Introduction

The use of cases in medical education is as old as the field itself, with a rich diversity of case methods available for adoption. From clinical experiences to virtual reality representations (Grundman, Wigton & Nickol, 2000), case-based teaching accomplishes a variety of objectives: students gain familiarity with common medical illnesses, are able to construct an adequate differential diagnosis, learn to think like an expert, acquire professional attitudes and behaviors and enrich their knowledge structures about the pathophysiology of disease. With the advent of on-line instruction, clinical faculty have begun to experiment with on-line cases, each with its unique set of instructional strategies. The purpose of this paper is to present the design process used to generate interactive web based case presentations in a leading medical school.

The Need for Effective Case-Based Education

In 1995, Irby conducted a thematic review of literature, based on 101 research articles in undergraduate and graduate medical education in ambulatory care settings. Based on the findings, he characterized education in ambulatory care settings as symptomatic of variability, unpredictability, immediacy and lack of continuity. Students saw a narrow range of problems in a single clinic, and experience limited continuity of care. Few cases were discussed and examined with attending physicians. Case discussions were short, with little teaching and virtually no feedback. The studies included in the review suggested that some students lacked interviewing and physical exam skills and management of psychosocial issues. In a separate qualitative study, Irby (1994) identified five principles of experiential learning in clinical settings derived from exemplary strategies used in teaching rounds: anchoring instruction in cases, actively involving learners, modeling professional thinking and action, providing direction and feedback and creating a collaborative learning environment. Thomas (1992) identified key concerns of students who had interacted with cases in a family medicine course: students felt most confident about skills acquired in relation to diseases with a limited number of key symptoms, signs and treatments, and less confident about diseases with many symptoms and treatments. The level of complexity in cases was thus a key issue for clinical faculty. The tutors emphasized that cases must be based on real patients, include most of the signs and symptoms of the disease, contain one or two foci, have nodal decision making points, emphasize clinical reasoning, reinforce prior knowledge and permit transfer to other cases.

Novice to expert research in medical education has yielded a body of findings that can be extensively utilized in the design of cases. Gruppen (1997) proposes a framework for ambulatory clinical education based on empirically drawn guidelines from cognitive psychology research. The author emphasizes the importance of context, students’ need for transferable knowledge, the importance of balancing depth and breadth of knowledge, and the role of prior knowledge in problem solving. Research on computer based and on-line cases has demonstrated the effectiveness of such cases in promoting performance and learning efficiency. Lyon, et al. (1991) report on PlanAlyzer—a computer-based, self-paced, cased-based system for anemia and chest pain diagnosis. The longitudinal study over three years demonstrated time savings resulting from the computer based versus text based cases while accomplishing the same level of mastery.

It is clear from a sample of research that in spite of the rigorous training that medical students receive during undergraduate years, the nature of the field defies grasp by novices- there are gaps in knowledge and intellectual skills which could be addressed with improved instruction. Case based education delivered via technology could fill gaps, lapses and enhance the development of clinical expertise among medical students. Indeed, such efforts in various medical schools have added to the body of knowledge on approaches to case based education (Bergeron, Sato, Bbeid, & Rouse, 1995; Sutyak, Lebeau, Spotnitz, O'Donnell, & Mehne, 1996).
Over the last three years, we have developed web based cases in the following specialties: Pathophysiology of Disease (Respiratory and Hematopathology), Pediatric Genetics and Emergency Medicine. In addition a case authoring tool has been created to allow clinical faculty to create cases with diagnostic reasoning in Family Medicine as a model. All cases can be viewed at http://www.medsch.ucla.edu/idtu/projects/frstprojects.html. In designing these cases, we briefly present criteria that guided the instruction.

Objectives: What do the cases intend to accomplish? These may consist of diagnostic reasoning skills, solving single complex cases, knowledge acquisition via cases and pattern recognition. Objectives might pertain to standardizing the clinical experience of dispersed students, provide cases infrequently seen during training, and those which need to be finely discriminated.

Learner Characteristics: Who is the primary audience? Beginning medical students, third and fourth year students or residents? How would the program adapt at some basic level to prior knowledge, motivation, technology access, and preference for learning modalities?

Fidelity: What is the level of realism that is desired in the cases? What is the range of imaging from virtual immersive reality to still images which would accomplish the objectives? What kind of multimedia options—audio, video, synchronized multimedia are feasible? Are standardized patients satisfactory, or real patients should be identified?

Scaffolding: Several studies have pointed to strategies for successful scaffolding (Hmelo & Day, 1999; Jonassen, 1996). What kind of support would expand students’ knowledge networks? How can prior knowledge be integrated in the scaffolding? How can it be presented in a transparent, well aligned, unobtrusive way? Should this be optional, under learner control, or required?

Communication: Theoretical considerations might dictate the structure of communication. Problem based learning which dominates medical education requires and embedded intervention, where students are required to post their hypotheses on diagnoses. Other communication strategies may be external to the program, and voluntary. The available technology may dictate what shape or form is assumed by the communication.

Interactivity: What is the depth of information processing that is required of learners? Diagnostic reasoning can be considered the highest form of problem solving—at a micro level, however, students need to make decisions which allow them to encode knowledge required for problem solving. Input mechanisms include recall, recognition, hypothesis generation and differential diagnosis. Input devices such as speech recognition software would be a consideration how student thought processes are elicited.

Case Structure: Much debate has occurred over learner versus program control over the last decade. Since we have high ability adult learners as the primary audience, we have largely self-paced, learner controlled case designs. The sequencing of information is another consideration—is this simple—offering a more linear approach, or complex with many options?

Instructional Strategies: Is the overall presentation a didactic, expository, or more discovery oriented? Are the strategies used supplanted or generative? What kind of cueing strategies are available as scaffolding assistance? How does the program adapt to various motivational levels? Is feedback rich or minimal? What is the modality of the feedback? Does the feedback offer modeling of appropriate clinical decision making skills?

Metacognition: Finally, what kinds of options optimize students’ self monitoring of performance and interaction? Are there explicit metacognitive tools which can be placed to make the case more meaningful?

Conclusion

In spite of pervasive use of cases in medical education, several studies have identified inadequacies in the required skills and knowledge of medical students. While some may be addressed within a larger framework of curriculum restructuring, the potential of online cases must also be examined in conjunction. This paper is an attempt to comprehend ways of acquiring medical expertise and use this knowledge to generate experiential instruction via web based case simulations. Initial evaluations have already indicated the positive perceptions of students using this learning modality. Whether the cases have also generated learning gains needs further evaluation.
References


Biographical Sketch

**Anju Relan** is an Assistant Professor of Medicine, and the Director of Instructional Design and Technology Unit at the School of Medicine, University of California, Los Angeles. She earned a degree in Educational Technology from the University of Minnesota in 1991. She assists the medical school faculty in the design and development of instructional web sites related to the 4-year undergraduate curriculum. Her research interests include web based multimedia in education, metacognitive strategies in case based education and the efficacy of handheld devices in the practice of medicine.

Address: 60-051 Center for Health Sciences
David Gefen School of Medicine at UCLA
Los Angeles, CA 90095
E-mail: arelan@ucla.edu
Phone: 310.206.0572
Fax: 310.267.0320