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Review Article

Innovation in Medical Education: Advantages and Limitations

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Abstract

Innovation in healing education is critical for healthcare professionals to meet the increasing demands of the healthcare landscape. Advancements in technology, education, and curriculum design have revamped established medical instruction, offering a range of benefits. First, creative methods such as imitation-based preparation and virtual reality embellish experiential learning, allowing undergraduates to practice clinical abilities in safe surroundings. This not only promotes skill command but also advances distracting thinking and decision-making. Additionally, electronics help in asynchronous education, enabling graduates to approach educational materials at their own pace. Online platforms, mutual modules, and the combined use of several media resources enhance a pliable and personalized education experience. Collaborative finishes further facilitate ideas and information sharing with students and skills, advancing a sense of community and supporting collaborative healthcare surroundings. However, changes in medical instructions suggest restraints. The integration of electronics demands significant economic contributions and ongoing perpetuation, posing challenges for organizations with limited possessions. Moreover, the digital separation concedes the possibility of exacerbating instructional prejudices, as students with varying approaches to electronics may have knowledge differences in learning moments. Furthermore, the rapid pace of progress in detail necessitates constant faculty to guarantee that educators are proficient in efficiently appropriating creative tools.

Keywords: scientific education; accreditation; persevering with education; curricula; education; clinical schools; postgraduate education; psychology; teaching; learning; curriculum; main care; faculty; inter professional; research; policy; simulation; supervision; clinical; interdisciplinary; teamwork

Introduction

Since the 1990s, technology has been carried out in a step-by-step manner and has generated a wealth of modern techniques for pre-clinical and medical scientific education through the adoption of asynchronous learning, simulation, game-based instruction, and even the use of social media as a mode of collaborative and peer-to-peer study (Tudor Car et al. 2019){1}. The advantages of technology-enhanced mastering have been extensively preferred over the past 12 months owing to the COVID-19 pandemic, and e-learning has become the foremost aspect of tutorial clinical schooling (Rajab et al. 2020){2}. In the final quarter of the twentieth century, we experienced an explosion of statistics in scientific sciences about advances in statistics and technological know-how that allow faster, more reliable, and more complete information collection. At the same time, a growing quantity of inappropriate statistics has come to be a limiting factor, mainly due to a developing hole between clinical expertise on the one hand, and the capacity of medical practitioners to comply with the evolution of records on the other. The present-day explosion in fitness science procedures, equipment, and strategies has extended healthcare in the easiest and the most high-quality ways: a synthetic pancreas (Boughton and Hovorka 2020){3}, a glucose screen constructed into smartphone instances (Yang et al. 2020){4}, the mySugr software (Debong et al. 2019){5} permitting for personalized digital populace health, synthetic slender talent (ANI) in surgical treatment (Namikawa et al. 2020){6}, cloud-based deep getting to know the algorithm for cardiac imaging (El-Askary et al. 2017){7}, and digital ingestion monitoring gadget to measure drug adherence (Van Biesen et al. 2019){8}, are simply some examples of the digitalization of fitness Innovation has grown to be an essential part of the healthcare panorama and has permeated many areas of scientific medicine. To reply to these challenges, college students should be organized for the Medicine of the Digital Era and consciousness of the new applied sciences that are being delivered (i.e., simulation, digital worlds, game-based instruction, and social media use). It ought to additionally be taken into account, however,

that healthcare and remedies are essentially unique from bodily sciences and that the exercise of medicinal drugs is complex. In addition to the evolution of clinical statistics and research, schooling itself drives the desire for renewal and modifications to the curriculum (Han et al. 2019){9}According to the NMC Horizon Report (2016){10}, the current technology of college students needs to have the ability units (i.e., digital literacy, complicated thinking, creativity) to be successful. Thus, in clinical schools, in addition to formal know-how and scientific experience, the integration of innovation techniques is critical to preparing college students for the developing complexity of scientific practice, which is regular with rising desires in the area and, together with interdisciplinary gaining knowledge of experiences, will permit college students to improve multi-institutional understanding of excellent tactics and exceptional practices (Bullard et al. 2019){11}. Medical educators ought to inspire pupil inquiry, feed their curiosity, and deepen their perception of scientific ideas (Dyche & Epstein 2011){12}. At the same time, they have to be geared up with the imperative knowledge, skills, and attitudes that will allow them to undertake innovative procedures in determining modern options for complicated problems in clinical education. Medical educators ought to think about new media applicable to coaching college students in the present-day healthcare settings of the digital generation and allow college students to exercise in real-world conditions (e.g., the use of a PC simulation that lets pupils attempt one-of-a-kind strategies) (Lateef 2010){13}. Thus, in the direction of a learner-centered method (Cullen et al. 2019), {14}. It makes sense to consider involving college students in the resolution and graph of equipment to stimulate their activity in fixing complicated healthcare problems. However, what does "innovation" without doubt mean? It is challenging to outline the fact that innovation is no longer a good overall performance. One viable definition is "the utility of chosen new key practices in training that will lead to a common improvement." For example, in a 2018 survey on innovation in clinical training methods involving college students at Concordia University's Portland College of Education (https://resilient educator.com/classroom-resources/educational-innovations-roundup/), the following elements were highlighted: ⊲ Finding any way you can to attain all of your students, by way of being inclined and bendy to regulate what you instruct and how you teach; ⊲ Stepping backyard of the box, difficult our techniques and techniques to guide the success of all college students as nicely as ourselves; ⊲ Keeping your self skilled about new traits and science in schooling and being innovative with the assets you are given; ⊲ Allowing creativeness to flourish and now not be afraid to attempt new things; occasionally these new matters fail however it's splendid when they are a success; besides the proper attitude, innovation would simply be a phrase and the artwork of training would pass over out on some superb accomplishments. Technological improvements for educating and mastering in greater training provisions that aim to promote the exercise of ability improvement and optimize academic trips are categorized into four principal groups: (i) structures based totally on PC assist in the mastering of primary scientific sciences; (ii) laptop simulation structures for coaching and checking out of scientific competency; (iii) systems-based PC consulting; and (iv) structures based totally on computer systems for record administration and satisfactory assurance.

Digital education aids and multimedia

A large variety of digital applied sciences are stated regarding their use for instructing allied fitness professionals. The applied sciences that are most often associated with practice-based knowledge acquisition are as follows: (i) video-based lectures enabling trainees to harness repetition, self-paced practice, and lively mastering (Dominguez et al. 2018; Liu et al. 2019); {15} (ii) cell gadgets that enable a series of facts associated with experience or accommodation of several needs of the relative cell clinician and trainee; 2 (iii) audio response structures that provide a revolutionary method to educate and learn, which suggests tremendous acceptance and extended attentiveness (Beaumont et al. 2017; Hussain and Wilby 2019){16}. This equipment stimulates greater energetic studying in the classroom, facilitates pupil in-classroom participation, inspires team problem-solving, and provides more suitable engagement and enjoyment of the lecture experience. However, outcomes in terms of long-term understanding retention and studying effects are vulnerable or equivocal (Atlantis and Cheema 2015){17}

Simulation

Simulation3 has been included in scientific schools these days, with simulation-based training an unexpectedly growing self-discipline that can supply protected and tremendous getting-to-know surroundings for students, leading to enhancements in appreciation of the primary principles of clinical sciences (e.g., pharmacology and physiology), enhancements in clinical knowledge, familiarity with procedures, upgrades in overall performance and medical capabilities in the course of retesting in simulated situations (diagnosis, treatment, resuscitation, etc.), and a discount in clinical errors, benefiting affected person protection (Khan et al. 2011, McCoy et al. 2017).{18} The simulation started with the first life-size model pelvis for midwives' education in childbirth in the ninth century. Growing several up to the late nineties and the early 2000s, student-variable nineties human-patient simulators were built for and sooner or later a high-fidelity simulator "patient" who talks, breathes, blinks, and strikes like an actual patient. Simulation leads to a discount in education time, coupled with an enhancement in the velocity of information uptake; however, it is also beneficial in instances of depleted sources (e.g., the unavailability of animals for experimentation). Examples of simulations include (i) SimMan as a device for coaching and examination (Swamy et al., 2014; Liu et al., 2019){19}; (ii) ventriloscope to examine medical examination competencies amongst undergraduate scientific college students (simulates auscultatory findings) (Verma et al. 2011){20}; (iii) simulation strategies to train intravenous catheter placement (McWilliams and Malecha 2017){21}; (iv) third-dimensional device for educating human neuro-anatomy (Estevez et al. 2010){22}; (v) target market response structures to consider overall performance and digital equipment used in combination with simulation (Hussain and Wilby 2019){23}; (vi) telesimulation as a progressive device for educating intraosseous insertion strategies in growing nations (Mikrogianakis et al. 2011){24}; and (vii) a web-based getting-to-know application mixed with simulation for indispensable care ultrasonography (Sekiguchi et al. 2013){25}. Patient protection constitutes a primary cause for the use of clinical simulation to avoid damage brought about by inexperienced trainees and moral worries (e.g., circumventing the desire for the affected person's consent and confidentiality) (Sørensen et al. 2017){26}. A high-fidelity simulator-affected person affords a blended higher education modality, gaining knowledge of strategy for certain tasks, while simulation provides the best device for evaluation and assessment of the medical capabilities of students, and the opportunity to retrain boosts scholar confidence. However, obstacles to the simulation also need to be recognized. These include incomplete mimicking of the human device (which is very complex), faulty getting to know (physical symptoms are missing, omission of security procedures, affected person consent, etc.), fee aspect (initial buy and ongoing renovation costs), time factor, lack of infrastructure, technical difficulties, and lack of full-time workforce (Qayumi et al. 2014){27}. Although there is no proof to aid the thought that simulation-based getting to know helps to produce higher medical doctors than standard instructing techniques (Bradley and Bligh 2005){28}, residents educated on simulators have been greater t– likelihood to adhere to the superior cardiac existence aid protocol for those who had obtained general education for cardiac arrest patients and residents skilled in the use of laparoscopic surgical treatment simulators confirmed enhanced overall procedural performance in the working room (Okuda et al. 2009){29}. Hence, future research must assist in elucidating the utility and cost of simulation in scientific education and in assessing the results of simulation instructing on the affected person's results instead of just assessing non permanent dreams, such as the acquisition of

knowledge, skills, and pupil delight (Okuda et al. 2009; Sørensen et al. 2017){30}.

Virtual learning environments and augmented reality

Virtual reality (VR) is modern technological knowledge that creates a simulation environment. It enhances the person's ride with the aid of convincing the human genius that it is in specific surroundings (Riva et al. 2019){31}. VR is beneficial in, among others, distance learning, distinct education, and the education of college students to idealize their competencies in coping with sufferers in distinct environments. It has also been used by universities as a way of disseminating data about campus to potential college students earlier than they enroll. Examples include (i) a digital reality-based coaching device to instruct about spinal anesthesia (Lövquist et al. 2012){32} (ii) laptop applications to reinforce knowledge associated with anatomy (digital cadaver) (Darras et al. 2019){33}, and (iii) digital sufferers for the online interactive strategy to clinical schooling (Cendan and Lok 2012; Baumann-Birkbeck et al. 2017){34}. A digital discipline timeout (VFT), used as a stand-alone activity, presents a guided exploration via the World Wide Web that organizes a series of pre-screened, thematically primarily based net pages into a structured online mastering experience. VFTs have been proven to encourage and excite students, encouraging and assisting the improvement of collaborative surroundings in which each trainer and college student takes accountability for the study that takes place. However, VFTs are less advisable than real-world trips, and mastering possibilities is downgraded if interplay with the actual world is restrained (Robinson et al. 2009){35}. Moreover, one cannot forget the reality that VR, in a sense, undermines human interaction, lacks the flexibility provided through stay-to-work collaboration, and calls for excessive expenses that only a few can afford, consequently exacerbating academic inequalities as a substitute for doctor-patient environment-to-environment learning, erasing them. Augmented truth (AR) is technological know-how that superimposes a computer-generated photograph onto a user's view of the actual world, hence presenting a composite view. In the generation of collaboration and sub-specialization, AR might also supply a much-needed contribution to academic advancement in the future. AR is used to consider dynamic anatomy in real-time through the use of digital ultrasound; it approves visualization of buildings and blood drift that can decorate the overall performance of invasive procedures; it can complement anatomy training by way of superimposing radiological (CT or MRI) pics onto a physique and by way of developing a direct view of spatial anatomy for the learner; furthermore, with the complementary use of haptic technology, it gives the person with tactile remarks that aids understanding of the consistency of unique tissue aspects (Kim et al. 2017){36}. Overall, this represents an interesting area for VR and AR improvement in anatomical education. The typical approach generally entails the use of an anatomical atlas, time spent in the dissection room, and fixed prosections, while AR and VR supply a higher grasp of buildings in the digital or actual area (e.g., Microsoft Kinect produces an interactive digital replicate that visualizes the structures/musculature, superimposed on the user's arm). Dassault Systèmes and Anatomage Table are regular examples that permit medical scientists to immerse themselves in the patient's anatomy; then, anatomic dissection and prosection remain the first-rate and most sensible 3D experiences, whilst all different structures are complementary techniques in under problem-solving about anatomy. AR performs a necessary function in the image-based augmentation of the surgical environment, and digital interactive presence and augmented truth (VIPAR) has developed a guide answer that lets faraway surgeons assign their palms to the show of some other medical professional sporting a headset (Shenai et al. 2011){.37}, according to the Lancet Commission on Global Surgery, 5 billion human beings do not have admission for safe, cheap surgical operations (Alkire et al. 2015){38}. In addition, in stay operations, the usage of AR has been broadcast to the world community, with feasibility confirmed for simple techniques in Paraguay and Brazil (Khor et al. 2016){39}. Proxima (a collaborative platform) allows surgeons to visualize real-time or recorded operations being carried out by way of professionals in different components of the world (El-Asmar et al. 2021){40}. Although AR and VR are effective tools and the literature displays their versatile rising functions in medicine, they additionally supply an upward jab to new challenges (Yeung et al. 2021){41}. Furthermore, the boundaries of AR encompass (i) the desire for an increasing number of effective microcomputers to pressure AR, (ii) gadgets that need to be an herbal extension of the surgeon's senses (light, mobile, cozy, and useful for probably lengthy durations of time), and (iii) ethical issues and prison pitfalls or troubles (e.g., digitally affected person records, confidentiality, and information management), which are some of the elements that may want to be a principal hurdle in the integration of this new science in training (Khor et al. 2016){42}

Cloud technology

Cloud technological know-how is, in all likelihood, the future of science in schooling considering that it hosts apps and offerings on the web alternatively of a user's computer, enabling facts to be stored, shared, and accessed on any gadget linked to the web (Mell and Grance 2011){43}. In education, the cloud is used to keep and share digital textbooks, lesson plans, videos, and assignments, giving college students the chance to have convenient entry to their instructors and other classmates through stay chat options; it permits "flipped classrooms" (where college students can watch a lecture earlier than classification and then spend the classification time engaged in discussion), crew work, and analytical things to do (Liu et al. 2015){44}; it reduces the probabilities of homework getting misplaced between college and home. A principal predicament to full adoption of the cloud, apart from insufficient access to the Internet, is security; however, nearly of community in the cloud has a protection device in the region to defend its records (Liu et al. 2015){45}

Gamification

Over the past 20 years, "gamified coaching platforms" for pre-clinical and medical scientific schooling have been developed (Kron et al. 2010, McCoy et al. 2016).{46} The use of gaming in the study room ambitions to collectively carry the exciting section of the play with the content material and principles that college students ought to learn; gamification will increase pupil engagement, create enthusiasm for the lesson, present on-the-spot feedback, and in well-known college students study higher when they are exciting (Hamari et al. 2014){47}. However, not every exciting recreation is fantastic about educating a given concept, not each thought is fun, and it takes time and coaching to examine how to use video games correctly to master (Gentry et al. 2019){48}.

Artificial intelligence

Artificial talent (AI) is all about developing machines that can be supposed like humans; it is making its way into the academic sphere by way of the ability of computerized grading and comments, and presenting customized studying opportunities. It can shop for instructors' time by grading and giving comments on their behalf, and by way of supplying a higher perception of ,getting-to-knowEven though a student's getting to know patterns. On the other hand, instructors can analyze a lot about a student's studying patterns by grading themselves, while the non-public thing of care, when an instructor offers personalized remarks (rather than letting a computing device generate it), needs not to be underproblem-solvinge fact that AI algorithms are more effective than traditional methods, recognition is rising among fitness professionals and managers as to the precise dangers of using these technologies, and non-public involvement and interplay between health practitioners and affected persons are of significant significance in constructing faith and profitable remedies (Davenport and Kalakota 2019){49}. Although the astonishing effects of AI can't be disregarded, aside from growing issues about the moral and medico-legal impact, medical security questions have to be viewed (Challen 2019){50}

Problem-based learning

Problem-based getting-to-know (PBL) in clinical training has been characterized as the most considerable academic innovation over the past 35 years (Lim 2012){51}. It is described as "an educational (and curricular) learning, student-centered approach, that empowers newcomers to behavior lookup and college students to strengthen a collaborative spirit." PBL is a peer tutoring exercise and a very advantageous studying method via which college students undergo brainstorming and combine and preserve ideas and exercise in the utility of know-how and skills to advance a doable answer to a described problem. It instills many specific skills, such as doctor–patientnvironmentto and argumentation. One issue with this technique is that scholar contact hours are four instances larger for educators in a PBL curriculum than for educators in an ordinary curriculum; hence, the monetary viability of problem-based mastering is a principal challenge (Hoiden and Kärkkäinen 2014){52}. The implementation of evidence-based medication (EBM), an idea developed from PBL, is viewed as a revolution in contrast to classical empirical clinical practice. Recent technological, scientific, and social traits are likely to change EBM into precision medication (König et al. 2017){53}. High-resolution, high-throughput data-generating applied sciences that proceed to emerge facilitate the budget-friendly era of big datasets (Cirilo and Valencia 2019){54}, state-of-the-art new algorithms and methodologies, and high-capacity computation facilities, giving upward jostle to medicine-based proof (MBE). MBE is capable of constructing and archiving profiles that emerge from all recognized kinds of research and information sources (Knottnerus and Dinant 1997).{55} A matter of perspective: what kind of medical education do we seek to deliver Appreciating the miracles of science is one thing, and making gorgeous use of them is another. A key element of cutting-edge innovation in clinical schooling is delivered using technology; however, the educator nevertheless has to play the key role of figuring out how to use it accurately to decorate clinical students' fundamental wondering and problem-solving skills and no longer replace him/herself as a teacher. Given this fact, the query is, "What variety of clinical training do we are trying to find to deliver?" In essence, this should be rephrased as, "What type of medical practitioner do we need?" Technology plays a big role in turning in daily healthcare; however, it has to be saved in thinking that its usage has to neither undermine the doctor–patient relationship (Chipidza et al. 2015){56} nor compromise the patient's proper life-saving and not expensive care. In this respect, though e-learning provides a substantial chance for amazing and universally standardized clinical training, it will in no way be in a position to exchange all elements of real-life, experience-based knowledge won with admiration to the affected person

Conclusion

There are numerous benefits of innovation in medical education. It can help improve the quality of medical education by providing students with access to the latest technology and resources. It can also help reduce the costs associated with medical education by providing students access to online resources and virtual learning environments. Additionally, innovations in medical education can help create a more engaging learning experience for students and provide opportunities to explore new ideas and concepts. However, there are some limitations to innovation in medical education. For example, it can be difficult to ensure that the quality of the educational materials and resources provided is up to the required standards. Additionally, the cost of implementing new technologies and resources can be prohibitive in some medical schools. Finally, some students may find it difficult to adapt to a new learning e and may need additional support and guidance to ensure that they can make the most of the new resources.Overall, innovation in medical education can provide many benefits; however, it is important to consider potential limitations when implementing new technologies and resources. When carefully planned and implemented, innovations in medical education can help improve doctor–properly, quality of medical education and provide students with access to the latest resources and technologies.

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