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Effective Use of Multimedia Technology in Athletic Training Education

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Objective: To examine the effectiveness of using a CD-ROM, *Sports Injuries 3-D,* by Cramer Products (Gardner, KS) in an introductory athletic training laboratory class as a supplement to traditional lecture instruction. Attitudes toward the computer-assisted instruction and usefulness of the CD-ROM program were also examined.

Design and Setting: Students in 2 introductory athletic training laboratory classes from one institution were randomly assigned to either a traditional lecture (n = 11) or traditional-lecture/CD-ROM (n = 15) group.

Subjects: Undergraduate kinesiology majors enrolled in ''Techniques of Athletic Training'' (10 men, 16 women; mean age = 22.39 ± 3.64 years).

Measurements: We compared scores from 2 written examinations and 1 practical examination between groups. Subjects also completed weekly journals and participated in a focus-group interview at the end of the semester to elaborate on how often they accessed each resource and their feelings toward their various resources. Subjects in the traditional lecture/CD-ROM group also completed the Allen Attitude Toward Computer-Assisted Instruction Survey to evaluate pre- and poststudy attitudes toward computer-assisted instruction.

Results: No significant differences ($P = .05$) were found between groups on either the written or practical examination scores. The journals and interviews both indicated that subjects used their lecture notes (8/11 [73%] in the control group, 14/15 [93%] in the CD-ROM group) most frequently, while several students used a combination of lecture notes and the laboratory manual when studying for their examinations. Although they did not list it as their primary resource, most subjects in the experimental group reported accessing the CD-ROM for anatomical landmarks on a weekly basis.

Conclusions: Although no significant difference was found between groups, we feel that given the correct application, computer-assisted instruction may have a place in athletic training education. Student attitudes toward the CD-ROM program were favorable, and the qualitative data suggest that students would use this type of educational resource provided it was targeted toward the specific course and offered a time-efficient method for access. We recommend examining the use of a CD-ROM specifically designed for a course to determine whether it would prove to be a more effective resource for students than traditional instructional resources.

Key Words: multimedia instruction, computer-assisted instruction, CD-ROM programs, Allen Attitude Survey, instructional technology

The use of computers is growing at an exponential rate as new technologies are being developed. Because of the increased availability and affordability of computers, their use is expanding to new educational arenas. Fincher and Wright[1] defined computer-assisted instruction (CAI) as ''any form of instruction that uses the computer to present instructional information.'' Multimedia simply refers to the use of a variety of mediums to convey information. For the sake of discussion in this manuscript, the terms *multimedia instruction* and *computer-assisted instruction* will be used interchangeably. Research examining the effectiveness of multimedia instruction is varied and controversial. Two types of research designs are basically used to examine the effectiveness of multimedia instruction: multimedia instruction as a supplement and multimedia instruction as an alternative.[2] Much of the controversy that exists in the literature is due to inconsistent, inappropriate, or ineffective means of multimedia implementation or application of the research design, or both. A large amount of research has been conducted in traditional medicine and nursing, with little focus on the field of athletic training. The research has centered on medical students,[3–9] nursing students,[10–12] radiology students,[13] and occupational therapy students.[14,15]

Multimedia instruction has been tagged with many advantages, including the capacity to provide high-quality images,[8] active learner involvement,[12,15] and flexibility by allowing students to learn at their own pace.[12] Computer-assisted instruction is an effective resource when teaching medical or occupational therapy students.[4,5,8,14] More specifically, it is as effective as using a textbook[8,14] or traditional seminars.[4,5] Comparable results have been found in nursing students.[11,12] Rouse[12] suggested that CAI was as effective as traditional classroom lecture for teaching nursing students; however, she believed that the combination of the 2 was the most effective because the test scores from the combined CAI-traditional lecture group were significantly higher ($P < .001$) than those of the other 2 groups.

According to Khoiny,[16] the effectiveness of CAI is based

on 3 main variables: quality of the software program, environment in which the computer is used, and characteristics of the learner. According to Lynch et al,[17] CAI ''permits the adaptation of educational content to individual student learning styles.'' This may have significant implications for athletic training students given the recent findings by Stradley et al.[18] No significant differences were noted in the distribution of learning styles among the 188 athletic training students surveyed nationwide using the Kolb Learning Style Inventory.[18]

While CAI appears to be an effective resource, the existing literature is unclear about attitudes toward computers and test performance. Lynch et al[17] suggested that CAI programs are effective resources, yet they did not find evidence to suggest that student learning preferences or attitudes toward computers allowed them to perform better. This supports the findings of Calderone,[19] who reviewed the existing literature with ''inconclusive results regarding computer-assisted instruction (CAI) on learning and attitude.''

The use of CAI has only recently been incorporated into athletic training. In 1996, Fincher and Wright[1] reported that approximately half of all undergraduate athletic training programs were using some form of CAI. Of those that were using CAI, approximately 80% reported using CAI for less than 5 years.[1] Toth-Cohen[14] suggested that CAI was particularly suited for visually intensive and detail-oriented subjects because it ''allows textual information to be combined with still and moving graphics.'' It would stand to reason that the use of CAI in athletic training education would benefit the visually intensive and detail-oriented athletic training student. Only recently have studies in athletic training focused on the effectiveness of CAI as an educational tool. Wiksten et al[20] showed that CAI was as effective as traditional lecture when teaching Q-angle measuring techniques to undergraduate athletic training students. However, attitudes toward instruction for the traditional-lecture group were significantly more favorable ($P < .05$) than for the CAI group. Thus, while the CAI module was effective, it might not be able to stand alone.

A subsequent pilot study conducted by Wiksten et al[21] examined the effectiveness of using a CD-ROM as a supplemental resource in conjunction with traditional lecture (CD-ROM/TL) versus traditional lecture (TL) alone when teaching upper extremity injury-evaluation skills over a 3-week time period. Both groups were taught the same content by the same professor. Teaching aids such as overhead transparencies, a laboratory manual, and hands-on demonstrations were used for both groups. Both groups had access to their lecture notes, laboratory manuals, and textbooks as standard resources. The only difference between the groups was that the CD-ROM/TL group had access to an additional resource, a CD-ROM program that served as a tutorial on special tests used during an injury evaluation. Subjects in the CD-ROM/TL group ($n = 9$) performed significantly better than the TL group ($n = 22$) on both the written ($P = .002$) and oral-practical ($P = .001$) examinations. All subjects in the CD-ROM/TL used the CD-ROM program at least once per week. All subjects in the CD-ROM/TL commented that they would continue to use the CD-ROM program if it was available. The most commonly cited dislikes of the CD-ROM program were related to computer compatibility and technologic glitches. Subjects in the CD-ROM/TL group felt that the CD-ROM was most helpful to them when they were studying for the practical examination. Due to the pilot nature of the study and unequal number of students registered in each laboratory section, it is difficult to draw definitive conclusions from this study. However, future researchers should examine the use of multimedia instruction as a supplement to traditional instruction throughout an entire course to further assess the effectiveness of multimedia instruction in athletic training education.

Therefore, the purpose of our study was to examine the effectiveness of a CD-ROM program as a supplemental resource in an introductory athletic training laboratory course taught over a 16-week period. Another purpose of our study was to assess whether athletic training students would actually use the computer-assisted resource over the course of a semester when it was offered as a voluntary (not required) resource. The final purpose of our study was to assess athletic training students' attitudes toward computer-assisted learning through the Allen Attitude Survey[22] and qualitative data from weekly journals and focus-group interviews.

METHODS

Subjects

Twenty-six students from 2 introductory athletic training laboratory classes at the same institution volunteered for participation in this study. Students enrolled in the laboratory classes were also enrolled in a concurrent introductory athletic training lecture course; however, only data from the laboratory classes were examined. One professor taught the lecture course and both laboratory classes to ensure that subjects received the same course information, lecture instruction, and demonstrations. The learning objectives for this course were based upon athletic training competencies relating to the domain of care and prevention of athletic injuries. Specifically, the laboratory course was designed to teach students psychomotor skills relating to palpation of pertinent anatomical landmarks, taping and wrapping techniques, spine-boarding techniques, and the application and use of various types of protective equipment and materials. The study was approved by the Committee for the Protection of Human Subjects. Informed consent was obtained from all volunteers.

The 2 classes were randomly assigned to either the traditional instruction method or the traditional-instruction/CD-ROM method. Before participating, subjects were asked to fill out a preliminary data sheet that assessed descriptive data, including overall grade point average (GPA), age, sex, ownership of a computer, and level of computer experience. The traditional-instruction (control) group contained 11 subjects (1 man, 10 women; mean age = 22.18 ± 2.14 years), and the traditional-instruction/CD-ROM (experimental) group contained 15 subjects (9 men, 6 women; mean age = 22.60 ± 5.14 years). Most subjects in both groups owned computers (control 9/11, 81.8%; experimental 14/15, 93.3%) and described their computer skills as intermediate or higher (control 9/11, 81.8%; experimental 13/15, 86.7%). Intermediate was defined as the ability to use or install (or both) word-processor, Internet, and other programs on the computer. Students were assured that participation would in no way affect their grade for the course. As an added measure of protection, subject data were not accessible by the professor and were not analyzed until the semester grades had been turned in.

Instructional Methods

Throughout a 16-week semester, one introductory athletic training laboratory class received traditional methods of in-

struction (ie, lectures, overhead transparencies, hands-on demonstrations and practice, and access to a laboratory manual and textbook). The other class received the same instruction and a multimedia CD-ROM as an additional resource. Each subject in the traditional instruction/CD-ROM group received an individual copy of the multimedia CD-ROM, *Sports Injuries 3-D* (Cramer Inc, Gardner, KS). This particular CD-ROM was chosen based on the introductory content presented in the program and how it correlated with the learning objectives of the introductory athletic training course at this institution. Information on the CD-ROM is divided into 7 sections (ankle, knee, hip, head and neck, abdomen, elbow, and shoulder), with each having several subsections (anatomy, range of motion, muscles and function, dermatomes, PRICES [protection, rest, ice, compression, elevation, and support], evaluation, referral, and common injuries). Students in the traditional-instruction/CD-ROM group were asked not to allow students in the control group to view the CD-ROM program until after the study was completed.

Assessment

To determine whether there were differences between the 2 instructional methods, we collected several outcome measures throughout the semester.

Written Examinations. Two written examinations were administered to each class. The first test consisted of 15 questions (2 short answer, 13 fill in the blank), and the second examination consisted of 16 questions (14 multiple choice, 2 short answer). Content-related validity was established by 6 certified athletic trainers (average experience = 8 years) at 3 local universities. After content-related validity was established, 2 questions on the first examination and 1 question on the second examination were removed, leaving the first examination with 13 questions (2 short answer, 11 fill in the blanks) and the second examination with 15 questions (13 multiple choice, 2 short answer). The examination scores were combined for analysis of cognitive knowledge at the end of the semester. Unfortunately, the researchers had access only to the subjects' examination scores and were not given the actual examinations for confidentiality reasons; therefore, written-examination reliability was not established

Practical Examination. Students were also administered a practical examination. The practical examination consisted of 15 anatomical landmarks or basic athletic training techniques (or both). Content-related validity was established by the same 6 certified athletic trainers. We were unable to establish practical-examination reliability because each student chose 15 different landmarks/techniques from a random list of 40 anatomical landmarks and athletic training techniques.

Allen Attitude Survey. The Allen Attitude Survey[22] was used in the traditional-instruction/CD-ROM group pre- and poststudy. The tool, which is designed to unveil any preconceived biases and changes in attitude toward interactive multimedia instruction, uses semantic differential scoring and is composed of 14 statements, each anchored by bipolar adjectives. The responses are rated on a 7-point scale. The positive adjective is scored as a 7, the negative adjective as 1, and the middle, or unbiased, response as 4. The 14 bipolar statements are grouped into 3 subscales: comfort, creativity, and function (Table 1). A total score and scores for each subscale were calculated. Total scores ranged from 14 to 98, while scores for each of the subscales were as follows: comfort, 4 to 28; creativity, 4 to 28; function, 6 to 42. The reliability coefficient alpha was .853 for undergraduate students.[22]

Table 1. Bipolar Adjectives Contributing to the 3 Subscales of the Allen Attitude Survey

Subscale	Adjectives	
Creativity	Rigid	Flexible
	Stimulating	Boring
	Creative	Unimaginative
	Impersonal	Personal
Function	Useful	Useless
	Meaningless	Meaningful
	Time saving	Time consuming
	Valuable	Worthless
	Efficient	Inefficient
	Inappropriate	Appropriate
Comfort	Comfortable	Uncomfortable
	Nonthreatening	Threatening
	Overpowering	Easy to control
	Pleasant	Unpleasant

Student Journals. Subjects in both groups kept a 12-week journal throughout the semester. The laboratory subject for each week and the students' time spent using each of their available resources (ie, lectures, laboratory manual and textbook, hands-on demonstrations and practice, overhead transparencies, and CD-ROM [for the traditional-instruction/CD-ROM group]) were recorded in the journal. The journal required weekly entries that took from 5 to 10 minutes.

Focus-Group Interviews. Focus-group interviews are structured and have specific, well-designed goals.[23] The groups consisted of 3 or 4 students and were held 2 weeks before final examinations. A facilitator was present to introduce several topics (subjects' likes and dislikes concerning the available resources, which resources they used most for tests and why, etc), and students were asked to elaborate from their perspectives. The interviews were recorded on audiotapes, and sessions lasted 15 to 20 minutes. The instructor was not allowed to listen to the tapes, and students were assured that their grades would not be affected in any way by their responses.

Statistical Analysis

Before we analyzed the examination scores, we conducted an independent *t* test on the overall GPAs to determine if there was a significant difference between groups. A Pearson product moment correlation was calculated between GPA and examination scores to determine whether GPA should be used as a covariant for a subsequent analysis of covariance. A paired *t* test was used on the total pre- and poststudy attitude scores, as well as each subscale's pre- and poststudy scores, for the traditional-instruction/CD-ROM group to evaluate whether their attitudes toward computer resources changed. Qualitative data were collected with a naturalistic framework, an approach using actual settings as the source of data.[23] Journal and focus-group data were analyzed thematically: data were coded by concept, then categories emerged based upon common themes.

For all statistical data analysis, an alpha level of .05 was used. The rather strict alpha level was due to the inability to establish reliability on the written and practical examinations; however, a stricter alpha level was not chosen because of the limited prior research in the field of athletic training.

Table 2. Grade Point Average and Test Scores (Mean ± SD)*

	Control Group (n = 11)	CD-ROM Group (n = 15)
Grade point average	3.39 ± 0.45	2.93 ± 0.43
Written test (139 points possible)	131.91 ± 5.17	130.80 ± 5.49
Practical test (30 points possible)	29.64 ± 1.21	28.80 ± 1.66

*SD indicates standard deviation; n, number of subjects.

RESULTS

Quantitative Results

The combined written examination score was worth 139 points, and the practical examination was worth 30 points.

Grade Point Average

An independent *t* test indicated a significant difference between group GPAs ($t_{24} = 2.61$, $P = .015$), with the control group having a significantly higher GPA (Table 2). Therefore, a Pearson product moment correlation was calculated between GPA and both written and practical examination scores. The correlation was positive between GPA and written examinations ($r = .40$, $P = .043$). There was no significant relationship between GPA and the practical examinations ($r = .27$, $P = .189$).

Written Examinations

Given the significant relationship between GPA and the written examinations, GPA was used as a covariate in an analysis of covariance. The adjusted written examination scores were 130.6 ± 1.6 for the control group and 131.7 ± 1.4 for the CD-ROM group. No significant difference was found between the adjusted scores of the groups ($F_{1,23} = .240$, $P = .629$).

Practical Examinations

We calculated an independent *t* test on practical examination scores. No significant difference was found between group scores on the practical examinations ($t_{24} = 1.42$, $P = .169$).

Allen Attitude Survey

Total pre- and poststudy and subscale results are presented for the CD-ROM group on the Survey (Table 3). Likert scores ranged from 1 (very negative) to 7 (very positive), with 4 being the neutral score.

Using the paired-samples *t* test, we found no significance difference between the traditional-instruction/CD-ROM total pre- and poststudy attitude survey scores ($t_{14} = 1.26$, $P = .227$), or any of the subscales: comfort ($t_{14} = -0.15$, $P = .886$), creativity ($t_{14} = 0.76$, $P = .461$), or function ($t_{14} = 2.27$, $P = .043$).

Qualitative Results

Both the weekly journals and comments made during the focus-group interviews were reviewed and thematically categorized to gather an understanding of students' feelings and attitudes about their available resources.

Table 3. CD-ROM Group Prestudy and Poststudy Allen Attitude Survey Scores (Mean ± SD) and Average Likert Scores (7-Point Scale)*

Subscale		Mean	SD†	Average Likert Score
Comfort	Prestudy	20.93	3.63	5.23
	Poststudy	21.13	4.05	5.28
Creativity	Prestudy	20.27	1.98	5.07
	Poststudy	19.73	1.75	4.93
Function	Prestudy	33.87	3.34	5.65
	Poststudy	29.87	5.04	4.98
	Prestudy	75.07	5.97	5.36
Total Score	Poststudy	70.73	8.63	5.05

*n = 15.
†SD indicates standard deviation.

Focus-Group Interviews

Using semistructured questions, the facilitator sought to obtain information concerning the most effective resources students used during the course. Both groups identified the lectures and demonstrations as the best course resources. Students commented on the benefit of ''very specific topics'' and that these resources ''brought the course to life.'' When asked about which supplemental resource prepared the students for their written tests, lecture notes were identified. Students stated that lecture notes ''covered everything that would be on the test.'' While the CD-ROM group identified the CD-ROM as having ''good pics,'' lecture notes were still selected as the best resource for written examinations. The best resource identified by students to prepare them for the practical examinations was hands-on experience and demonstrations.

Questions specific to the use of the CD-ROM provided information concerning student perception of this resource. Positive responses for the computer program included ''lots of information,'' ''good visuals,'' and ''ease of use.'' In spite of the positive comments, some students believed that the computer program was ''difficult to boot up'' and ''too time consuming,'' and because there was ''no test section,'' they felt it did not help them study. Overall, students felt the CD was a beneficial resource and they would purchase the CD if it were specifically related to the content of the course.

Journals

The journals were not a required course component; therefore, student accountability to the journals was low. For example, 2 students in each group did not even complete the journals. Furthermore, most students did not reflect or take the time to elaborate on answers to the journal questions. As a result, the qualitative data from this source were compromised and lacked the richness of quotes and perspectives. Data from the journals were analyzed by frequency to provide the approximate amount of time that students used each resource.

Frequencies of journal responses indicating time spent using each resource, usage, and the percentage of the group spending the specified resource time are presented in Table 4. Frequency data indicated that students used their laboratory manual and lecture notes for either less than 30 minutes or about an hour most (>60%) of the time. Students typically accessed their

Table 4. Students Using the Resource for the Specified Time Reported*

	<30 min	~ 1 h	> 1 h	~ 2–3 h	> 4 h	No Data
Laboratory Manual						
Control	49 (39%)	28 (22%)	4 (3%)	2 (2%)	3 (2%)	40 (32%)
CD ROM	87 (48%)	34 (18%)	5 (3%)	3 (2%)	0	53 (29%)
Notes						
Control	53 (42%)	23 (19%)	3 (2%)	3 (2%)	2 (2%)	42 (33%)
CD ROM	86 (47%)	35 (19%)	9 (5%)	2 (1%)	0	50 (28%)
Textbook						
Control	35 (28%)	1 (1%)	0	1 (1%)	0	89 (70%)
CD ROM	46 (25%)	10 (5%)	0	0	0	126 (70%)
CD ROM	84 (46%)	14 (8%)	2 (1%)	0	0	82 (45%)

*Number of students (percentage).

textbook less frequently than the other 2 resources. The CD-ROM group indicated that they used the computer program for anatomical landmarks but typically for less than 30 minutes (46%). Similar to the number of student responses indicating that they accessed the program, another group of responses indicated either no access or a blank answer (45%). This brings to bear an important aspect of the journal data for this group. In hindsight, it is unfortunate that the journal did not have a category for ''no use.'' This proved to confound the data, as many students would create a ''no-use'' space or leave the area blank. Therefore, whether a ''blank'' response indicated that the students did not use the resource or whether they just skipped the question is unknown. Hence, the ''no-data'' category encompassed student responses of ''no use'' and ''blank.''

DISCUSSION

We found no significant difference between groups on either the written or practical examination scores. Qualitative data suggested that some students in the CD-ROM group used the CD-ROM as a resource for anatomical references, but overall, the CD-ROM program was not perceived as a necessary or valued resource. Both groups reported using lecture notes and the laboratory manual as their primary resources when studying for the course. Additionally, the students' attitudes in the CD-ROM group toward computer-assisted resources did not appear to change over the course of the semester. These findings are different from previous studies reported by Wiksten et al[20,21] and Voigt et al[24] in athletic training education. One potential explanation for the conflicting results reported in athletic training education may be related to the specific multimedia program investigated and the learning environment in which it was applied. Keane et al[2] emphasized the criticality of researchers recognizing the learning environment in which certain CAI programs are applied. Additionally, they felt that more educational research should identify the learners and learning tasks for which CAI may be most appropriate.[2] Devitt and Palmer[25] evaluated the appropriateness of CAI based upon teaching style and learning style of the students. They concluded that when the learning outcome is measured by short-term recall, as typically occurs with multiple choice examinations, students performed best when the information was presented in a didactic or textbook manner. Furthermore, they suggested that students whose success depends on the ability to pass a knowledge-based test will most likely choose a learning method that delivers ''information in as uncluttered a manner as possible.''[25] Perhaps the *Sports Injuries 3-D* program would be better suited for more advanced learning-acquisition methods.

One of the first questions we posed when designing this study was the level of athletic training student that should be used as subjects. The CD-ROM was very elementary and only introduced the very basics of athletic training knowledge and techniques; therefore, introductory kinesiology students enrolled in a ''Techniques of Athletic Training'' course were chosen as subjects. This may have been a drawback of this study. The laboratory is a required class for all kinesiology majors; therefore, not all students in this course were pursuing a career in athletic training. As a result, some of the information taught in the class was not perceived as relevant to some students. Focus-group data supported this notion, as the CD-ROM program content was identified as ''too advanced,'' and these students tended not to use the program. In fact, several students said the CD-ROM program would be more advantageous in an advanced course. Interpretation of the qualitative data would have been greatly enhanced had students been asked to report whether athletic training was their future career choice or not.

Another goal of this study was to see if the experimental group would use the CD-ROM, although they were not required to do so. Based on the data from the journals and focus-group interviews, the subjects in the experimental group did use the CD-ROM on a regular basis but for less than 30 minutes per week and not as a primary resource when studying for examinations.

Many of the students in this study reported that the program was very effective for reviewing anatomy because the graphics and animations made it easy to see landmarks and muscles. Several students reported that the visual aids ''brought the anatomy to life.'' Many students stated that they did not use the program as much for actual techniques in athletic training because the professor and laboratory manual were so thorough. Also, subjects reported that they did not use the program because they did not need it to do well in class, and this was their primary goal. This may have been due to the fact that the combination of the professor's lectures and the laboratory manual were so effective. The laboratory manual had been designed by the professor to outline the topics discussed in lectures. Because the manual has been revised and refined several times to allow the students to follow along, the CD-ROM may have been at a disadvantage from the outset. A CD-ROM similar to the manual might have been more effective, and

several of the students even commented that they would have paid extra money for *Sports Injuries 3-D* had it accompanied the laboratory manual.

Unlike the pilot study conducted by Wiksten and Voigt and colleagues[21,24] the CD-ROM used for this study was not designed specifically for the class in which it was used. This might explain the statistically favorable CAI results reported by Wiksten and Voigt and colleagues,[21,24] who used a CD-ROM specifically designed for an ''Injury Evaluation'' course, as compared with the lack of support for CAI in this study. In fact, not only was the CD-ROM designed specifically for the ''Injury Evaluation'' course, but the instructor of the course also designed it. Keane et al[2] reported that learning-effect differences were larger when the same instructor has authored both the CAI and non-CAI resources, which was not the case in the present study. The explanation offered for this instructor effect is that the CAI author is better informed pedagogically and more aware of the advantages of various resources for different learning tasks. The CAI author is also more strongly motivated to demonstrate the superiority of CAI over the other resource.[2] Again, this might explain the favorable CAI pilot results reported by Wiksten et al[21] and Voigt et al.[24]

We found no studies that specifically looked at the effectiveness of a professor's teaching style and philosophy versus computer-assisted learning or that examined professor outcome measures as a potential confounding variable (for example, student evaluations). Most students would probably agree that a very effective professor offers the advantage of quality dissemination of information and the option of one-on-one feedback and classroom dialogue. Most of the literature[4,5,12,14,20] has sought to replace traditional teaching methods, traditional lectures, or textbooks with computer-assisted programs. On the other hand, we think that an effective CD-ROM program, properly implemented, can offer quality instruction. It can provide immediate feedback and be readily available to the student at any time of day or place when a computer is available, for example at home at 1:00 AM.

Previous research[4,8] shows that the major drawback of computer resources is that they are too time consuming and tedious to use. For this study, we sought to negate that issue by giving the students an entire semester, not a specified time or day, to use the program. The results were surprising because some of the students reported that, although the program had good information, it was still too time consuming. They reported that it took too long to turn the computer on, wait for the computer to boot up, and then have to look through the program when they could just grab their laboratory manual or notes to get a quick answer. As mentioned earlier, Devitt & Palmer[25] concluded that for certain introductory levels of learning, sophisticated interactive CAI might not result in any advantage and might even be considered a waste of time by some. They believed that students who wish to do well on basic knowledge testing prefer that the information be presented in a logical and uncluttered manner.

Although the subjects did not use the CD-ROM as much as had been hypothesized, the attitude surveys did not reflect a negative reaction toward computer resources. The literature is controversial concerning whether attitudes toward computer resources control their effectiveness. Billings and Cobb[26] found that the strongest predictor of achievement was attitude toward computer resources. Lynch et al[17] reported no significant correlation between students' attitudes toward computers and test performance. The results of the pre- and poststudy attitude surveys were not significantly different; however, there did appear to be a negative trend in the students' attitudes. The difference between the pre- and poststudy attitude survey total scores is a direct reflection of the function category (Table 3). The negative trend in the function category may relate to the fact that the CD-ROM was not designed specifically for the course. Regardless, overall the students' attitudes were favorable in the attitude surveys (>4) and focus-group interviews. These findings are similar to those of Voigt et al,[24] whose subjects reported that their computer-based instructional materials were effective and useful.

In addition to the limitations and concerns presented, we caution readers to keep in mind the small sample size of the laboratory groups studied and to be careful about generalizing these data. The varied results reported in athletic training education related to multimedia instruction can be best explained by the following recommendations. When determining the pedagogic delivery of your course content, first consider your specific learning objectives for the course, your teaching style, and the learning styles of your audience. A combination of educational resources may have the most effective impact on student outcomes. Our data and those of Dewitt and Palmer[25] suggest that perhaps a multimedia CD-ROM program is not well suited for introductory-level knowledge. When considering the use of a CD-ROM program, evaluate how well the program fits with your teaching style and the organization of your course. Based upon our pilot data[21,24] and the observation reported by Keane et al,[2] highly motivated delivery and support for the multimedia program will affect student response and learning outcomes; therefore, we recommend that faculty subscribe to multimedia programs that they have reviewed carefully or even developed themselves for appropriate application to their course. Finally, we recommend developing specific course assignments or projects that incorporate the use of the CD-ROM to enhance its value. Several investigators[27] have strongly asserted that when using technology, the purpose should be clearly defined and should be perceived as valuable by the students.

CONCLUSIONS

Even though there were no statistically significant findings, our qualitative data suggest that computer-assisted learning may be an effective resource in athletic training education, given the appropriate application of its use. As stated by Wiksten et al,[20] our role as educators is to maximize the advantages of all types of instructional resources and minimize the disadvantages. We hope that continued examination of instructional techniques and their application to athletic training education will serve to guide our future curricula and educational strategies.

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