A New Way to Integrate Clinically Relevant Technology into Small-Group Teaching

Hugh Silk, MD, Thomas Agresta, MD, and Catherine M. Weber, PhD

Abstract

Medical educators need to teach learners to efficiently access the best available evidence at the point of care and apply it in a patient-centered manner. As information becomes more readily available via the Internet and handheld computers, strategies to use these tools as part of the educational process become more important. New teaching skills are needed when attempting to seamlessly introduce technology into small-group settings in the midst of blending old and new teaching methods.

The authors' development of a conceptual model known as "e-microskills" at the University of Connecticut School of Medicine in 2002 has facilitated the smooth integration of technology into teaching. This model's cornerstone is direct empowerment of learners during small-group sessions to perform observed searches for the best medical evidence on the Internet and with handheld computer resources. This is done in the context of a mnemonic, PEARL: (1) Choose a "**P**replanned search intervention"; (2) allow learners to "**E**xecute the search," thus committing themselves; (3) **"A**llow learners to teach other learners" about their search process; (4) "**R**eview the quality of evidence" for the information found; and (5) discuss "**L**essons of the search."

Additional features of this teaching model include ground rules for teaching with technology that optimizes teaching time by reducing anticipated obstacles. The rules add structure in an otherwise impromptu setting thus maximizing the teachable moment. While "e-microskills" are described here within the context of a third-year family medicine clerkship, they can easily be adapted to other small-group teaching settings.

Acad Med. 2006; 81:239–244.

In this article, we describe PEARL, a new approach developed by the three of us at our medical school to help faculty more easily teach medical students to use information technology in clinical settings. This description is based on our experiences and those of other participating faculty members and students using PEARL. The interventions are subtle, and, when used properly, are part of a seamless process of faculty instruction, invisible to students yet very helpful.

Importance of Teaching Technology Skills

Physicians need to be ethical, knowledgeable, humanistic, and personable; they must also be able to adapt to the demands of an ever evolving high-tech world.[1,2] Rapid access to patient-centered, evidence-based information can significantly enhance clinical outcomes. But accessing information, particularly at the point of care, is not something learners do instinctively, nor do they see it modeled effectively by many physicians. Students and residents are best served in the 21st century by simultaneously learning clinical skills and information mastery. These skills are now deeply intertwined and should be taught in a synergistic manner.

Many organizations, individuals and the federal government have recommended strategies of this type. The Association of American Medical Colleges has made medical informatics and population health one of the cornerstones of the Medical School Objectives Project, stating that "physicians will have to possess the knowledge, skills, and attitudes required to be competent in medical informatics if they wish to incorporate into practice systematic approaches for promoting and maintaining the health of defined populations."[3] The Liaison Committee on Medical Education has made it a requirement that faculty and students have access to and become competent with information resources, data systems and contemporary information technology for solving problems commonly encountered in medical practice.[4] The Accreditation Council for Graduate Medical Education also has clear technology-based objectives within the competencies of patient care, medical knowledge, and practice-based learning and improvement.[5] The Institute of Medicine, in recent publications, has strongly recommended integrating the use of technology into team-based teaching of patient-centered, evidence-based clinical care.[6] Yet medical educators are just beginning to explicitly address these recommendations.

The medical education literature contains many articles describing several of the merits of self-directed Web-based learning (WBL). The research includes observations that learners show a preference for WBL over slides, lectures, texts, and most other traditional teaching approaches. While there are limitations to WBL, learner evaluations show satisfaction ratings are high, including the perception of WBL as being more efficient, improving learners' confidence, and being a strong adjuvant to traditional learning. In addition to these benefits there is also evidence that knowledge

Dr. Silk is assistant professor, Department of Family Medicine, University of Connecticut School of Medicine, Farmington, Connecticut.

Dr. Agresta is associate professor and pre-doctoral director, Department of Family Medicine, University of Connecticut School of Medicine, Farmington, Connecticut.

Dr. Weber is associate professor, Department of Family Medicine, and assistant dean for educational resources, University of Connecticut, School of Medicine, Farmington, Connecticut.

Correspondence should be addressed to Dr. Hugh Silk, University of Connecticut Health Center, MC 2918, 263 Farmington Avenue, Farmington, CT, 06030; telephone: (860) 679-2928; fax: (860) 679-1350; e-mail: ⟨hsilk@uchc.edu⟩.

gains are at least equivalent to those gained via other forms of education.[7] The handheld computer, loaded with medical software, is another tool that has clearly begun to both demonstrate benefits for improving access to point-of-care, evidence-based medical information by physicians[8] and also enhance clinical education.[9]

Yet the Internet and handheld computers, despite their merits, are only part of the evolving educational landscape. We propose that this evolution should involve the convergence of WBL and handheld computer education with evidence-based learning, small-group learning, problem-based learning (PBL), informatics, and simulated patients studied via electronic health records. This collaboration between technology and innovative teaching practices formulates a new learning strategy, which we refer to as *electronic-based learning* (EBL). This strategy will best serve the educational needs of physicians in training. While each teaching modality has been evaluated on its own,[10–13] there is little information regarding the intermingling of these strategies. As educators begin to use EBL, both a clear approach and a precise way to describe it, will help move the dialogue forward.

History and Philosophy of PEARL

At the University of Connecticut School of Medicine in 2002, the three of us developed and implemented a set of microskills for faculty, to help them teach learners how to access information in a small-group setting. We also devised a mnemonic, PEARL, to characterize these microskills; it can be easily remembered and implemented, either formally or informally (see List 1). We employed the concept of microskills for the same reasons given by Neher et al. in their landmark paper[14]: the skills are easy to remember, they encourage and test many aptitudes, and faculty find them helpful.[15] Furthermore, they are based upon reports of what learners want from their faculty, including presenting teaching points in a well-organized manner, demonstrating adequate breadth of current medical knowledge, and giving frequent constructive feedback.[16] Our experience so far shows that having a common language such as PEARL to describe specific teaching techniques makes collaboration and further development easier. We have named the skills *e-microskills* to denote that they are skills for electronic teaching.

Electronic-based learning requires a coordinated delivery plan to create an effective curriculum. While specific objectives exist for each small-group session, each group will follow a unique path to achieve them. EBL follows adult learning principles, allowing students to learn as individuals and giving them an opportunity to teach their peers. However, EBL can permit multiple tangents and minor objectives to predominate, which can frustrate faculty and students. It has been estimated that small-group PBL takes approximately 20% more time than traditional teaching methods to achieve the same objectives.[17] Within this flexible small-group learning format, our e-microskills provide direction. These skills help reduce the potential for misdirection of time and energies.

Our Teaching Setting

We have developed the e-microskills in the context of working with a simulated family during the third-year family medicine clerkship. Our three-generation simulated family (the "McQ standardized family" curriculum) is based upon the work of Pugnaire at the University of Massachusetts Medical School.[18] We have further developed this teaching tool at the University of Connecticut School of Medicine by creating an electronic version of the family members' charts. We call this "practice" electronic health record the Mock Electronic Medical Record for Education (m-EMR-E©). During the six-week required family medicine rotation, students spend four small-group sessions (each lasting four hours) treating the McQs. The presentation of each visit is similar to an actual electronic medical record, with patient data appearing in text format including history and physical exam information. Images in the patient chart include a photo of the patient, ECG and lab results, X-rays, and questionnaires. Students can enter data, including prescriptions, and assessments and plans, for each patient encounter. A small group consists of one faculty facilitator and six or seven students; two groups are conducted simultaneously to accommodate all the students in the rotation. The remainder of the rotation consists of four half-days of interactive lectures, large-group discussions, workshop training, and four days per week working with a community family physician.

In each small-group session, students simulate seeing several members of the family by accessing an individual's electronic chart and reviewing the history, physical, and diagnostic data for that visit. Students address typical health issues: tobacco abuse, asthma, hypertension, and several other common health issues. Beginning with the 2001–02 academic year each student has been equipped with a handheld computer loaded with an evidence-based medicine (EBM) program (Inforetriever©); a drug database (Epocrates Pro© or Lexidrugs©); a clinical calculator (Archimedes©); and a student experience log. They also borrow from the department a laptop computer (or use their own) for the rotation with wireless access to m-EMR-E and to linked articles and medical Web sites. Students are expected to learn information access skills in the small group setting and then utilize those skills in actual patient encounters.

In our orientation to the rotation, we remind students that physicians must have a wide variety of skills beyond standard medical and clinical skills. They must find a way to balance the need for patient-centeredness with keeping current. The latter includes taking an evidence-based approach and accessing vast amounts of information rapidly and efficiently while also minimizing risk. We

List 1

PEARL—Teaching the Use of Technology Using E-Microskills, University of Connecticut School of Medicine, 2005

P: Choose a ***P****replanned search intervention* (see List 2 below).
E: Allow learners to ***E****xecute the search,* thus committing themselves.
A: ***A****llow learners to teach others* about their search findings.
R: ***R****eview the quality of evidence* for the information found.
L: Discuss ***L****essons of search*.

explain that the efficient use of technology enhances the primary goal: allowing the physician to spend more time with the patient while giving the physician better information. We have found that students sometimes protest that they want to learn "medical" information first and technology information later. Our experience has been that it takes much less convincing with each passing medical school year as students are seeing the changes occurring in patient care first-hand. Similar resistance was initially expressed about PBL, and over time has faded as the benefits have been well documented.[19]

Description of the PEARL E-Microskills

Below we briefly describe the five e-microskills that constitute PEARL; these are also listed in List 1.

Preplanned search intervention. When a faculty member feels an information search is needed he or she chooses a specific preplanned search intervention. The faculty member can often predict, based on previous experiences and searches, what intervention will be most effective as he or she reviews the objectives for an upcoming small-group session. There are the following four main categories of preplanned search interventions that facilitate different outcomes.

- *Scatter.* "Scatter" is a strategy involving all students in the group simultaneously. It is ideal for information that is readily available and relatively easy to find, interpret, and report to the group. Once a question is identified, students search independently for answers for a predetermined amount of time (usually less than five minutes) and report back to the group individually. Using urinary tract infections (UTIs) as an example, students might search the Internet for the best patient education handout or the handheld computer for comparing approaches for prevention of UTIs. This strategy allows learners to compare the range of resources available and learn how differing search strategies yield varied results.
- *Going together.* A second strategy, "going together," is more suitable for teaching learners about a specific resource that they need to know about in greater depth. The faculty member will usually demonstrate how to answer a given clinical question to the whole group by projecting the actual site, resource, and/or strategy onto a screen. Examples from Internet searches would include showing students a best evidence clinical pathway for asthma management or a recommendation for a screening test from the United States Preventive Services Task Force. Examples for a handheld computer demonstration might include a clinical calculator (e.g., a cardiac risk calculator) or a picture of a common dermatologic lesion. This strategy relies less on the learner and is a good way to ensure that all learners have a basic knowledge of the most critical of the available resources. The search should be followed by an explanation of how this search strategy can be applied in patient-centered ways in clinical settings.
- *Single searcher.* The "single searcher" strategy is very efficient for finding factual information, community resources, or responses to questions that are tangential to the main objectives for the small-group session. When an interesting question arises that a faculty member feels is best answered immediately, then a single student is tasked with pursuing an answer while the rest of the group continues with the prior discussion. This allows the group to progress rather than being sidetracked with one small fact; the strategy models effective time management yet still acknowledges the relevance of the question. Once the student has found the relevant information, the student may either politely interrupt or wait for a natural break in the group's discussion to report the answer. Previously, groups would table such topics and look them up after the group's meeting. But doing that could sometimes cause the topic to lose its relevance. An example that has arisen from our use of this intervention is an Internet search for pertinent state laws on treating minors. Searches via the handheld computer have included quickly looking up the cost of a drug on a pharmaceutical database or finding the formula for calculating body mass index.
- *In-depth home search.* Finally, the "in-depth home search" is a strategy that has historically been used by faculty in many small-group settings. This is helpful for topics that require a deeper review and understanding of medical literature. When a question arises that is best answered in this manner, a student is asked to investigate a topic and report to the group at its next meeting. Alternatively, each student can be asked to report on different topics. This allows for a smooth group process when questions arise that are too complex to search for in a five-minute time frame. It is imperative that the faculty leader decide what topics should not be pursued "live" in the classroom in order to avoid disrupting the group process. For example, we have used the in-depth home search approach to have a learner report on the pathophysiology of breast milk jaundice and the indications and options for treatment. This approach has also been helpful in the many instances when handheld computers were less useful in the classroom because they could not access large databases. The limitation of databases on handhelds is an important concept for students to learn about information technology.

Execute the search. Once the preplanned search intervention has been decided upon, learners are encouraged to execute the search for information in order to actively practice the "just-in-time" retrieval skills needed for patient-centered, EBM clinical care.

Allow learners to teach others. In one small-group session, one of the simulated family members has a back strain. The students are given five minutes to search Internet databases for approaches to back strains. The faculty member then allows learners to report their search findings to one another. Students use a variety of resources including UptoDate©, Inforetriever©, MDConsult©, Ovid©, Google©, and Google Scholar©. The faculty member encourages learners to describe *how* they found the information as they present it. This creates a peer feedback system for learners which helps them to evaluate and enhance the quality of the searches they perform.

Review the quality of evidence. The faculty member next encourages the learners to review the quality of evidence in their search results with the entire group. We use strategies such as PICO

(Population, Intervention, Comparison, and Outcome)[20] and the level of evidence criteria (which are traditionally presented as levels 1a through 5) and grades of recommendations (traditionally graded as A through D) created by Sacket et al.[21] At first, students are prompted by a faculty member to provide this information, but over time they offer it as part of the presentation. In our back strain example, students will find conflicting data on chiropractic care and physical therapy, which highlights the importance of evaluating the evidence. It also shows the limitations of information technology; it is only as good as the evaluation that is performed using it.

Lessons specific to the search. Last, the faculty member teaches lessons specific to the search. The faculty member comments on the search technique, the quality of the Internet site or handheld resource found, and the level of evidence, and gives feedback on the style of the presentation. Giving feedback on effective presentation skills promotes the idea that physician presentation styles will also be pertinent in the clinical exam rooms when presenting the results of a search to a patient for a patient-related question. It reinforces the importance of remaining patient-centered in the delivery of the information to patients and clinical faculty. Criteria for a good presentation style include making eye contact while relaying information (instead of having a computer or handheld screen in the field of vision), using language devoid of medical jargon when appropriate, and ensuring that others understand what is being communicated. Likewise, the other learners in the classroom are encouraged to show respect for fellow students as they are sharing their findings by practicing active listening skills and not focusing on their own search results. These presentation skills should be encouraged and modeled by faculty to help emphasize how essential they are for practicing "high-touch" medicine while using "high-tech" tools.

Overcoming Obstacles Inherent in Teaching with Technology

While technology is very helpful in improving patient care, the implementation of a teaching change has resulted in the identification of many hurdles. The obstacles that we have faced include time management issues, students being distracted by e-mail and entertainment Web sites, physical barriers in the classroom, the risk of the classroom setting being impersonal, and the cost and stability risks of the infrastructure (see List 2). However, we have found that many of these obstacles can be easily overcome and prevented by attention to a set of "ground rules" for our electronic teaching environment. Observing our ground rules (see List 3) helps to avoid many of the straightforward pitfalls discussed above, facilitating buy-in and ownership from the faculty and students. These ground rules can be divided into three main areas: (1) preparing the technology infrastructure needed for teaching; (2) assuring adequate faculty development and comfort; and (3) teaching students to be proficient in the use of required technology and to avoid distractions.

We have found that we are most effective in our use of Internet and technology resources when each person in the room has his or her own laptop computer with a wireless connection. We have an information technology staff who are both supportive and knowledgeable about the how, where, and what we plan to do with technology while teaching.

List 2

Obstacles to Teaching with Technology

Time Management
- Information searches in real time
- Unplanned, impromptu curricula
- Getting everyone to same site
- Computers and PDAs crash
- Set up and pack up time

Electronic Distractions
- Entertainment Web sites
- Checking e-mail
- Processing time delays

Physical Barriers
- Some laptops/PDAs are bulky
- Risk of damage from food, drinks, trauma

Less Personal
- Less listening and eye contact
- Focus on technology versus patient

Cost and Technology Considerations
- Costs of PDAs and computers
- Rapidly evolving technology
- Students reluctance to learn technology
- Previous operating system bias
- Different levels of skills among students and faculty
- Battery life/access to power source

They are also very accessible. We use the same room for each session, with table-style seating and easy access to electrical outlets and projection equipment, which diminishes downtime. We keep a supply of charged replacement batteries, extra power cords, and a multicomputer Ethernet© adapter to avoid any other frustrations.

Creating faculty comfort prior to working with students is essential. The first aspect of the faculty orientation is to the hardware and software. The amount of time spent on this will vary depending on the degree of faculty members' technological background. The second part is more focused on the classroom process. We have new faculty observe a skilled mentor using technology in a small-group setting on several occasions. We supply our faculty with software so they can practice using it in a clinical situation at the point of care. We then have them do a few small-group teaching sessions where they are observed and can receive our feedback.

Students need a more formal orientation to handheld-computer use, which is aimed at the level of the least proficient user; this target changes rapidly and requires monitoring. While Internet use is now universal, time should be built-in to the first small-group discussion to teach students information mastery principles as well as a tour of high-quality, faculty-selected Web sites that have a proven track record for successful EBM searches. Students are explicitly taught skills for presenting the data found in searches during interactive small-group sessions.

The remainder of the ground rules simply help to avoid wasting time and to maintain a sense of cohesion between participants rather than simply a connection between participants and their machines. These include frequently establishing eye contact with peers and not checking e-mail or doing other distracting computer-related activities during class time.

Evaluation

The development of our teaching model has evolved over several years as a result of observing our own educational dilemmas and what seemed to work in solving them. We solicit student

List 3

Ground Rules for Learner-Centered Technology Use

Technology Preparation and Protection

- Easy access to wireless and power sources (e.g., extra batteries, power cords, multicomputer Ethernet© router)
- Easily accessible information technology support
- Faculty and students use own laptops and handhelds
- Software and instructions available to faculty and students
- All participants help in set up and clean up
- No food or drinks near computers

Faculty Preparation

- Training in use of applicable hardware and software
- Practice use of EBM tools in own clinical care
- Observe and be observed in student teaching sessions

Student Preparation

- Students taught to be "Group Centered" (e.g., encourage frequent eye contact with fellow learners/faculty)
- No use of e-mail, entertainment sites in small group
- Orientation to hardware and software

evaluation on the small-group teaching sessions via end-of-rotation focus groups and the open-ended comment section of our postrotation survey. Due to the nature of trying to seamlessly insert the PEARL approach it is difficult to do formal evaluation. If it is done well, the students are not even aware that it is being done. However, from reviewing students' evaluations of the course we have been able to ascertain their indirect perspectives on this new teaching method.

Students' feedback can be grouped into the following themes:

- Students find practicing with a handheld computer and various software programs in class very helpful to their learning. This is especially true if they had never used such computers or programs previously.
- Students reflect that it is helpful for the group to compare what different students find on different Web sites using different search terms.
- Students find they can cover more topics within the small-group sessions because everyone has immediate, simultaneous access to the Internet. This is a favorable departure from previous experiences where only one student could access one computer in the room.

The four faculty members (including HS, TA) who teach the small-group sessions provide feedback to our evaluation specialist (CW) on their small-group teaching via e-mail surveys for their thoughts on PEARL and the "ground rules." Faculty comments echo some of the same sentiments expressed by the students, particularly around improved efficiency and efficacy. Here are some of the key comments from faculty:

- Having an organized framework for the spontaneous searching has allowed much more efficient and effective student searches of the evidence to occur.
- The Internet is a potentially distracting tool in a didactic setting. The PEARL framework makes the broad information landscape navigable.
- Having proper orientation for faculty and students, as well as being prepared for other obstacles, has also made teaching small groups more enjoyable.
- After starting to train students with more focused methods, a marked improvement has been observed in students' ability to apply the skills during patient encounters.

Future Adaptations

We have used our teaching principles mainly with third-year medical students during their family medicine rotation. It is logical that the next step would be to export the use of the principles to other medical school specialty rotations and to residencies for their small-group teaching sessions. For example, the teaching concepts outlined by PEARL could easily be used during resident didactic conferences, morning report, and during clinical precepting. As questions arise in these small-group settings, learners would be encouraged to use the technology (handheld computers, the Internet) in real time to answer the questions, and faculty could utilize the PEARL strategy for improving efficiency.

There are additional opportunities to expand this teaching style. Because we believe firmly that students should learn search strategies early in their medical training while learning other basic science knowledge, there is no reason that preclinical faculty could not incorporate PEARL and our ground rules into their small-group or PBL sessions. Continuing medical education (CME) has often been criticized for its lack of effect because it relies so heavily on the lecture format.[22,23] Small-group learning could present a more effective model to help clinicians improve their "point of care" information mastery skills, which are seldom taught in practical formats at CME meetings.[24]

We have recently used this technique successfully in a slightly modified format for a "hands-on" faculty development workshop. This was targeted at community-based faculty, who were being taught to use the same handheld computer programs used in our small-group sessions, to enhance clinical care and better educate and evaluate our students. Post-workshop evaluations revealed that this was a needed skill and the format was highly rated.

Summing Up

Experience in our small-group teaching environment has taught us that with the application of the e-microskills, faculty create a learning environment where students are better able to find and evaluate evidence-based medical information more efficiently. A nonclinical, small-group learning environment allows learners to simulate how they might eventually replicate this process with a patient in the office. The small-group setting emulates the time constraints and the need to respect other people involved in the process; in our setting it is fellow students, in the office or hospital it will be patients. The setting also allows for emphasis on both process and results, promoting "high-tech" *and* "high-touch." Finally, it teaches learners the benefits and limitations of Internet and hand-held computer-based

information. Because the future holds a much more integral role for technology in medical education, it is imperative that medical educators learn how to best educate learners with these tools.

Acknowledgments

The authors would like to acknowledge Drs. David Henderson and E. Spencer Joslin for their teaching contributions and ideas, and Kelly Hookstadt, Cory Lebson, and the late Diane Martin for their support in the classroom and in the development of our innovative teaching strategies.

This project was supported by a Predoctoral Training in Primary Care grant (02-D56HP00074-04-00), Bureau of Health Professions, Health Resources and Services Administration, United States Department of Health and Human Services.

References

1 Swick HM. Toward a normative definition of medical professionalism. Acad Med. 2000;75: 612–16.

2 The Medical School Objectives Writing Group. Learning objectives for medical school education: guidelines for medical schools. Report I of the Medical School Objectives Project. Acad Med. 1999;74:13–18.

3 Contemporary issues in medicine: medical informatics and population health. Report II of the Medical School Objectives Project. Acad Med 1999;74:130–41.

4 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; October 2004 edition (with updates as of October 2005) ⟨http://www.lcme.org/standard.htm⟩. Accessed 5 January 2006.

5 General Competencies, Outcomes Project. Accreditation Council for Graduate Medical Education. February Meeting, 1999 ⟨http://www.acgme.org/outcome/comp/compFull.asp⟩. Accessed 5 January 2006.

6 Institute of Medicine: Academic Health Centers Leading Change in the 21st Century. Washington DC: National Academy Press, 2003.

7 Chumley-Jones HS, Dobbie A, Alford CL. Web-based learning: sound educational method or hype? A review of the evaluation literature. Acad Med. 2002;77 (10 suppl): S86–S93.

8 McAlearney AS, Schweikhart S, Medow M. Doctors' experience with handheld computers in clinical practice: a qualitative study. BMJ. 2004;328:1162–66.

9 Bower DJ, Bertling CJ. Using PalmPilots as a teaching tool during a primary care clerkship. Acad Med. 2000;75:541.

10 Schmidt HG, Van der Molen HT. Self-reported competency ratings of graduates of a problem-based medical curriculum. Acad Med. 2001;76:466–68.

11 Peters AS, Greenberger-Rosovsky R, Crowder C, Block SD, Moore GT. Long-term outcomes of the new Pathway Program at Harvard Medical School: a randomized controlled trial. Acad Med. 2000;75:470–79.

12 Muller JH. Increasing the value of small-group learning. Acad Med. 2000;75:518.

13 Norman GR, Shannon SI. Effectiveness of instruction in critical appraisal (evidence-based medicine) skills: a critical appraisal. CMAJ. 1998;158:177–81.

14 Neher JO, Gordon KC, Meyer B, Stevens N. A five step "microskills" model of clinical teaching. J Am Board Fam Pract. 1992;5: 419–24.

15 Koen FM, Vivian AS. Learning the skills of clinical pharmacy teaching. Am J Pharm Educ. 1980;44:61–65.

16 Wolverton SE, Bosworth MF. A survey of resident perceptions of effective teaching behaviors. Fam Med. 1985;17:106–8.

17 Frost M. An analysis of the scope and value of problem-based learning in the education of health care professionals. J Adv Nurs. 1996; 24:1047–53.

18 Pugnaire MP, Leong SL, Quirk ME, Mazor K, Gray JM. The standardized family: an innovation in primary care education at the University of Massachusetts. Acad Med. 1999; 74 (1 suppl):S90–S97.

19 Bernstein P, Tipping J, Bercovitz K, Skinner HA. Shifting students and faculty to a problem-based learning curriculum: attitudes changed and lessons learned. Acad Med. 1995;70:245–47.

20 Sacket DL, Straus SE, Richardson WS, Rosenberg W, Haynes RB. Asking answerable clinical questions. In: Evidence-Based Medicine: How to Practice and Teach EBM. 2nd ed. Edinburgh; Churchill Livingstone, 2000:13–27.

21 Sacket DL, Straus SE, Richardson WS, Rosenberg W, Haynes RB. Asking answerable clinical questions. In: Evidence-Based Medicine: How to Practice and Teach EBM. 2nd ed. Edinburgh; Churchill Livingstone, 2000:173–77.

22 Mann KV. Educating medical students: lessons from research in continuing education. Acad Med. 1994;69:41–47.

23 Dunn EV, Bass MJ, Williams JI, Borgiel AE, MacDonald P, Spasoff RA. Study of relation of continuing medical education to quality of family physicians' care. Acad Med. 1988;63: 775–84.

24 Barnes BE. Creating the practice-learning environment: using information technology to support a new model of continuing medical education. Acad Med. 1998;73: 278–81.

Did You Know?

In 1970, the nation's first academic program for emergency medicine was established at the Keck School of Medicine of the University of Southern California.

For other important milestones in medical knowledge and practice credited to academic medical centers, visit the "Discoveries and Innovations in Patient Care and Research Database" at ⟨www.aamc.org/innovations⟩.