Medical Education Reimagined: A Call to Action

Charles G. Prober, MD, and Salman Khan

Abstract

The authors propose a new model for medical education based on the "flipped classroom" design. In this model, students would access brief (~10 minute) online videos to learn new concepts on their own time. The content could be viewed by the students as many times as necessary to master the knowledge in preparation for classroom time facilitated by expert faculty leading dynamic, interactive sessions where students can apply their newly mastered knowledge.

The authors argue that the modern digitally empowered learner, the unremitting expansion of biomedical knowledge, and the increasing specialization within the practice of medicine drive the need to reimagine medical education. The changes that they propose emphasize the need to define a core curriculum that can meet learners where they are in a digitally oriented world, enhance the relevance and retention of knowledge through rich interactive exercises, and facilitate in-depth learning fueled by individual students' aptitude and passion. The creation and adoption of this model would be meaningfully enhanced by cooperative efforts across medical schools.

Today, more than 100 years after the Flexner Report sparked major reforms in U.S. and Canadian medical schools, the general format of medical student education remains more or less the same. A period of didactic-heavy preclinical education (typically two years) is followed by a series of clinical experiences of similar total length. Medical education is constantly evolving at most of our schools, leading to many innovations in teaching strategies, such as problem-based learning, team-based learning, and the use of simulation. However, the net effect of all these efforts on the way we educate physicians has been limited.

The introduction to a life of medical education often is not as compelling as it could be. Especially during their preclinical education, students frequently ponder the relevance of what they are being taught. Absent a clinical context, the information may be difficult to embrace and retain beyond the requisite course quizzes and national examinations. And, unfortunately, because the results of national board exams, especially the United States Medical Licensing Examination (USMLE) Step 1, have taken on so much emphasis in the selection of residents, students feel compelled to memorize all preclinical material so that they can obtain a high score on a test originally designed to be binary, pass or fail.

Notwithstanding these issues, the current system of medical education has resulted in the training of a superb workforce of physicians, who contribute to the health and welfare of society through a broad range of professional activities. This system, however, is generally inflexible and not sensitive to the skills and aspirations of individual learners. Furthermore, biomedical knowledge continues to accrue at an exponential rate, and the complexity of patients and the health care system continues to increase. It is neither possible nor desirable for all students to deeply explore all aspects of biomedical knowledge. Our belief is that medical students should be provided a framework on which knowledge can be built over a lifetime of learning. And students who have aptitude and passion for developing a focus in a specific area of biomedicine or medical practice should pursue this area more deeply. Our proposed model reflects this belief.

Flipping the Classroom

In *The One World School House: Education Reimagined*, one of us (S.K.) described a new model of education, informed in part by ongoing work with K–12 students.[1] In this model, which uses the leverage of computer technology, students acquire basic knowledge and facts about a subject through a series of short videos hosted online. Young learners watch these videos on their own schedule and as many times as necessary to master the content. Students demonstrate mastery by providing a consecutive series of correct responses to a number of embedded questions. In subsequent classroom sessions, students engage with their teacher in problem-solving exercises. There is a "flipping of the classroom": Lessons previously taught in class are learned at home, and "homework" is performed in the classroom in collaboration with peers and guided by teachers. The pace of learning is guided by the individual student, and the relevance of the material is underscored through in-class problem solving.

Reimagining Medical Education

We believe that the model for reimagining K–12 education is equally relevant to medical education. In fact, the flipped-classroom model is already widely used in medical education through gross anatomy courses. Students learn anatomical facts in lectures (or videos)

Dr. Prober is senior associate dean for medical education and professor of pediatrics, microbiology, and immunology, Stanford School of Medicine, Stanford, California.

Mr. Khan is founder and executive director, Khan Academy, Mountain View, California.

Correspondence should be addressed to Dr. Prober, Office of the Dean, 291 Campus Dr., Stanford, CA 94305-5101; e-mail: cprober@stanford.edu.

Acad Med. 2013;88:00–00.
First published online
doi: 10.1097/ACM.0b013e3182a368bd

and from textbooks. The embedding of the information occurs in the gross anatomy lab during dissections. Most of those who have attended medical school, even in the distant past, continue to remember these learning experiences in the anatomy laboratory.

Figure 1 depicts the three key components of our proposed model for medical education: building a framework of core knowledge; embedding the knowledge in richly interactive, compelling, and engaging formats; and encouraging in-depth pursuit of knowledge in some, but not all, domains. These "deep dives" reflect the passion of the individual learner and the strengths of the specific medical school. For example, some medical schools are recognized for strengths in basic science, health policy and economics, and biomedical engineering. Other schools are recognized for strengths in primary care, immigration health, and population-based research. Although most medical schools can support and nurture the full range of student interests, invariably the depth of educational opportunities at a school will be influenced by the expertise and interest of the school's faculty.

Building a framework of core knowledge

The central element of our medical education proposal, depicted at the top of Figure 1, is the core preclinical curriculum. This curriculum should focus on medical knowledge that is foundational and known to be true ("evergreen"). Students often are told at the beginning of medical school that much of what they will be taught over their time as students will prove to be wrong. Perhaps we should not spend our most valuable asset, time, on what may not be true. Rather, a goal should be to identify a limited amount of critical material that serves as the building blocks for subsequent lessons. It is striking that such a core curriculum is not defined on a national basis. Core curricula tend to be organic, arising and growing over time at each medical school, even though a high proportion of core content will be similar between schools.

The one unifying driver of medical schools' core curricula appears to be the content of the USMLE. Although some schools pay particular attention to these examinations during curriculum planning, students, irrespective of their own medical school's curriculum, typically prepare for these examinations by using third-party review material rather than their course syllabi. Students often express a high degree of frustration and stress when they recognize that their school's curriculum does not mirror the content of standardized national examinations. In a recent survey of preclinical students at Stanford, 73% identified this perceived misalignment between curricular content and what they "needed to know for USMLE Step 1" as one of their major sources of stress (Porwal A, Newell G. Unpublished data. June 2012).

This is not to suggest that medical school curricula should be designed to "teach to the test." Rather, there needs to be a conscious alignment between those responsible for creating medical school curricula and the National Board of Medical Examiners. To that end, we propose the creation of a medical school collaborative, charged with the identification of material that would represent a consensus opinion on the core content of the curriculum.

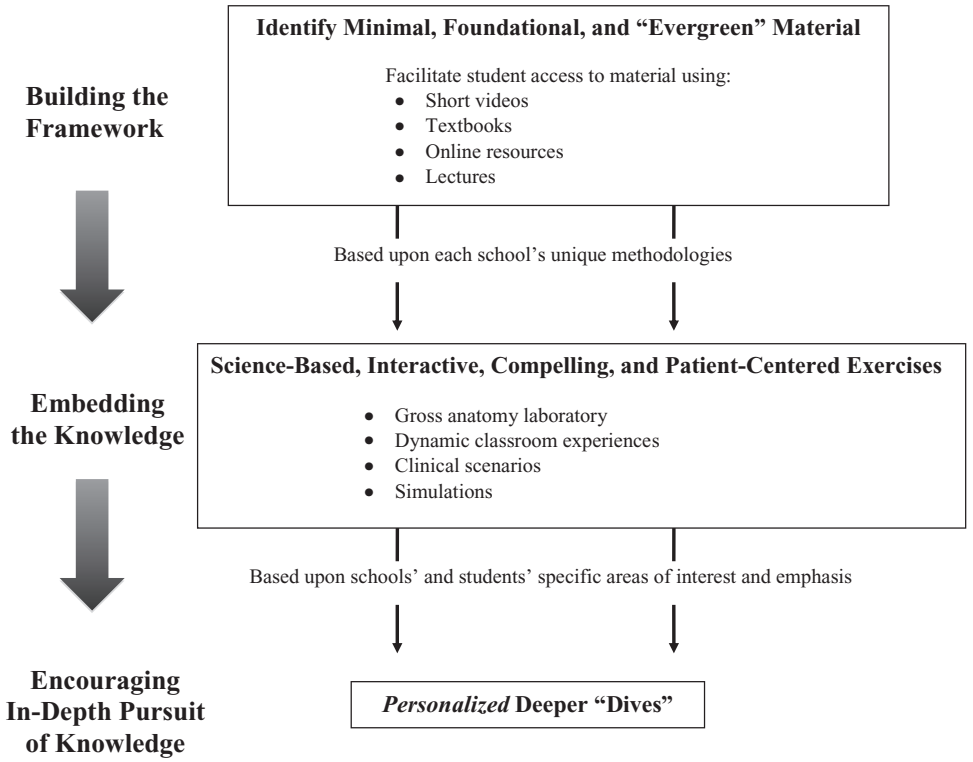

Figure 1 Key components of a proposed model for medical education. Adapted with permission from: The Blue Ridge Academic Health Group. Report 17. Health Professions Education: Accelerating Innovation Through Technology. Figure 2 (p 14). Atlanta, GA: Emory University; Spring 2013. http://whsc.emory.edu/blueridge/publications/archive/blue-ridge-2013.pdf. Accessed July 1, 2013.

Following the identification of the core content, we further propose the creation of a library of short (~10 minute) videos that learners can use to access the content in an order consistent with the organization of their school's curriculum. The content could be viewed by the students as many times as necessary to master the knowledge in preparation for their "flipped classroom" experiences. Ten-minute videos have the advantages of being sensitive to the typical peak learning period for adults and being easily archived and searchable. Content could be revisited in the context of subsequent patient encounters, allowing foundational knowledge to become even more deeply embedded.

We have been experimenting with different video formats, including the use of a blank slate (much like a blackboard), inserted images, onscreen text (like a PowerPoint slide), embedded quizzes, the ability to alter the speed of presentation, the ability to view the instructor, and dialogue versus monologue. Different formats appeal to different faculty and different learning styles. We believe that it would be advantageous for multiple schools to produce videos on the same core content. Students could select the version of the presentations most consistent with their learning style. Videos could be voted up or down by learners in a manner analogous to Yelp reviews. Over time, the "best" videos would emerge.

Material would need to be updated over time, although this need would be minimized through the selection of core content that has withstood the test of scientific validation. The short video format would facilitate the timely introduction of contemporary discoveries. Instead of creating an entire new one-hour lecture, critical supplements could be added to the video library with relative ease. However, we caution against the premature inclusion of new discoveries in the medical curriculum because many new "facts" turn out to be wrong.[2]

Embedding knowledge through interactive formats

The second defining element of our medical education proposal is the creation of dynamic interactive sessions. The 10-minute videos have limited value unless learners use the knowledge gained from them in meaningful exercises with faculty and peers. These videos are, in fact, only a fraction of our overall Stanford Medicine Interactive Learning Initiative (SMILI).[3] Our SMILI working group includes faculty, students, educational scientists, learning specialists, and information technology experts. Our central goal is to support faculty who want to evolve their classes into a more student-centric, interactive format. Problem- and team-based exercises are prominently represented in many of our interactive sessions. Other interactive strategies capitalize on simulation resources, patient encounters, role-playing, and debates. The ideal ratio of students to teachers varies by the format of the sessions, ranging from about 4:1 to about 25:1. These sessions often benefit from the participation of faculty with different types of expertise, as when a clinician and a basic scientist cofacilitate a session on the clinical presentation and management of children with metabolic disorders. These interactive sessions also may be facilitated through the use of movie clips and bedside visits.

Our current first- and second-year medical students have been exposed to a few of our early efforts in the flipped-classroom style of education, including content in biochemistry, genetics, health policy, biomedical ethics, endocrinology, and women's health. Although the students identified a number of opportunities for improvement in course evaluations, 82% of 141 respondents favored this model of instruction when compared with a primarily lecture-based format (Ransohoff K, Xie J. Unpublished data. December 2012). The most common concern expressed by our students was time management. The students expressed concern about simply adding interactive sessions without concurrently reducing the amount of time allocated for didactic instruction (by video). We acknowledge that the process needs to be at least time-neutral.

Encouraging in-depth pursuit of specific knowledge

The third defining element of our medical education proposal is depicted at the bottom of Figure 1. Students are encouraged to take "deep dives" beyond their core curriculum. These more in-depth experiences are fueled by students' specific learning objectives and passions, linked to the areas of expertise represented in their medical schools. Examples of "deep dives" include, but are not limited to, what we currently offer students for their "scholarly concentration" pursuits at Stanford: bioengineering, biomedical ethics and humanities, informatics and data-driven medicine, clinical research, community health, health services and policy, molecular basis of medicine (a range of basic sciences), and medical education. The need to complement medical school with in-depth and focused experiences may not be felt by all students or by all schools. This should be respected. For many, completing medical school in as short a period as possible and entering the physician work force is critical and should be supported. For others, beginning to build an area of special expertise that will help to drive changes in biomedical science and health care delivery is critical. The key is to tap into and support the individual learner's aptitude and passion. We believe that our model of medical education is sensitive to this need.

A recent editorial, authored by Bruce Alberts,[4] the editor-in-chief of *Science*, underscored the "failure of skin-deep learning." Alberts argues that we need to replace the current overview of subjects with a series of deep explorations. He cites research that demonstrates that "the most meaningful learning takes place when students are challenged to address an issue in depth."[4]

Effecting Change Through Multi-Institutional Collaboration

In summary, the convergence of the modern "digital native"[5] learner, exponentially growing biomedical knowledge, and a dated medical education delivery system compel a need to change the way we educate contemporary physicians. The change that we propose defines a core curriculum that can meet learners where they are in a digitally oriented world, can embed knowledge through rich interactions, and can facilitate in-depth learning fueled by individual students' aptitude and passion. The creation and adoption of our proposed model could be enhanced by cooperative efforts among medical

schools. Perhaps the result would not be a one-world medical school house but a collaborative, multi-institutional effort to reimagine medical education.

Funding/Support: None.

Other disclosures: Sal Khan is the founder of the Khan Academy.

Ethical approval: Not applicable.

References

1 Khan S. The One World School House: Education Reimagined. New York, NY: Twelve; 2012.
2 Prasad V, Cifu A, Ioannidis JP. Reversals of established medical practices: Evidence to abandon ship. JAMA. 2012;307:37–38.
3 Stanford School of Medicine. Stanford Medicine Interactive Learning Initiative. http://med.stanford.edu/smili/. Accessed June 18, 2013.
4 Alberts B. Failure of skin-deep learning. Science. 2012;338:1262–1263.
5 Prensky M. Digital natives, digital immigrants. In: On the Horizon. Vol. 9, No. 5. Bingley, UK: MCB University Press; October 2001.