



Published in final edited form as:

*Acad Med.* 2022 June 01; 97(6): 832–838. doi:10.1097/ACM.0000000000004589.

## Defining Student-as-Teacher Curricula in the Absence of National Guidelines: An Innovative Model

**Michael A. Fuchs [medical student],**

Harvard Medical School, Boston, Massachusetts.

**Andrea W. Schwartz, MD [assistant professor of medicine],**

Veterans Affairs Boston Healthcare System and Harvard T.H. Chan School of Public Health, Harvard Medical School, Boston, Massachusetts.

**Julia B. Caton, MD [clinical assistant professor of medicine],**

Stanford Medical Center, Stanford Medical School, Stanford, California.

**Holly Gooding, MD, MSc [associate professor of pediatrics],**

Emory University School of Medicine, Atlanta, Georgia.

**Jeremy B. Richards, MD, MA [assistant professor and director]**

Medical Education Research Laboratory, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts.

### Abstract

Teaching is a critical skill in the medical profession, yet has only recently gained recognition as a core skill for medical students and trainees. Student-as-teacher (SAT) programs provide medical students formal teaching instruction with opportunities for practice. While efforts to determine how SAT courses should be taught are ongoing, the authors' review of SAT programs in medical schools' curricula shows they are diverse and often developed by faculty and trainees who advocate for formal teacher training at their institutions, rather than by medical school leadership. Consequently, there is significant heterogeneity among known SAT programs with regard to content, format, and evaluation methods. As efforts are underway to create guidelines and competency frameworks for SAT programs, medical educators must engage in open and critical discussion about the optimal content and organization for SAT educational experiences, emphasizing outcomes-based value and curricular and experiential consistency across programs. The authors describe an innovative SAT elective at Harvard Medical School (HMS), discuss research supporting curricular content and decisions, and emphasize potential implications for the conception and implementation of SAT programs at other institutions. The HMS SAT course is a year-long, elective, longitudinal curriculum built on a community of practice model and comprising 5 key components: Fundamentals of Medical Education seminar series, teaching field experiences, teaching observations, final educational product, and self-reflection. This 5-component theoretically justified model covers essential topics of SAT programming, providing students a comprehensive educational skills training curriculum. Medical educators developing

---

Correspondence should be addressed to Jeremy B. Richards, Beth Israel Deaconess Medical Center, Harvard Medical School, 330 Brookline Avenue, KS-B23, Boston, MA 02215; jbrichar@bidmc.harvard.edu.

*Other disclosures:* None reported.

SAT courses must identify common core competencies and curricular activities to implement SAT programs informed by the perspective of local stakeholders and institutional needs. Further growth of SAT programs in medical education offers opportunities for collaboration and coordination among medical educators, institutions, and licensing and accreditation bodies, to further develop consistent guidelines for teaching medical education skills to future medical educators.

---

Educational skills are increasingly recognized as important components of the education of future physicians, particularly in residency training when learners take on new teaching responsibilities for their teams and medical students.<sup>1</sup> To prepare residents for their educational duties, training about best practices in education has historically been first introduced in the graduate medical education setting, but increasing clinical demands on residents, coupled with early interest in medical education among medical students, has led to the incorporation of educational skills training at the undergraduate level.<sup>2</sup> In recent years, student-as-teacher (SAT) programs have emerged at many medical schools to prepare students for the teaching demands of residency and for their lifelong careers as physician-educators.

Although teacher training programs vary in format and content, in this article, we define SAT programs as those that combine formal training in educational skills with dedicated opportunities for practice.<sup>3</sup> This definition has been used previously in the literature about students as teachers.<sup>2,4</sup> Formal training serves to prepare students with a breadth of educational concepts and skills, as opposed to serving as an orientation for a specific role (i.e., clinical skills facilitators, problem-based learning co-facilitators, or laboratory assistants in anatomy). The experiential component of an SAT program is grounded in a set of educational objectives and should give students exposure to a broad range of educational concepts. SAT programs can feature activities that go beyond the scope of training and practice, but we define SAT programs as those that include these 2 core components.<sup>3</sup>

Broad implementation of SAT programming in undergraduate medical education continues to face significant challenges. To our knowledge, there are currently no guidelines from professional societies or accrediting institutions in the United States to guide the development of SAT programs. Formal educational skills training is not currently endorsed by any undergraduate accreditation organization, and institutional barriers such as competition with other educational demands for medical students, problems finding faculty to teach in SAT curricula, and difficulty convincing stakeholders of the value in SAT programming further complicate implementation of these programs.<sup>5,6</sup> According to a national survey of U.S. MD-granting medical schools, SAT programming is offered at fewer than half of U.S. undergraduate medical institutions,<sup>5</sup> although the exact prevalence remains unknown and only a fraction of these programs have published their curricula.<sup>3</sup> As a result, there is significant heterogeneity among SAT courses and curricula and, according to the most recent nationwide study in the United States available in the literature, a 2008 survey of 99 U.S. medical schools, only 44% offer an SAT program at their institution.<sup>3,5</sup>

In this article, we highlight ongoing challenges in SAT programming and present the SAT elective at Harvard Medical School (HMS) as an example of a comprehensive SAT experience for medical students, using a community of practice framework<sup>7</sup> to explain our

curricular decisions. To define the community of the SAT elective at HMS, we draw on literature to identify important SAT stakeholders. In subsequent sections, we introduce the SAT program at HMS and contextualize our curricular decisions against common practice.

## Welcoming Students Into the Community of Educators

For the SAT elective at HMS, there are multiple relevant stakeholders, with students, faculty, and the institution representing the most pertinent and invested members of this community of practice. In the subsequent sections, we review their perspectives on and contributions to developing, implementing, and sustaining our medical school's SAT elective.

### Student perspective

Research into and anecdotal accounts from SAT participants suggest that most students rate their experiences in SAT courses or curricula positively. Students perceive benefits relating to both professional development and their understanding of clinical content, insofar as they are given an opportunity to serve as educators, as well as revisit previous concepts for additional mastery.<sup>8–11</sup> With regard to clinical knowledge, SAT electives provide students an opportunity to engage with content in new ways that may improve their own retention of knowledge and concepts.<sup>9</sup> For instance, many SAT programs offer teaching experiences by allowing students to participate as academic tutors, case conference leaders, or teaching assistants, roles often described as “near-peer teaching.” Near-peer teachers must engage in the act of self-explanation when anticipating or generating answers to student questions, a process of cyclical practice and feedback that ultimately improves their own learning by reinforcing concepts.<sup>12</sup> As novice teachers, however, students must also confront potential limitations in their knowledge when teaching peers or near-peers.<sup>13</sup> Clinical questions may not always have definitive answers, and student teachers must learn to grapple with, as well as explain, clinical ambiguity and dealing with uncertainty.<sup>10,14</sup>

Medical students recognize that they are likely to have important teaching responsibilities as residents.<sup>15</sup> According to a frequently cited and unique survey study from 1992, a majority of medical students say residents play a significant role in their clinical training and attribute at least one-third of their medical knowledge to teaching led by residents.<sup>15</sup> Subsequent similar studies of medical students' perceptions regarding their own readiness to teach others,<sup>16</sup> and medical students' perceptions of residents' teaching skills,<sup>17</sup> also demonstrate that students view residents as positively contributing to student education. These early experiences of resident-led teaching may encourage students to prepare for their upcoming role as resident teacher. In addition, SAT programs can introduce medical students to the possibility of pursuing careers in medical education, such that some medical students may ultimately focus their future careers on teaching and scholarship in medical education. The long-term outcomes of existing SAT electives are not fully known, but early graduates of one SAT program have been more involved in medical education in their careers 6–9 years after graduation than students who did not take the SAT, including students who had expressed interest in participating in the SAT but did not do so.<sup>18</sup>

### Faculty perspective

The available reports and studies indicate that faculty views of SAT programs are similarly positive.<sup>2,12</sup> On a practical level, the addition of near-peer teachers increases the amount of individual attention per each student learner and can also alleviate teaching burden on faculty without affecting learning outcomes.<sup>6,19</sup> Beyond the practical benefits of SAT programs, many faculty enjoy the opportunity to collaborate with former students on curriculum development and to work as colleagues to improve the learning process.<sup>20</sup>

Some medical educators argue that early exposure to educational principles, beginning in medical school and extending through postgraduate education and continuing medical education, is a necessary part of lifelong medical training for physicians.<sup>12</sup> Citing educational theory, faculty state that the process in which students relearn and organize information for teaching purposes reinforces clinical knowledge.<sup>9</sup> They also report that medical students who participate in active teaching become more effective communicators, leaders, and learners.<sup>12</sup>

### Institutional perspective

Although teaching is recognized as an important skill of residency training and faculty development, it is not universally considered a core skill in undergraduate medical education. In the absence of national guidelines, the establishment of SAT programs largely depends on the expertise and willingness of faculty members at each medical school. Whereas the Accreditation Council for Gradual Medical Education mandates residencies instruct their residents on how to teach<sup>21</sup> and the Liaison Committee on Medical Education (LCME) accreditation standards require schools to provide resources to enhance residents' teaching,<sup>22</sup> no such mandate exists to prepare students as teachers in undergraduate medical education.

From an institutional perspective, which we define as that of curricular administrators and directors from all levels of medical education, there are several reasons to bring educational skills training to medical students. Some have argued that educational training often competes with clinical care during residency, so beginning this training during medical school may help prepare residents to teach medical students without detracting from their clinical training and obligations.<sup>10</sup> Moreover, others have argued that incorporating teaching skills into undergraduate medical education is necessary to move the culture of medicine closer to prioritizing teaching as a core competency, beginning in medical school and continuing through postgraduate training.<sup>9</sup> These considerations have potential benefit for institutions, as well. For instance, medical schools may benefit from increased faculty support and may see better clinical and academic performance by medical students participating in SAT programs. Residency programs may benefit from having resident physicians better prepared to engage in teaching activities.

## Defining the Domain of SAT Curricula in the Absence of National Guidelines: An Ongoing Challenge

In the last 15 years, several reviews of SAT programs have been published and collectively present a similar set of findings (Table 1).<sup>3,6,8,23,24</sup> Although more prevalent now than in years past, SAT programs continue to face challenges in disseminating curricular material and creating objective instruments to evaluate their effectiveness.<sup>3,6,8,23,24</sup> Most offer formal instruction in teaching methods, coupled with opportunities for practice (i.e., serving as near-peer teachers, academic tutors, or teaching assistants),<sup>4</sup> and are typically offered to upper-level medical students in either the third or fourth year of medical school. Instruction is variable, but common content areas include educational theory, teaching methods, and feedback. Course evaluations are mostly subjective, with few objective measures reported.<sup>3,6,8,23,24</sup>

To date, there are no formal guidelines for SAT programming, although the basic premise of most SAT courses is to offer formalized teaching instruction to medical students. At HMS, SAT elective students and faculty published recommendations detailing 12 tips to guide the development of SAT programs at other institutions.<sup>2</sup> Informed by the literature and the experience of implementing an SAT program at HMS, the authors recommended focusing on 3 stages: preimplementation, implementation, and postimplementation.<sup>2</sup> More recently, authors of a national Delphi study put forward a list of essential topics for SAT programs. Experts identified 5 “essential” content areas for SAT programs: feedback, bedside teaching and precepting in clinical contexts, small-group teaching, case-based teaching, and professionalism as a medical educator. Thirteen other topics were rated as “important, but not essential” by a majority of panelists, including competency-based assessment, curriculum planning, digital innovations in teaching and learning, and how to write SMART (specific, measurable, attainable, relevant, and time-bound) objectives.<sup>4,25</sup>

At HMS, the SAT program is an 8-month longitudinal elective that develops students’ teaching skills and prepares them for careers focused on teaching patients, trainees, and colleagues. Given the range of formats that exist among SAT programs, it is difficult to compare the content or duration of different programs; however, of those described in the available literature, SAT programs at other institutions are generally not longer than 1 year, with many being short, intensive, day-long or week-long programs.<sup>23</sup> Like many teaching electives at other institutions, the HMS SAT program is offered to third- and fourth-year medical students who have completed or nearly completed their primary clinical clerkships. Since inception, the HMS course has enrolled 25–35 students per year and has been organized by 2–3 core faculty leaders each year. We also invite a small number of guest faculty, who are generally experts in the field of medical education, to lead seminars for the core curriculum. To accommodate students’ clinical schedules, the HMS SAT seminar series occurs in the evenings, a common practice among longitudinal SAT programs that run concurrently with clinical rotations.<sup>26,27</sup>

Many medical schools have published analyses of student evaluations of their SAT programming, but course objectives and curricular activities have often been minimally discussed in the available literature.<sup>3,23</sup> Variability among these electives may have a

significant effect on the learning outcomes and skills obtained and subsequently employed by SAT participants. As discussed above, there is multistakeholder support for SAT electives, but an absence of guidelines has produced significant uncertainty among educators about how to best design of these curricula. In response to ongoing challenges in developing these programs, as well as building consensus around the definition of SAT electives, we provide a detailed description of the SAT curriculum at HMS, contextualize our curricular decisions against previously described SAT programs, and identify areas for further improvement.

## Teaching the Practice of Medical Education to Students: A 5-Component Model

### Fundamentals of Medical Education seminar series

The HMS SAT seminar series is taught by expert medical educators from HMS and affiliated Harvard hospitals. As described by Freret and colleagues, the process of building a seminar series was informed by review of SAT literature and an institutional needs assessment.<sup>2</sup> From its inception, this course required no academic prerequisites and was available to all third- and fourth-year medical students on a first-come, first-serve basis.<sup>2</sup>

In Rana and colleagues' Delphi study of core topics of SAT programs, 5 skill-based topics were rated as essential by a majority of participants; however, the Delphi panel found that that theory-based topics may be equally important despite not reaching consensus as either essential or important.<sup>4</sup> While the HMS course covers essential skill-based topics, we believe educational theory has practical value for future medical educators. This is reflected in the second course goal for SAT participants (List 1). Based on institutional resources, the longitudinal nature of the HMS SAT program, and the expectation that students pursue a scholarly project in medical education, the HMS SAT syllabus covers both skill-based and theory-based topics (Table 2).

As noted by Burgess and McGregor, SAT programs are rarely all-encompassing and may omit important content areas in medical education.<sup>23</sup> It therefore remains important for SAT program course directors to collect feedback from participants and routinely check for potential gaps in their curricula. For instance, simulation-based medical teaching is rarely taught in SAT programs, despite its increased popularity in recent years.<sup>23</sup> Recognizing that similar gaps existed in the first iteration of the HMS SAT program in response to student feedback, we subsequently updated our syllabus to include an additional session on simulation-based medical education and its application in group scenarios. Other changes to the HMS SAT program were necessary due to external forces, such as during the COVID-19 pandemic, when we were forced to quickly adapt the curriculum to a synchronous, virtual model.<sup>28,29</sup> Modifications to the SAT curriculum require close monitoring of the impact on student engagement and learning to determine whether changing content, organization, and/or pedagogy is effective or not.

## Teaching field experience

A cornerstone of the HMS SAT curricula for medical students is the opportunity to serve in student teaching roles, a curricular decision that was grounded in both educational theory and empirical research. From a theoretical perspective, involving underclassmen as learners in near-peer teaching is supported by cognitive and social congruence theory. According to cognitive congruence theory, student teachers use cognitive frameworks and language that relate more closely to that of their peers or near-peers than do their faculty instructors,<sup>29</sup> which may uniquely advantage student teachers when teaching their peers. Similarly, according to social congruence theory, student teachers are better suited to empathize with their peers, particularly during challenging and difficult experiences in training.<sup>29</sup>

Empirically, research on near-peer teaching suggests benefits to both learner and student teacher. A meta-analysis of published works found few differences in knowledge and skill outcomes among learners taught by faculty or student teachers,<sup>19</sup> yet learners report perceived benefits to near-peer teaching such as improved understanding of anatomy and preparedness for clerkships.<sup>30,31</sup> Furthermore, evidence suggests that student teachers also benefit from their participation in these programs. Specific positive outcomes for student teachers include increased academic preparation, improved perception of knowledge and skills, and, in one study, stronger academic performance on internal and standardized exams.<sup>26,32,33</sup>

At HMS, SAT participants must complete 20 hours of student teaching to pass the SAT elective course (Table 3). Most students complete this requirement by serving as student instructors for a clinical skills course, teaching assistants for a core preclinical physiology course, or coaches and instructors in a simulation-based clinical reasoning curriculum and other course-approved medical education settings. For students interested in working with community partners, the program also offers teaching opportunities in K-12 outreach and community-based ambulatory clinics.

## Teaching observation

Feedback is considered an essential instructional topic of SAT programs, yet few SAT courses provide participants receive in-course feedback on their teaching performance.<sup>24</sup> Unlike evaluation, which is used in formal assessment of competence, feedback is intended to be formative, to help trainees improve their skills.<sup>34</sup> As discussed by Shi and colleagues, 2 common models for feedback in medical education differ according to the relationship between observer and observed participant.<sup>35</sup>

In the developmental model, an “experienced educator is paired with a junior educator to develop the junior educator’s skill set,” whereas in the peer review model, “educators at similar levels are paired to promote collaborative approaches to self-improvement.”<sup>35</sup>

Historically, these feedback models have been used among clinicians seeking to improve their teaching skills as medical educators. Although reports of their application exist in the SAT literature, the effectiveness of these models in student teaching contexts is poorly understood. Following the methods of other medical education institutions,<sup>36</sup> we have adapted our faculty peer feedback forms for SAT participants. Students are required to

observe one near-peer teacher and provide feedback on their performance. Students meet to “pre-brief” before a teaching session to discuss the observed student’s goals and the skills upon which they would like feedback. Once the observation is complete, students meet in “post-brief” to share feedback and reflect on the peer observation process. Students are also asked to observe an HMS expert teacher in either the classroom or clinical setting, which provides them an opportunity to observe, reflect on, and provide feedback about the skills and strategies used by the expert teacher.

In addition, students in the HMS SAT program engage in a microteaching activity in which they teach a small group of peers for 5 minutes while videorecording themselves.<sup>37</sup> After this brief teaching session, the student teacher watches the video of their teaching while the other students develop constructive feedback to provide to the student teacher. After the student teacher has watched the video, they engage in self-assessment by commenting on what they think went well and what were opportunities for improvement. The other students then provide peer assessment by providing constructive and reinforcing feedback. The student teacher role then rotates to a different student in the small group, and the cycle of teaching, review, reflection, and feedback continues.

### **Final educational product**

Some SAT programs require a final assignment, which may include curricula developed by students, learning goals and objectives, oral presentations, teaching proposals, and/or other educational initiatives.<sup>23</sup> At HMS, guidelines for the educational product are purposely broad, to encourage creativity and innovation and to allow students to explore personal interests in medical education. During the first half of the SAT program, students are required to submit a proposal that defines a problem in medical education, identifies stakeholders, and proposes goals and objectives. Course faculty review these proposals and provide verbal and written feedback, which students subsequently use to revise their proposals before beginning their final educational product. We encourage students to work with faculty so they can implement their educational product into the HMS curriculum, although implementation is not formally required. Some students have published their projects, such as the Geriatrics 5Ms Pocket Card.<sup>38</sup>

### **Self-reflection**

Many SAT programs involve end-of-course self-reflections. The rationale for requiring students to self-reflect is based on the learning benefits of metacognition.<sup>39</sup> In medical education, metacognitive practices have been shown to help students develop their clinical expertise and identify cognitive biases.<sup>40,41</sup> Structured reflection, including experiential narratives, can be an effective way to promote metacognition and self-directed learning among students.<sup>42</sup> At HMS, students in the SAT program were encouraged to keep a teaching journal to document their thoughts after each teaching session in which they participated. An end-of-course reflection on these teaching experiences is a required component of the SAT elective, as well as 2 shorter reflections on the feedback process and on observing an expert teacher.



## Recommendations

Our discussion of ongoing challenges in SAT programming and description of the HMS SAT elective using a communities of practice framework leads us to several recommendations. In the absence of guidelines from professional societies or accrediting agencies, we strongly recommend undergraduate medical institutions implement SAT programs informed by the perspective of local stakeholders and an institutional needs assessment based upon review of SAT literature. As undergraduate medical education moves toward wider adoption of SAT programming, we also recommend that medical educators continue to identify core competencies of SAT programming and disseminate curricular material broadly to drive change at national level.

At HMS, we have implemented an innovative longitudinal elective that prepares students for lifelong careers in medical education. This 5-component model covers essential topics of SAT programming while incorporating unique but theoretically justified features, providing students a comprehensive educational skills training curriculum. As SAT programs become more prevalent in undergraduate medical education, medical educators must put forward a common set of core competencies and curricular activities to guide their implementation. To support educational skills as an accreditation requirement, we also recommend further evidence about the outcomes of such SAT programs. Once established, we advocate that some aspects of SAT programming become required content in undergraduate medical education curricula and incorporated into existing entrustable professional activities and LCME standards.

## Acknowledgments:

The authors would like to acknowledge Drs. Richard Schwartzstein and Ed Hundert, whose support was integral to the development of the student-as-teacher elective at Harvard Medical School.

## Funding/Support:

The student-as-teacher elective at Harvard Medical School was funded by the Harvard Medical School Academy Curtis Prout Fellowship.

## References

1. McKeon BA, Ricciotti HA, Sandora TJ, et al. A consensus guideline to support resident-as-teacher programs and enhance the culture of teaching and learning. *J Grad Med Educ.* 2019;11:313–318. [PubMed: 31210863]
2. Freret T, Rana J, Schwartzstein RM, Gooding HC. Twelve tips for implementation of “student-as-teacher” programs. *Med Teach.* 2017;39:1221–1226. [PubMed: 28598708]
3. Pasquinelli LM, Greenberg LW. A review of medical school programs that train medical students as teachers (MED-SATS). *Teach Learn Med.* 2008;20:73–81. [PubMed: 18444189]
4. Rana J, Sullivan A, Brett M, Weinstein AR, Atkins KM; SaT Delphi Working Group. Defining curricular priorities for student-as-teacher programs: A national Delphi study. *Med Teach.* 2018;40:259–266. [PubMed: 29171329]
5. Soriano RP, Blatt B, Coplit L, et al. Teaching medical students how to teach: A national survey of students-as-teachers programs in U.S. medical schools. *Acad Med.* 2010;85:1725–1731. [PubMed: 20881824]

6. Yu TC, Wilson NC, Singh PP, Lemanu DP, Hawken SJ, Hill AG. Medical students-as-teachers: A systematic review of peer-assisted teaching during medical school. *Adv Med Educ Pract*. 2011;2:157–172. [PubMed: 23745087]
7. Wenger-Trayner E, Wenger-Trayner B. Communities of practice: A brief introduction. <http://wenger-trayner.com/introduction-to-communities-of-practice>. Published 2015. Accessed December 8, 2021.
8. Burgess A, McGregor D, Mellis C. Medical students as peer tutors: A systematic review. *BMC Med Educ*. 2014;14:115. [PubMed: 24912500]
9. ten Cate O, Durning S. Peer teaching in medical education: Twelve reasons to move from theory to practice. *Med Teach*. 2007;29:591–599. [PubMed: 17922354]
10. Rana J, Freret T. Training medical students how to teach helps them embrace ambiguity. *Stat*. May 2017. [www.statnews.com/2017/05/22/medical-students-teaching-training](http://www.statnews.com/2017/05/22/medical-students-teaching-training). Published May 22, 2017. Accessed December 8, 2021.
11. Hill E, Liuzzi F, Giles J. Peer-assisted learning from three perspectives: Student, tutor and co-ordinator. *Clin Teach*. 2010;7:244–246. [PubMed: 21134199]
12. Dandavino M, Snell L, Wiseman J. Why medical students should learn how to teach. *Med Teach*. 2007;29:558–565. [PubMed: 17922358]
13. Niaz HF, Mistry JR. Twelve tips for being an effective clinical skills peer teacher. *Med Teach*. 2021;43:1019–1024. [PubMed: 33136451]
14. Gheihman G, Johnson M, Simpkin AL. Twelve tips for thriving in the face of clinical uncertainty. *Med Teach*. 2020;42:493–499. [PubMed: 30912996]
15. Bing-You RG, Sproul MS. Medical students' perceptions of themselves and residents as teachers. *Med Teach*. 1992;14:133–138. [PubMed: 1406122]
16. Henry BW, Haworth JG, Hering P. Perceptions of medical school graduates and students regarding their academic preparation to teach. *Postgrad Med J*. 2006;82:607–612. [PubMed: 16954460]
17. Byrne R, Barbas B, Baumann BM, Patel SN. Medical student perception of resident versus attending contributions to education on co-supervised shifts during the emergency medicine clerkship. *AEM Educ Train*. 2018;2:82–85. [PubMed: 30051073]
18. Kloek AT, van Zijl AC, ten Cate OT. How a teaching rotation in medical school affects graduates' subsequent careers. *Perspect Med Educ*. 2016;5:325–331. [PubMed: 27757916]
19. Rees EL, Quinn PJ, Davies B, Fotheringham V. How does peer teaching compare to faculty teaching? A systematic review and meta-analysis (.). *Med Teach*. 2016;38:829–837. [PubMed: 26613398]
20. Law M, Baker L, Leslie K, et al. Negotiating learner-teacher boundaries in medical education. *Med Teach*. 2015;37:490–491. [PubMed: 25156642]
21. Accreditation Council for Graduate Medical Education (ACGME). Common program requirements (residency). <https://www.acgme.org/Portals/0/PFAssets/ProgramRequirements/CPRResidency2020.pdf>. Published February 3, 2020. Accessed December 8, 2021.
22. Liaison Committee on Medical Education. Functions and structure of a medical school: Standards for Accreditation of Medical Education programs leading to the M.D. degree. <https://lcme.org/publications/> Accessed December 1, 2021.
23. Burgess A, McGregor D. Peer teacher training for health professional students: A systematic review of formal programs. *BMC Med Educ*. 2018;18:263. [PubMed: 30442139]
24. Marton GE, McCullough B, Ramnanan CJ. A review of teaching skills development programmes for medical students. *Med Educ*. 2015;49:149–160. [PubMed: 25626746]
25. Chatterjee D, Corral J. How to write well-defined learning objectives. *J Educ Perioper Med*. 2017;19:E610. [PubMed: 29766034]
26. Blatt B, Greenberg L. A multi-level assessment of a program to teach medical students to teach. *Adv Health Sci Educ Theory Pract*. 2007;12:7–18. [PubMed: 17041788]
27. Burgess A, Black K, Chapman R, Clark T, Roberts C, Mellis C. Teaching skills for students: Our future educators. *Clin Teach*. 2012;9:312–316. [PubMed: 22994470]
28. Said J, Schwartz A. Remote medical education: Adapting Kern's curriculum design to tele-teaching. *Med Sci Educat*. 2021;31:805–812.

29. Loda T, Erschens R, Loenneker H, et al. Cognitive and social congruence in peer-assisted learning —A scoping review. *PLoS One*. 2019;14:e0222224. [PubMed: 31498826]
30. Lufler RS, Lazarus MD, Stefanik JJ. The spectrum of learning and teaching: The impact of a fourth-year anatomy course on medical student knowledge and confidence. *Anat Sci Educ*. 2020;13:19–29. [PubMed: 30793847]
31. Knobloch AC, Ledford CJW, Wilkes S, Saperstein AK. The impact of near-peer teaching on medical students' transition to clerkships. *Fam Med*. 2018;50:58–62. [PubMed: 29346691]
32. Wong JG, Waldrep TD, Smith TG. Formal peer-teaching in medical school improves academic performance: The MUSC supplemental instructor program. *Teach Learn Med*. 2007;19:216–220. [PubMed: 17594215]
33. Peets AD, Coderre S, Wright B, et al. Involvement in teaching improves learning in medical students: A randomized cross-over study. *BMC Med Educ*. 2009;9:55. [PubMed: 19706190]
34. Kelly E, Richards JB. Medical education: Giving feedback to doctors in training. *BMJ*. 2019;366:l4523. [PubMed: 31324645]
35. Shi CR, Nguyen MO, Rana J, Burgin S. Teaching and learning tips 12: Peer observation of teaching. *Int J Dermatol*. 2018;57:1233–1236. [PubMed: 30187923]
36. Rees EL, Davies B, Eastwood M. Developing students' teaching through peer observation and feedback. *Perspect Med Educ*. 2015;4:268–271. [PubMed: 26358978]
37. Dayanindhi VK, Hegde SP. Effectiveness of microteaching as a method of developing teaching competence among in-service medical teachers. *J Adv Med Educ Prof*. 2018;6:155–161. [PubMed: 30349826]
38. Holliday AM, Hawley CE, Schwartz AW. Geriatrics 5Ms Pocket Card for medical and dental students. *J Am Geriatr Soc*. 2019;67:E7–E9. [PubMed: 31802487]
39. Ross MT, Cameron HS. Peer assisted learning: A planning and implementation framework: AMEE guide no. 30. *Med Teach*. 2007;29:527–545. [PubMed: 17978966]
40. Gooding HC, Mann K, Armstrong E. Twelve tips for applying the science of learning to health professions education. *Med Teach*. 2017;39:26–31. [PubMed: 27665669]
41. Mamede S, van Gog T, Moura AS, et al. Reflection as a strategy to foster medical students' acquisition of diagnostic competence. *Med Educ*. 2012;46:464–472. [PubMed: 22515754]
42. Quirk M. *Intuition and Metacognition in Medical Education: Keys to Developing Expertise*. New York, NY: Springer; 2006.

**List 1****Specific Goals for ELO700, Harvard Medical School**

- 
- 1 Goal: Develop skills to teach in a variety of settings (small-group facilitation, large-group interactive teaching, beside clinical skills teaching, ambulatory precepting).
    - Objective: By the end of the elective, each student will have spent at least 20 hours of direct teaching time in addition to at least 20 hours of preparation for teaching.
  - 2 Goal: Apply principles of educational theory and learning science as an NPT and a lifelong learner.
    - Objective: Each student will participate in 24 hours of interactive sessions on core topics in medical education, such as case-based teaching principles, adult learning theory, clinical skills/procedural teaching, and principles of effective feedback.
    - Objective: Each student will have the opportunity to observe HMS Masters Teachers in clinical or classroom settings, reflecting on the application of learning science and theory employed by these educators.
    - Objective: Students will have the opportunity to participate in a peer observation of at least one other NPT during the course, using the appropriate HMS Academy Peer Observation of Teaching Instruments.
  - 3 Goal: Development as an educator: Understand how to thoughtfully design, implement, and/or evaluate curricula.
    - Objective: Each student will create an educational product that they conceptualize and/or that meets the needs of the faculty directing their teaching field experience.
    - Objective: Each student will have the opportunity to undergo at least one structured observation of his or her teaching by either the teaching field experience faculty or another supervising faculty member.
- 

Abbreviations: HMS, Harvard Medical School; ELO, Educational Longitudinal Opportunity; NPT, near-peer teacher.

**Table 1****Systematic Reviews of Student-as-Teacher and Related Programs**

<b>Authors</b>	<b>Year</b>	<b>Major findings</b>
Pasquinelli and Greenberg <sup>3</sup>	2008	Variability in content and teaching roles across student-as-teacher programs. Few reports discuss curricular content or measure long-term outcomes.
Yu et al <sup>6</sup>	2011	Student outcomes in peer teaching are comparable to those of faculty-led teaching. Student teachers benefit academically and professionally, as well. Long-term impact remains poorly understood.
Burgess, McGregor, and Mellis <sup>4,8</sup>	2014	Significant variability in training programs and evaluation methods. No conclusive evidence to suggest that serving as a peer teacher improves examination performance.
Marton, McCullogh, and Ramanan <sup>2</sup>	2015	Program participants are usually in the third and fourth years of training. Subjective scales were common for course evaluation. Few objective outcomes were reported.
Burgess and McGregor <sup>1</sup>	2018	Most teaching programs are uni-disciplinary, volunteer based, and offered to senior-year students. Common content areas included educational theory, teaching methods, and feedback. Program evaluation methods were predominantly subjective.

<sup>4</sup>Review of peer-assisted learning, formal peer teaching programs with a practical focus.

**Table 2**

**Fundamentals of Medical Education Seminar Series and Session Objectives, Harvard Medical School**

Session	Objectives
1. Adult Learning Theory and the Science of Learning	<ul style="list-style-type: none"> <li>• Review course format, expectations, and goals</li> <li>• Delineate expectations for the curriculum project and articulate personal goals for the project portion of the course</li> <li>• Apply principles of adult learning theory to making teaching memorable</li> <li>• Describe specific strategies for active teaching and learning informed by scientific evidence</li> </ul>
2a. Design Thinking for Curriculum Development	<ul style="list-style-type: none"> <li>• Define and classify goals and objectives for an educational project</li> </ul>
2b. Writing Goals and Objectives	<ul style="list-style-type: none"> <li>• Practice using specific strategies from design thinking to identify an educational problem or need</li> </ul>
3. Clinical Skills Teaching	<ul style="list-style-type: none"> <li>• Identify the steps involved in teaching a psychomotor skill like the physical examination</li> <li>• Demonstrate the ability to teach a skill to fellow students</li> <li>• Practice 2 models of ambulatory precepting (which are also applicable to inpatient teaching)</li> <li>• Discuss the strengths and challenges of teaching at the bedside with a patient present</li> </ul>
4. Small Group Teaching and Asking Good Questions	<ul style="list-style-type: none"> <li>• Discuss different specific strategies for engaging in small-group teaching</li> <li>• Identify best practices for working with quiet and dominant learners in small-group settings</li> <li>• Practice asking questions that promote deeper learning during a case discussion</li> </ul>
5. Giving and Receiving Feedback	<ul style="list-style-type: none"> <li>• Identify components of effective feedback</li> <li>• Understand techniques that allow constructive feedback to be given and received</li> <li>• Practice peer observation of teaching and provision of feedback to a fellow near-peer teacher</li> <li>• Demonstrate the ability to use Harvard Medical School Academy Peer Observation of Teaching forms</li> </ul>
6. Effective Teaching Strategies in Action	<ul style="list-style-type: none"> <li>• Practice writing learning objectives and choosing instructional formats to match</li> <li>• Design and deliver a brief teaching session</li> <li>• Practice delivering a brief teaching session</li> </ul>
7. Microskills of Teaching	<ul style="list-style-type: none"> <li>• Deconstruct what effective teachers do to enhance learning</li> <li>• List strategies for dealing with commonly encountered challenges when teaching, including the unprepared student, the quiet student, and the dominant student</li> </ul>
8. Simulation-Based Medical Education	<ul style="list-style-type: none"> <li>• Describe the benefits of simulation-based medical education in acquiring knowledge, skills, and attitudes</li> <li>• Discuss the evidence supporting simulation as an effective medical education intervention</li> </ul>

Session	Objectives
	Develop a large-group simulation scenario for preclinical medical students
9a. Using Technology in Teaching 9b. Best Practices in Small-Group Teaching Skills	<ul style="list-style-type: none"> <li>• Describe the diversity of ways in which technology can be used in medical education</li> <li>• Consider best practices and emerging challenges in using technology in medical education</li> <li>• Apply concepts to education projects and consider role for technology</li> </ul>
10a. Assessment and Evaluation in Medical Education 10b. Scholarship in Medical Education	<ul style="list-style-type: none"> <li>• Review the use of Kirkpatrick's pyramid and levels of evaluation of medical education</li> <li>• Discuss scholarship opportunities in medical education and Glassick's criteria for scholarship</li> <li>• Apply frameworks to educational projects and consider how to transform into educational scholarship</li> </ul>
11. Educational Project Forum: Student Presentations	<ul style="list-style-type: none"> <li>• Discuss the role of the hidden curriculum in promoting or hindering learning</li> <li>• Review the spectrum of clinical teaching opportunities as a resident and beyond</li> <li>• Recognize how teaching integrates with a variety of medical careers</li> </ul>
12a. Professionalism in Medical Education 12b. Medical Education as a Profession	<ul style="list-style-type: none"> <li>• Describe the conception and implementation of an educational initiative</li> <li>• Practice presenting the conception and preliminary implementation of an education initiative</li> <li>• Interact with faculty and peers to gain constructive criticism about one's educational project</li> <li>• Implement revisions to one's educational project in response to constructive criticism</li> </ul>

**Table 3**

**Student-as-Teacher Elective Course Requirements, Harvard Medical School**

<b>Component</b>	<b>Time requirement</b>
<b>Medical education longitudinal elective core requirements (2 credits)</b>	<b>80 hours</b>
Teaching field experience	20 hours direct contact with learners + 20 hours of teaching preparation/reflection
Foundations of Education Seminar series	24 hours
Creation of education product	10 hours
Final end-of-course reflection	4 hours
<b>Medical education longitudinal elective additional requirements<sup>a</sup></b>	<b>6 hours</b>
Observation of HMS master teachers	Up to 6 hours
Peer observation of teaching	Up to 6 hours (includes prebrief, observation, debrief)
Observation and feedback of students teaching by faculty	Up to 6 hours (includes observation and feedback by field experience faculty supervisor)

Abbreviation: HMS, Harvard Medical School.

<sup>a</sup>Students are expected to do at least 1 of these 3 activities or some combination totaling 6 hours.