ORIGINAL ARTICLES

The Development of an On-line Self-Guided Diagnostic Imaging Tutorial and Its Impact on Course Performance

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Purpose: The purpose of this article is to discuss the development of an on-line self-guided tutorial in diagnostic imaging and its effects on student performance and faculty work load. **Methods:** An on-line self-guided tutorial in diagnostic imaging was developed and made available to students taking a course in interpretation of diagnostic images. The proportion of students passing the course and those earning a ''B'' or better was compared between the students taking the course before access to the self-guided tutorial ($n = 204$) and students with access to the tutorial ($n = 544$). **Results:** Prior to the tutorial, 90% earned a ''C'' or better as compared to 92% with access to the tutorial. Prior to the tutorial, 53% earned a ''B'' or better as compared to 52% with access to the tutorial. The instructor's subjective assessment of requests from students for individual meetings was that this component of faculty work load decreased with implementation of the tutorial. **Discussion:** Differences in course performance noted between the two cohorts of students are of no practical significance. Other outcomes of interest, including faculty work load and student satisfaction, were not formally evaluated. (The Journal of Chiropractic Education 19(2):81–84, 2005)

Key words: computer-assisted instruction, diagnostic imaging, education, tutorial

INTRODUCTION

One of the most common comments received from students taking courses in the department of diagnostic imaging is the need for more guidance when viewing radiographs. The decision was made to create an on-line tutorial that students can access at any time, with the goals of assisting students while reducing faculty work load. The self-guided tutorial was completed and implemented for the Summer 2000 iteration of the course, and required over 100 man-hours to produce. The tutorial can be accessed by students through the university's intranet service and is available to all students (even those not enrolled in the course), year round and anytime of the day.

Several prior studies have demonstrated that one of the main benefits of developing a computer-assisted learning module or tutorial was to free up instructor time (1–3). Additionally, computer-assisted instruction is an excellent design for health care education, as large amounts of information that changes little from year to year must be learned by many successive cohorts of students. A previous study evaluating computer-assisted instruction in radiology demonstrated that students accepted this form of instruction and preferred it to other forms of instruction, and student comments indicated that their learning was enhanced by the required interaction as they went through the material (1). In addition, students can benefit from being able to study at a time that is convenient for them, to determine their own pace, and to repeat the lesson as often as necessary (1,3).

METHOD

The development of the tutorial was guided by simulating what occurs in the laboratory environment,

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Figure 1. The figure demonstrates a slide from the tutorial. **A**, *Unobstructed view of the radiograph.* **B**, *As the student advances, a question pops up.* **C**, *After the student reviews the radiograph to answer the question, he or she can advance to expose the answers and a color-coded arrow (shown as a dark gray arrow on this figure) pointing out the finding.* **D**, *The complete page with all answers exposed and arrows pointing out the findings.*

where students study images at a view box. Using Microsoft's PowerPoint as the tutorial platform, radiographic images are presented. As the student uses the mouse to click on the image, questions and answers appear on the screen. For each case the student initially observes the entire image unobstructed, and, as the student advances through the presentation, the student is asked about the image that he or she is viewing. At this time the student should ponder the question and try to find the answers on the image. With consecutive mouse clicks the answers appear along with color-coded arrows or circles indicating the findings. For example, the question "What roentgen signs are seen on this radiograph?" is asked. Answers are listed one by one with the findings then exposed by color-coded arrows or circles (Fig. 1). Text information was added along with questions and answers, as if an instructor was present to expand upon the subject matter or direct the students to their note material.

The tutorial was developed for Radiographic Interpretation I at Southern California University of Health Sciences. The course covers degenerative joint disease, diffuse idiopathic skeletal hyperostosis, neurotrophic joint, rheumatoid arthritis, ankylosis spondylitis, psoriatic arthritis, enteropathic arthropathy, Reiter's disease, scleroderma, lupus, septic arthritis, scoliosis, and spondylolisthesis. The tutorial consists of 135 slides covering the above mentioned topics. A variety of images other than radiographs were included that were either humorous in nature or designed to invoke memory recall. One example is an image of a sausage, used when discussing "sausage digit," a finding seen in psoriatic arthritis (Fig. 2).

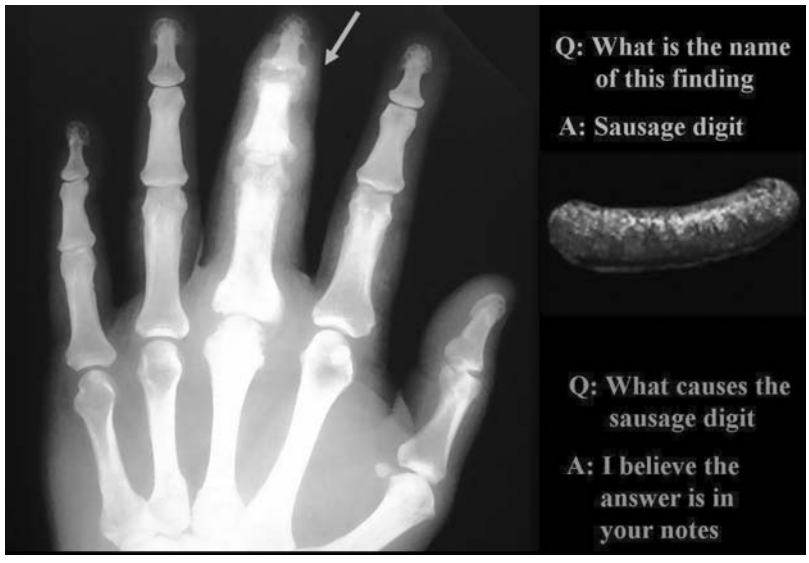

Figure 2. Slide from the tutorial demonstrating the "sausage digit" appearance due to tenosynovitis associated with psoriatic arthritis. The image of the sausage rotates through the screen after the answer is revealed and is designed to assist in memory recall.

Table 1. Summary of Course Grades for Students Before and After Implementation of the Diagnostic Imaging Tutorial

	Before tutorial ($n = 204$)		After tutorial ($n = 544$)	
Grade	% of students	# of students	% of students	# of students
A	5%	11	7%	37
B	48%	98	46%	248
C	37%	75	40%	216
D	9%	19	8%	42
F	>1%	1	>1%	1

Course grade data from two cohorts of students without access to the tutorial and seven cohorts with access to the tutorial were assessed for the frequency of passing with a grade of C or better and the frequency of achieving a grade of B or better. No formal statistical tests for significance were employed.

RESULTS

Comparing overall course grades, in the group prior to administering the tutorial 53.4% earned a B or better and 90.2% earned a C or better ($n = 204$), while in the group of students who used the tutorial 52.4% earned a B or better and 92.1% earned a C or better ($n = 544$). This reveals that there was no difference of any practical significance between groups who did and did not receive the tutorial. More detailed quantitative results are summarized in Table 1.

DISCUSSION

The main disadvantage of developing this tutorial was the time invested in preparation, which was well over 100 hours. Also, there have been rare occasions when, because of power outages and server malfunctions, students have been unable to have access to the University intranet or tutorial.

The intent of the tutorial is to help students understand the course material and concepts, and there is an expectation that the students have the intent to help themselves as well. There will be no educational benefit gained if the student sits at the screen

and clicks away revealing answers and comments without engaging—hence the self-guided component to create an effective tutorial.

Originally there was no plan to collect or analyze any data associated with the implementation of the tutorial, and in hindsight this was a mistake. Significant changes in pedagogical methods should be evaluated, both to assess their efficacy for the intended purpose and for the possibility of unintended negative outcomes. There was a realization after implementation that it would still be possible to assess changes in the students' overall course performance after implementation of the tutorial. Jacoby compared a lecture format to a computer-assisted tutorial, and found no significant difference between groups (1). In this scenario, students received the lecture material as well as the tutorial.

Students informally reported that they appreciated the existence of the tutorial, liked it as a reviewing tool before examinations, and felt it had helped their overall understanding of the material. Students who had completed the course and were reviewing for national boards also commented that is a great review of the course material. As an instructor, I have noticed a reduction in the surge of student questions just prior to an examination, as well as in the overall comments of unavailability to answer questions. These potential secondary benefits of the tutorial could have been explored through student surveys and recording a log of student visits if formal assessment of the tutorial had been contemplated prior to implementation.

When designing a tutorial, a prime consideration would be the features that are likely to make a tutorial effective for students. The characteristics of an effective tutor might translate well to the tutorial. Schmidt and Moust performed an analysis of the characteristics of an effective tutor in a problem-based curriculum (4). They found three distinct qualities were needed to be effective: a suitable knowledge base with regard to the topic of study; authentic involvement with students; and the skill to express oneself in a language understood by the student. This author feels that these qualities were reflected in the tutorial. Additionally, Jacoby found that computer-assisted instruction in radiology is as effective as a lecture when judged by the resulting short-term gain in knowledge (1).

The pragmatic objective in developing the tutorial was to provide guidance to the students outside the classroom as students begin interacting with the course material in the final hours before examinations. The surge of faces and questions just prior to an examination can be overwhelming, and providing a tutorial that can be accessed at any time is quite a relief to many students and faculty. Use statistics for MEDICOL (Medical and Dentistry Integrated Curriculum Online) indicate that approximately 90% of their students regularly used and found helpful the variety of Web-based resources that act as important adjuncts to all teaching components within their curriculum (5).

CONCLUSION

No difference of practical significance with regard to course performance was found after implementation of the tutorial. The tutorial appears to be effective at providing some work load relief to faculty, on-demand assistance to students, and an excellent review process when preparing for national boards a year after the course is delivered.

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