

Use of Computerized Multimedia to Facilitate Learning in the Anatomy and Physiology Laboratory

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Abstract

We have developed a Microsoft PowerPoint® based CD-ROM for use in the two-semester Anatomy and Physiology course sequence at Owens State Community College. This multimedia tool has been utilized since the Fall 2000 semester. Data analysis indicates a significant impact on academic performance in the laboratory curriculum. Student questionnaire responses also show an appreciation for this new instructional tool. Benefits of utilizing this instructional delivery format include reduced concomitant costs, resource conservation, and diminished safety risk. We anticipate development of similar media in a more modular format as well as expansion of media creation into other science courses. This is in line with current United States efforts to improve science and mathematics education.

Introduction

In the current climate of managed health care, efficient health care delivery is essential and allied health care workers must have a solid educational background, including a comprehensive understanding of basic human anatomy and physiology. In large part, the responsibility of providing a quality education for students in the allied health professions falls upon the community college. Most students entering these fields will either pursue a terminal Associates degree or transfer to a four-year college upon completion of the first two years at the community college level.

At Owens State Community College (OCC), all students in eight health technology programs must take a two semester sequence of anatomy and physiology courses. An efficient and comprehensive pedagogy in this area thus has a large impact on student success later in their programs. Any educational tools which would foster a deeper grounding in the basics of human anatomy and physiology (A&P) should then be welcomed with enthusiastic support. Computer Assisted Instruction (CAI) is such a tool which has been successfully employed in teaching concepts of anatomy and physiology in health care education [Cardinale and Smith, 1994; Garvin and Carrington, 1997; Gaston, 1988; Guy and Frisby, 1992; Ritt and Stewart, 1996; Rosse, 1995; Samsel et al., 1994; Toth-Cohen, 1995].

Using CAI as an adjunct to traditional "wet labs" has several advantages: (a) Students will be working with computer technology in their fields, and introducing essential concepts in a high technology format will prime them for their clinical experience; (b) Traditional methods of learning anatomy are no longer adequate. Dissection of non-human mammals as models for human anatomy does not accurately represent human anatomy. In addition, the very act of dissection destroys the specimen and alters important anatomic relationships. The two traditional

approaches to teaching anatomy, regional and systemic, cannot be integrated in the usual laboratory; one must choose one approach or the other. There is a need to view the body as a three-dimensional whole (i.e. to employ *anatomical reasoning* [Rosse, 1995]) rather than as a conglomerate of disparate organ systems. Again, this goal is not easily achieved in the usual A&P laboratory; (c) CAI allows for self-directed learning, which empowers students to take responsibility for their own education; (d) Interactivity and multimedia of CAI foster a more lively learning environment; (e) Unlike cadaver dissection, virtual dissection using CAI offers a renewable resource which can be reviewed as much as necessary, thus decreasing learning cost [Hoffer and Bamett, 1990].

A CD-ROM Teaching Tool for Anatomy and Physiology

We have developed a Microsoft PowerPoint® based CD-ROM for use in the two-semester A&P course at OCC. This CD-ROM material accompanies a proprietary laboratory manual developed by OCC Biological Sciences faculty. The product incorporates high-quality graphics, video, animation, and explanatory text into an interactive teaching and learning tool to enhance instruction in both lecture and laboratory sections of the A&P two-course sequence. Development necessitated integration of multiple software and hardware resources and the built-in VBA (Visual Basic for Applications) macro language was utilized to enable run-time navigation between several dozen files.

The laboratory manual/CD-ROM package have been used over the past several three years as direct instructional tools within the laboratory setting, as well as a means of review to extend the laboratory experience outside the confines of the “brick and mortar” laboratory. This effectively expands the student’s opportunity to learn required information. Our expectations therefore are that this new paradigm is welcomed by students and that improved learning will be reflected in higher test scores.

To assess students’ perceived utility of the CD-ROM material a survey was conducted near the end of the Fall 2000 semester. Of 169 respondents, 72% used the CD-ROM at least some time during the semester, 65% felt better prepared for laboratory examinations, and determining particular features to be “very useful” varied between 36% and 94%.

As a preliminary test of the effectiveness of this new format on student learning, statistics were run on two student groups: (1) the experimental group consisted of first semester A&P students using the CD-ROM between the Fall 2000 and Fall 2002 semesters (n = 335); (2) the control group consisted of first semester A&P students between the Spring 1997 and Spring 1999 semesters (n = 335). These sections were chosen for analysis because they were all taught by the same instructor, thus controlling for variation in teaching style. Descriptive statistics are summarized in Tables 1 and 2 for the control and experimental groups, respectively.

Table 1. Descriptive Statistics for Student Performance PRIOR to Incorporation of the CD-ROM into the Anatomy and Physiology Curriculum.

	Exam 1 %	Exam 2 %	Exam 3 %	Total Points %
Mean	77.44	77.18	72.62	75.23
Sample Variance	1.66	2.60	5.98	2.53
Minimum	40.00	28.00	5.00	24.44
Maximum	100.00	100.00	100.00	98.89
Count	335	335	335	335

Table 2. Descriptive Statistics for Student Performance AFTER Incorporation of the CD-ROM into the Anatomy and Physiology Curriculum.

	Exam 1 %	Exam 2 %	Exam 3 %	Total Points %
Mean	76.84	79.68	77.72	78.05
Sample Variance	1.85	2.28	5.67	2.25
Minimum	24.00	36.00	7.50	32.22
Maximum	100.00	100.00	100.00	100.00
Count	335	335	335	335

As can be seen, student performance on the first laboratory examination showed no difference between the two groups. Results in the experimental group on the second examination showed almost a 3% improvement in the mean, and over a 5% mean improvement on the third examination. Comparison of the total percentage means of all three tests indicates a 3% improvement in scores with use of the CD-ROM ($p < 0.05$). Paired t-tests for the sample means indicate no difference between group results for examination 1. However, there is a significant improvement for examination 2, and an even greater improvement on examination 3. The total percentage means are significantly different as well ($p < 0.05$), thus supporting our hypothesis of higher test scores. The improvement on the third test is particularly heartening because this test material is so visually oriented and the CD-ROM media are evidently very useful study aids. This opinion was also expressed by 56% of the respondents in the Fall 2000 student survey.

Future Directions

We propose development of this software in “plug-in” modular units with a view to dissemination of modules for use in A & P courses at both the two and four year undergraduate curriculum. The modular design will facilitate incorporation of appropriate material regardless of concept coverage or sequence.

In addition, we propose to migrate to the newer technology platform of digital video disk (DVD). Utilizing this platform has the advantage of increased portability for material presentation, since it can be viewed on a computer equipped with a DVD-ROM drive as well as a DVD player attached to a television set or monitor. Released dependency on a computer system for software use also carries the advantage of increased access for a broader population of students and educational systems. In addition, platform-dependency then ceases to be an issue in software design.

We anticipate expansion of this digital technology into other science courses including general biology, microbiology, chemistry, and physics. Our goal is to create a "virtual laboratory" experience for students, providing distance education opportunities and satisfying science requirements for on-line educational degree programs. In addition to contributing to an alternative delivery of education, decreased reliance on laboratory specimens carries the advantages of reduced concomitant costs, resource conservation, and diminished safety risk.

The current United States mandate to improve science education as expressed in the U.S. science/mathematics reform movement calls for incorporation of multimedia into the educational process [Bailey and Chambers, 1996]. The community college is primed for the introduction of computer-based instruction by its nature of focusing on teaching, instructional standardization, pragmatic education, and technological orientation [Doucette, 1990]. Use of digital multimedia software on DVD will present a new paradigm for teaching and learning A&P via CAI in concert with traditional laboratory exercises. This is anticipated to result in better educated, more well-prepared health care professionals equipped to use high technology modalities in the delivery of patient care.

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