William B. Jeffries

Kathryn N. Huggett

Editors

An Introduction to Medical Teaching

Neurological Exam

- 7 steps
  - Mental status
  - Cranial nerves
  - Strength
  - Sensation
  - Cerebellar
  - Reflexes

≜ Springer

William B. Jeffries · Kathryn N. Huggett
Editors

An Introduction to Medical Teaching

Springer

Editors
Dr. William B. Jeffries
University of Vermont
College of Medicine
Office of Medical Education
Burlington VT 05405
E-125 Given Bldg.
USA
William.B.Jeffries@med.uvm.edu

Dr. Kathryn N. Huggett
Creighton University
School of Medicine
2500 California Plaza
Omaha NE 68178
USA
KathrynHuggett@creighton.edu

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

This book was conceived as a tool for the many varieties of medical teacher: the basic scientist, the clinical faculty member, the resident physician and the community practitioner. Individuals from each of these groups often assume the responsibility for educating the physicians of tomorrow. However, the formal training of these teachers is usually not centered on educational principles. Medical teachers often enter their careers ill equipped to engage in a scholarly approach to teaching. Thus we chose to create this volume as a how-to guide for medical teachers who wish to gain an understanding of educational principles and apply them to their teaching.

In keeping with the spirit of the book as an introduction, we have not produced a comprehensive textbook on medical education. Rather, the book is intended to introduce the reader to a variety of major topics that might serve specific needs. This work will be particularly useful to the educator who wants to introduce new methods into their teaching. As such, all of the chapters are grounded in the modern literature underlying adult learning theory and educational methods; however, the advice contained in each chapter is overwhelmingly practical and can be put to immediate use. The chapters begin with a focus on the learner, followed by a survey of the most common teaching modalities encountered by a medical teacher (large group, small group, problem-based, team based, clinical, simulation, and laboratory). We also examine critical elements that comprise the essentials of teaching and learning (using technology, student assessment, teaching evaluation, course design). Finally, we introduce the topic of educational scholarship and supply advice on documenting teaching for career advancement. In addition, to encourage the reader to further investigate each topic, chapters are fully referenced and the appendix provides additional educational resources.

The scope of educational scholarship is now quite broad. Thus no single author could adequately address the topics presented herein. We have thus assembled an exceptionally qualified and highly regarded team of authors who represent a diverse pool of teachers, clinicians and educational scholars. We are extremely grateful to the authors, who generously devoted their time and talents to this project.

Contents

Contributors

Mark A. Albanese, PhD University of Wisconsin School of Medicine and Public Health, Madison, WI, USA

M. Brownell Anderson, MEd Association of American Medical Colleges, Washington, DC, USA

Karen J. Brasel, MD, MPH Medical College of Wisconsin, Milwaukee, WI, USA

David A. Cook, MD, MHPE Mayo Clinic College of Medicine, Rochester, MN, USA

Kristi J. Ferguson, PhD University of Iowa Carver College of Medicine, Iowa City, IA, USA

Kathryn N. Huggett, PhD Creighton University School of Medicine, Omaha, NE, USA

William B. Jeffries, PhD University of Vermont College of Medicine, Burlington, VT, USA

Brian Mavis, PhD College of Human Medicine, Michigan State University, East Lansing, MI, USA

Kathryn K. McMahon, PhD Department of Medical Education, Paul L. Foster School of Medicine, Texas Tech University Health Sciences Center, El Paso, TX, USA

Susan J. Pasquale, PhD University of Massachusetts Medical School, Worcester, MA, USA

Christopher B. Reznich, PhD College of Human Medicine, Michigan State University, East Lansing, MI, USA

Janet M. Riddle, MD, FACP Department of Medical Education, University of Illinois-Chicago, College of Medicine, Chicago, IL, USA

Nicole K. Roberts, PhD Southern Illinois University School of Medicine, Springfield, IL, USA

Deborah Simpson, PhD Medical College of Wisconsin, Milwaukee, WI, USA

Carole S. Vetter, MD Medical College of Wisconsin, Milwaukee, WI, USA

Travis P. Webb, MD Medical College of Wisconsin, Milwaukee, WI, USA

Chapter 1
# Facilitating Student Learning

Kristi J. Ferguson

Helping students learn in medical education presents unique challenges that have changed rapidly over the last 10 years. For example, the growth of medical knowledge is accelerating exponentially, making it impossible for prospective physicians to learn everything they need to know during medical school, and making it essential for them to learn the skills related to lifelong learning that will serve them for their entire medical careers. Prospective physicians must learn how to identify their own learning needs, identify appropriate sources for addressing those needs, and learn how to apply the information and skills acquired to the care of patients during medical school and beyond. In addition, traditional models that feature pre-clinical training followed by 2 years of clinical training are giving way to newer models, which emphasize early application of basic science knowledge to clinical problems (e.g., through problem-based learning), as well as revisiting basic science content in the clinical years.

While growth in knowledge creates the need for lifelong learning, characteristics of students and their access to technology have changed as well. For example, incoming students have grown up with access to technology, and are accustomed to using it in their daily lives. This creates advantages as well as challenges for the medical educator. Using technology to store information for later retrieval is easy; being critical of available information and identifying sources of information that are valid is more difficult. Newer high-fidelity simulation allows students to learn and practice skills before they use them on patients, it provides opportunities for learning to work in teams to solve critical problems without putting patients at risk, and it provides a mechanism for assessing these skills in an authentic setting.

Later chapters in this book will address specific educational methods, e.g., Chapter 2 looks at the use of large group teaching methods, Chapter 3 addresses the use of small groups, Chapter 4 looks at problem-based learning, and Chapter 7 looks at simulation. Others will address issues of concern to the field in general, such as assessment of students, evaluation of teaching and learning, scholarship, and planning.

K.J. Ferguson (✉)
University of Iowa Carver College of Medicine, Iowa City, IA, USA
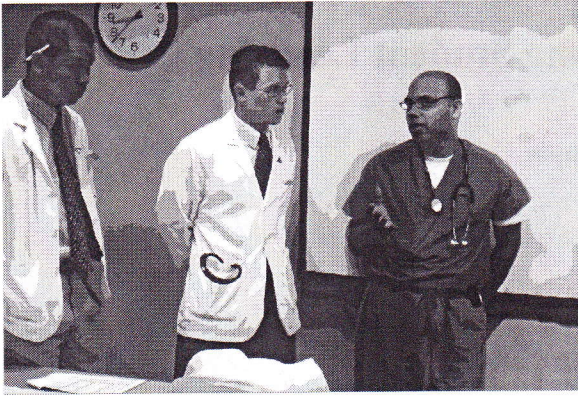
This chapter will begin with a discussion of key concepts related to helping students learn. It will then cover student-centered approaches, such as self-directed learning, that can enhance learning with understanding. Next, it will review the role of the teacher in developing appropriate learning activities and assessment strategies, and will conclude with a discussion of the role of feedback and the learning environment in enhancing student learning.

Key Terms

Active learning refers to instructional approaches that require learners to interact with the material in some fashion, as opposed to being passive recipients of information.

Self-directed learning means that learners control the objectives as well as the approach to their learning. It can also refer to control over the methods used to assess learning. Self-directed learning is more a matter of degree than an all-or-nothing proposition.

Surface learning refers to acquiring knowledge through memorization, without reflecting on it, and the main purpose of surface learning is often to meet external requirements.

Deep learning, on the other hand, relates prior knowledge to new information, integrates information across courses, and organizes content into a coherent knowledge base. Motivation for deep learning is more internal (to the student).

Scaffolding refers to assistance that students receive early on in their learning that is gradually taken away as students become more responsible for their own learning.

Learning environment in this chapter refers to the extent to which the overall organization of learning and support services demonstrates concern for students' well-being as well as for their academic achievement. The **hidden curriculum** refers to learning that occurs outside the classroom, and in medical education often refers to behavior observed by learners that demonstrates such attributes as honesty, respect, and professional values (or their absence).

Role of Learners

Marchese (1998) discusses several criteria that are associated with long-term learning and retention (see Table 1.1). Independent learning, having choices about what to learn, and building on students' intrinsic motivation and natural curiosity all present special challenges for medical educators. External forces such as accrediting bodies and licensing boards have a significant impact on the context of what medical students have to learn. Even so, it is possible to build more self-directed, motivating ways of learning into the curriculum. For example, one of the major benefits of problem-based learning is that students enjoy learning and spend more of their time in independent, self-directed learning. Team-based learning, which builds small group learning activities into large classes, may offer some of the benefits of problem-based learning within a more traditional structure. In addition, hybrid curricula that incorporate self-directed, small group learning experiences alongside traditional classes may offer some of the benefits of problem-based learning while maintaining some of the efficiency of large group teaching.

Table 1.1 Criteria associated with long-term learning and retention (Adapted from Marchese, 1998)

Role of the learner
- Learners function independently
- Learners have choices about what to learn and how to learn
- Learners have opportunities to build on intrinsic motivation and natural curiosity

Role of the learning activities
- Learning activities require the application of higher-order thinking skills
- Learning activities mirror the tasks that learners will face in the real world

Role of feedback and assessment
- Learners are able to practice and receive feedback in challenging interactions with other learners, with minimal threat
- Learners receive frequent feedback and are encouraged to reflect on the feedback
- Learners are assessed in ways that mirror the above criteria

No matter what strategy is used, it is important to maintain students' natural curiosity about how the human body works and about how to take care of patients. Most students come to medical school with high levels of curiosity, but the more they are required to memorize isolated facts or engage in very deep learning about relatively esoteric principles, the less likely they are to maintain that enthusiasm. The challenge comes in identifying core material and teaching it in an interesting, clinically relevant manner.

Another aspect of the role of the learner concerns individual learning style. While learning style has been studied extensively, claims have been made based on minimal evidence in terms of the effect of learning style on learning outcomes, or of designing instruction to match an individual's learning style. That being said, there is little harm in designing instruction that has the potential to meet the needs of students with varying learning styles. A traditional method to reinforce material in

multiple ways is to offer instruction that students can both see and hear. For example, a lecture with slides and accompanying written materials reinforces the material in multiple ways. Other variants of learning style indicate whether the learner prefers to learn alone or with others. Since medical practice often involves interacting with other professionals as well as with patients, having practice interacting with colleagues in a learning environment is important even if an individual student's general preference is to work alone.

Role of the Teacher

How students learn is affected by how teachers teach. A model presented by Kern et al. (1998) and others is especially helpful in looking at the process of developing curriculum in medical education (see Fig. 1.1). Kern and colleagues talk about the importance of first doing a needs assessment, to determine what learners already know and what they need to know. Then the teacher must develop goals and objectives for learners. Once this process is complete, educators must develop strategies that will be effective in reaching those goals and objectives. Finally, the teacher must assess learners in ways that reflect the goals, objectives, and strategies.

Overall Goals	→	Learning Objectives	→	Teaching Strategies	→	Assessment of Learning

Fig. 1.1 Aligning goals, objectives, strategies, and assessment

Writing Objectives, Developing Strategies, and Designing Assessment Plans

In medical education, decisions about curriculum content are often made without first determining the overall goals and learning objectives. Goals are statements about the overall purposes of a curriculum. Objectives must be specific and measurable, and can be related to the learner, the process, or the outcomes of education. Each must be written in a way that allows for measurement to determine whether the objective has been achieved. Then strategies must be selected that allow the learner to achieve the desired objectives. Once the curriculum has been implemented, learners and the curriculum are evaluated, feedback is provided, and the cycle continues. Too often, educators select a teaching strategy without a clear idea of what they are trying to accomplish, e.g., incorporating small group teaching methods without understanding what such methods can reasonably accomplish or when they can be used most effectively.

Kern et al., discuss five types of objectives, each of which is most appropriately addressed by different types of educational strategies. For example, cognitive objectives related to knowledge acquisition can be taught by readings and lectures, while problem solving can be learned through problem-solving exercises or learning

projects. Affective objectives may be achieved most appropriately through discussion, psychomotor skills must be demonstrated and practiced, while behavioral objectives may require real life experiences to be achieved.

Role of Learning Activities

Learning with understanding, as described in "How People Learn" (2000), assumes that a strong knowledge base of facts is important, but not sufficient for learning. Knowledge must be organized around important concepts, which improves understanding and ability to apply the knowledge to other contexts. Obtaining a large knowledge base involves being exposed to multiple examples of a given concept, active processing of the information, and use of higher-order thinking skills in working with the facts. Bloom's Taxonomy has been cited widely in educational circles. An approach that may be even more useful in medical education is Quellmalz' Taxonomy (see Table 1.2). The five levels are **Recall, Analysis, Comparison, Inference** and **Evaluation**.

At the **Recall** level, students remember key facts, and are asked to repeat them, either verbatim or by paraphrase. At the **Analysis** level, students break down a concept into separate components, and may look at cause/effect relationships. At the **Comparison** level, students are required to explain similarities and differences. At the **Inference** level, students may be given a generalization and asked to explain it, or they may be given the evidence and be asked to come up with a generalization. At the **Evaluation** level, students are asked to judge the worth of a particular statement or idea.

In order to encourage higher-order thinking, the goal should be to identify objectives, design teaching strategies, and assess learners at levels that are deeper than simple recall of information. While learners need to have certain basic facts, it is in analyzing, comparing, drawing inferences, and evaluating information that learning for understanding occurs.

Table 1.2 Taxonomy of thinking skills (Adapted from Stiggins et al., 1988)

Category	Description	Sample questions and tasks
Recall	• Remembering or recognizing key facts, definitions, concepts. • Repeating verbatim or paraphrasing information that has already been provided to the student.	• Define the word digestion. • List the vital signs. • What is a normal blood pressure? • Name the amino acids.
Analysis	• Understanding relationships between the whole and its component parts and between cause and effect. • Sorting and categorizing. • Understanding how things work and how the parts of something fit together. • Understanding causal relationships. • Getting information from charts, graphs, diagrams, and maps. • Reflectively structuring knowledge in new ways.	• In what sequence did the symptoms occur? • How does a blood pressure cuff work? • Use the values provided to determine whether the patient is acidotic.
Comparison	• Explaining how things are similar and how they are different. • Comparisons may be either simple or complex. • Simple comparisons are based on a small number of very obvious attributes. • Complex comparisons require an examination of a more sensitive set of attributes of two or more things. • Comparisons start with the whole/part relationships in the analysis category and carry them a step further.	• In what ways are pneumonia and asthma alike? In what ways do they differ? • Compare the risks and benefits to treatment of these.
Inference	• Reasoning inductively or deductively. • In deductive tasks, students reason from generalizations to specific instances and are asked to recognize or explain the evidence. • In inductive tasks, students are given the evidence or details and are required to relate and integrate the information to come up with the generalization.	• What would happen if the patient lost 30 pounds? • Predict what will be the result if you stopped the patient's blood pressure medication. • Based on your research, what can you conclude about the need for this biopsy?
Evaluation	• Expressing and defending an opinion. • Evaluation tasks require students to judge quality, credibility, worth, or practicality using established criteria and explain how the criteria area met or not met.	• Is the experiment designed so that you will be able to tell whether the treatment is more effective than placebo? • What is the most cost-effective way to diagnose pulmonary embolisms?

Requiring students to apply and integrate material may also require faculty members and course directors to integrate material across courses as well as across years of the curriculum. This means that faculty members need to know what is being taught in other courses, and, as much as possible, to reinforce learning that is going on in other courses. In a hybrid curriculum, this would mean that cases for problem-based learning sessions are identified and selected based on the cases' ability to provide clinical relevance for what is being learned in the basic sciences, and for integrating material across courses.

Role of Feedback and Assessment

Another criterion identified by Marchese (1998) i.e., giving learners frequent feedback and encouraging them to reflect on the feedback, can be challenging in medical education as well. For example, evidence about the accuracy of learners' self-assessment suggests that higher achieving students tend to underestimate their performance while lower achieving students tend to over-estimate their performance. This makes the role of feedback and mentoring especially critical in helping students improve.

In the pre-clinical curriculum, too often the only form of feedback is exam scores, and there is often not enough time for students to reflect on exam performance and learn from their mistakes. The focus for reflecting on individual and class performance should be to identify areas of misunderstanding, and to identify ways in which the teaching or preparing for exams can be improved. Methods of assessment and feedback have powerful effects on student motivation. Giving students multiple chances for practice and feedback, for everything from interviewing skills and professional communication to knowledge about anatomy, can go a long way toward enhancing student learning. Doing so with groups of learners, so they can learn from each other, can be especially valuable, as long as the opportunities for practice and feedback occur in an environment supportive of learning and of the students. The key is to be sure that the assessment methods reward higher-order thinking skills.

Following are examples of general goals, learning objectives related to the goals, learning strategies appropriate for achieving the objectives, and methods for evaluating both learners and the process to determine whether goals and objectives have been achieved. Let's consider a hypothetical course entitled "Foundations of Clinical Practice."

One overall goal for Foundations of Clinical Practice is for the student to become a competent, compassionate, and ethical clinician. An objective related to that goal is for the student to develop basic skills in conducting and summarizing the patient interview. Strategies for helping students achieve this goal include lectures, small group discussion and practice, and interaction with simulated patients. Lectures address general communication skills, specific components of taking a history, and dealing with patients' emotions. Small group sessions provide students with multiple opportunities to practice these skills before they interact with simulated patients. Assessment strategies include evaluations by the simulated patients, written exam
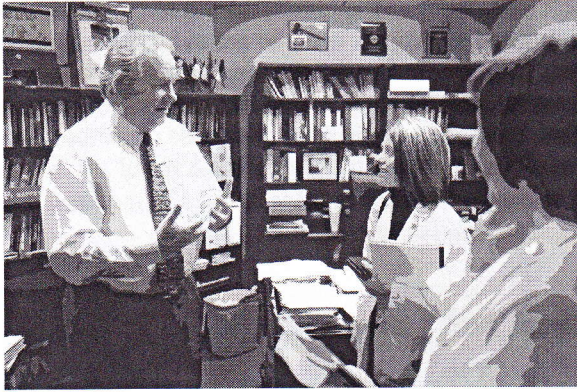
questions related to factual knowledge about elements of the history, and essay questions that require students to demonstrate that they know what questions to ask to characterize a symptom for a written case scenario.

Another example of an overall goal is to teach students to apply relevant basic and clinical science principles to the practice of medicine. One objective states that the course will help students integrate information learned in other courses in a clinically meaningful way. This is accomplished primarily through small group discussion in problem-based learning groups. Assessment includes facilitator evaluations, peer evaluations, written tests over the terminology, and a one-page essay question that asks students to write as though they were talking to the patient in the problem-based learning case in order to explain the diagnosis, explain what is causing the problem, describe how the lab tests and history confirmed the diagnosis, and tell the patient what to expect from the treatment.

The Learning Environment

How well students learn is influenced by a variety of factors. Their own prior knowledge and motivation are certainly important. Input from their fellow students, especially if instruction is designed to take advantage of collaborative learning, can also be important. The environment can also have a profound effect on learning. For example, is the physical environment arranged so that students have easy access to study space? Is the schedule organized to maximize student learning? Are services such as tutoring or study groups available for students who need them? Does the learning environment in the preclinical years minimize unnecessary competition? Do faculty members set realistic standards for what students are expected to achieve? During the clinical years, do faculty members and residents serve as role models in the compassionate and ethical treatment of patients? Do they demonstrate professionalism in interactions with colleagues? Creating a collaborative learning environment is particularly challenging in medical education, as students who are admitted to medical school often have gotten there because of individual

achievement, not because they have been working in collaborative learning environments. Yet medicine is not practiced in isolation. Physicians must know how to work with other professionals and with their patients. So it is important to create a learning environment in which collaboration is encouraged.

Take Home Points

- Exponential growth in medical knowledge requires new approaches in medical education.
- Long-term retention of knowledge requires active processing of information and use of higher-order thinking skills.
- Students who have choices about their learning and can maintain intrinsic motivation will learn better and be able to apply their knowledge outside the classroom.
- Teachers have an important role in designing learning activities and assessment strategies that foster independent learning and higher-order thinking skills.
- Frequent feedback and reflection are important components in self-directed learning.
- Working in a supportive learning environment that reinforces self-directed learning and professional behavior can enhance student learning.

References

Commission on Behavioral and Social Sciences and Education, National Research Council (2000) How people learn. In: Brain, mind, experience, and school. National Academy Press, Washington, DC, Available via http://www.nap.edu
Kern DE, Thomas PA, Howard DM, Bass EB (1998) Curriculum development for medical education: A six-step approach. Johns Hopkins University Press, Baltimore, MD.
Marchese TJ (1998) The new conversations about learning insights from neuroscience and anthropology, cognitive science and workplace studies. In: New horizons for learning. Available via http://www.newhorizons.org/lifelong/higher_ed/marchese.htm
Stiggins RJ, Rubel E, Quellmalz E (1988) Measuring thinking skills in the classroom, rev ed. National Education Assn Professional Library, West Haven, CT.

For Further Reading

Ferguson KJ (2005) Problem-based learning: Let's not throw the baby out with the bathwater. Medical Education Apr 39(4): 352–353.

This is an editorial responding to criticism of problem-based learning.

Team Based Learning Collaborative, Website: http://www.tlcollaborative.org/

This website is a great resource for those interested in learning more about team-based learning.

Eva KW, Regehr G (2005) Self-assessment in the health professions: A reformulation and research agenda. Academic Medicine 2 Oct 80(10): S46–S54.

This article reviews the evidence related to self-assessment, and recommends approaches for improving self-assessment.