain essentially the same, regardless of an in-person or online platform. Dr. Yodh then posited that the online transition may permanently change some aspects of PBL. In addition to allowing for remote and hybrid accommodations for students and facilitators, online platforms also enable guests to easily join groups, which may be helpful for facilitator training and evaluation. PBL

sequencing may also change, with in-person PBL being conducted mainly during the first year of medical school to promote team building, and online PBL conducted during the second year to accommodate students’ busier schedules. Dr. Yodh concluded by sharing opportunities to evolve online PBL methods, including more socially enhanced learning strategies such as real-time annotation, games, and concept mapping.

Mr. Read then provided his perspective of online learning as a PBL/small group facilitator at Norwich Medical School at the University of East Anglia. During online PBL sessions, Mr. Read noticed greater passive participation and pauses, reduced topic discussion and session length, less creativity and innovation, and decreased conversation during breaks. He hypothesized that motivational problems primarily influenced these changes and consulted the literature to find applicable solutions for his students. His findings included the use of blended learning by adding in-person sessions to the online curriculum [5], increasing faculty involvement and effort to help students engage [4], and modifying online and in-person feedback delivery methods to be timely and active [6]. He shared that learning models designed to promote activity and engagement, such as exploratory, dialogical, and constructivist models, elicit better participation from students [7]. Finally, he identified other strategies that “force” engagement, such as rules regarding mandatory microphone and camera use during learning sessions. However, these frameworks did not address the underlying cause of reduced student engagement, so Mr. Read explored conceptual frameworks and motivational theories [8] to help him understand the psychology of his students and why they were struggling to engage.

The theory most applicable to the problem of student engagement was self-determination theory, which posits that the ideal motivation is intrinsic motivation, where an individual acts out of one’s own internalized values and for the joy or pleasure the activity gives them personally. To promote intrinsic motivation, three psychological conditions or needs must be met: autonomy (the perception of being able to control one’s actions and success), competence (the perception that one’s abilities are well-suited to the difficulty level of a task), and relatedness (the feeling of connectedness and belongingness with others). Using this lens, Mr. Read reexamined strategies for promoting engagement and concluded that solutions such as blended learning encourage intrinsic motivation by supporting social connectedness and allowing students to feel more in control of their learning. Similarly, strategies that encourage friendly competition and collaboration and/or teamwork between small groups of students promote connectedness. Availability of the educator through timely and frequent feedback helps students feel connected, competent, and in control of their learning. Other elements promote extrinsic motivation, such as greater

faculty involvement to call on students to participate and mandatory camera and microphone rules. In summary, Mr. Read concluded that while online learning overcomes many barriers to learning, it cannot overcome them all, especially relatedness, which cannot realistically be maximized in an online setting. In conclusion, Mr. Read suggested that online learning is a tool that should be used only when its benefits outweigh its disadvantages.

Acknowledgements We wish to thank each of our presenters for their contributions to this series!

Declarations

Ethical Approval N/A

Informed Consent N/A

Conflict of Interest The authors declare no competing interests.

References

1. MacPFD Team site: program for faculty development. <https://www.macpfd.ca>.
2. Gagnon K, Young B, Bachman T, Longbottom T, Severin R, Walker M. Doctor of physical therapy education in a hybrid learning environment: reimagining the possibilities and navigating a ‘new normal.’ *Phys Ther.* 2020;100(8):1268–77. <https://doi.org/10.1093/ptj/pzaa096>.
3. Garrison DR, Anderson T, Archer W. Critical inquiry in a text-based environment: computer conferencing in higher education. *Internet Higher Educ.* 1999;2(2–3):87–105. [https://doi.org/10.1016/S1096-7516\(00\)00016-6](https://doi.org/10.1016/S1096-7516(00)00016-6).
4. Coiado OC, Yodh J, Galvez R, Ahmad K. How COVID-19 transformed problem-based learning at Carle Illinois College of Medicine. *Med Sci Educ.* 2020;30:1353–1354. <https://doi.org/10.1007/2Fs40670-020-01063-3>.
5. Vallée A, Blacher J, Cariou A, Sorbets E. Blended learning compared to traditional learning in medical education: systematic review and meta-analysis. *J Med Internet Res.* 2020;22(8). <https://doi.org/10.2196/2F16504>.
6. Li J, Wong SC, Yang X, Bell A. Using feedback to promote student participation in online learning programs: evidence from a quasi-experimental study. *Educ Tech Res Dev.* 2020;68:485–510. <https://doi.org/10.1007/s11423-019-09709-9>.
7. Kauffma H. A review of predictive factors of student success in and satisfaction with online learning. *Res Learn Technol.* 2015;23. <https://doi.org/10.3402/rlt.v23.26507>.
8. Cook DA, Artino AR. Motivation to learn: an overview of contemporary theories. *Med Educ.* 2016;50(10), pp 997–1014. <https://doi.org/10.1111/2Fmedu.13074>.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.