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The Effects of a Multimedia Computer Program on Preservice Elementary Teachers' Knowledge of Cognitive Components of Movement Skills

by Robert McKethan, Brett Everhart, and Erik Stubblefield

Abstract

This study analyzed the effects of a multimedia-based computer approach to teaching cognitive components of sport skills to elementary education majors enrolled in a course on methods of teaching physical education. All of the subjects were divided into two different treatment groups. Treatment 1 was a multimedia-based computer group (N = 45) and Treatment 2 was a lecture-based group (N = 52). The computer group was asked to learn the required information on the overhead throw, catch, and kick via the computer-assisted instruction approach, while the lecture group learned via the traditional lecture method. All subjects completed a pretest and posttest of the critical components and cue descriptions of the motor skills based on information in Gabbard's (1992) text on motor development. Researchers used a rating system for assessing the accuracy of subjects' listing the critical components and cue descriptors of the motor skills. By using a multivariate analysis of variance (MANOVA) with repeated measures followed by Wilks Lambda, results indicated that the lecture group scored significantly higher than the computer group on the post-test on all of the components of the catch, throw, and the total component scores. However, no differences were indicated between groups on specific cue descriptions.

Computers have been used over two decades to supplement the information provided by teachers at various levels of education. Many educational programs have implemented computers as an instructional tool, assigning a greater role to computer use as a means of disseminating learning content. When compared to traditional teaching methodologies, the literature has not generated consistent evidence that the use of computers produces increased achievement.

The term, Computer-Assisted Instruction (CAI), refers to the interaction of a learner with a computer in a direct instructional role. CAI addresses course content in a variety of formats, with or without the direction of a teacher (Lockard, Abrams, and Many, 1997). CAI applications are utilized across many different computer platforms and operating systems. Research involving the use of computers cited in this review represent the use CAI in various curricular areas, including physical education.

Some studies have found CAI to generate positive findings related to student achievement in reading (McCreary & Maginnis, 1989), business education (Din, 1996), and opinions of teachers to CAI (Berry, 1994). Another study compared the effects of hands-on activities in science to a combination of hands-on activities and CAI as well as to a third instructional format, text-based activities, and found the combination group produced higher achievement measures (Gardner, 1992). Stennett (1985) found favorable results in the literature when reviewing CAI in education. A related meta analysis of 199 comparative studies involving instruction in high schools, institutions of higher learning, and adult education settings.
found that CAI increased test scores by .31 standard deviations (Kulik & Kulik, 1985). Although described research supports the use of CAI as a supplement to course instructor-provided information, the effectiveness of CAI as an independent instructional tool to learning gains is not conclusive. A number of studies have found no favorable results when comparing CAI to traditional instructional methods (LaBonty, 1989; Morrell, 1992; Ruef & Layne, 1990; Wiksten, Patterson, Antonio, Cruz and Buxton, 1998).

Much of the research generated in physical education in relation to using computers has been in the area of biomechanics and kinesiology (Abraham & Barr, 1991; McPherson & Guthrie, 1991; Tant, Harper, Lindstrom, Rettammel, Scherr & Wyatt, 1991; Tavi, Sholev, & Ayalon, 1992). That area of the literature presents computer use as a favorable tool in teaching scientific concepts related to sport and physical education. In another investigation, on the effects of an interactive computer tutorial on ballet allegro terminology, subjects receiving the multimedia instruction performed at significantly higher levels on both written and practical tests (Fisher-Stitt, 1996). In the field of athletic training, investigations (Chen, Buxton, Holgen, & Speitel, 1995 and Buxton, Speitel, & Holgen, 1995) show that interactive computer programs used in combination with other instructional approaches produce results superior to single traditional approaches. Research in other areas of physical education has generated outcomes which do not support CAI as an instructional alternative to the classroom teacher (Deere, Wright, & Solomon, 1995; Deere, Wright, Solomon & Whitehill, 1995; Kerns, 1989; Skinsley & Brodie, 1990; Steffen & Hansen, 1987).

Research has examined the effects of using computers on knowledge of sport rules, scoring procedures, and terminology (Alvarez-Pons, 1992), statistics to physical education majors (Whitaker, 1991), tennis rules and strategies (Kerns, 1989), cognitive and psychomotor aspects of bowling (Steffen & Hansen, 1987) and the knowledge of golf rules (Adams, Kandt, Throgmartin & Waldrop, 1991). However, results of the aforementioned studies do not show that the use of CAI is more effective in producing student learning than more traditional methods in physical education.

Computer Platforms and Computer Assisted Instruction

Today's multimedia computers generate higher quality graphics and video in addition to being faster and more user-friendly than their predecessors (Haggerty, 1997; Silverman, 1997). Early research examined the effects of CAI on student achievement, however, the early research was not conducted with current, user-friendly, point-and-click graphical users' interface (GUI) computers which use state-of-the art graphics and multimedia. Examples of the GUI interface are Microsoft Windows and Apple Macintosh. The mainstream introduction of graphical computing had its beginnings in 1990 with the introduction of Windows 3.0 (Gates, 1995). Prior to the introduction of the GUI environment, research has examined the effects of CAI on achievement using non-graphic or low graphics-capable computer technology. Although GUI applications have been in mainstream use since the early nineties, computer platforms and software programs are typically not described in CAI research. Therefore, a continued examination of the impact of multimedia-based CAI on learning outcomes is still warranted.

Classroom Teachers and Computer Assisted Instruction

Across the United States, classroom teachers, rather than trained physical education teachers, are often charged with the responsibility for teaching physical education (Allison, 1990; Pangrazi, 1997). The learning needs in the area of sport skills for the prospective classroom teacher/physical educator is as great or perhaps greater than prospective physical educator. Consequently, the purpose of this study is to determine the effects of multimedia-based CAI instruction on...
preservice teachers’ acquisition of knowledge of motor skill components and cue descriptions.

Method

Subjects and Setting
Since elementary classroom teachers are responsible for much of the physical education which is taught, preservice elementary classroom teachers were selected as subjects in this investigation. Participants for this study were enrolled in a required undergraduate course on teaching physical education. All subjects were preparing for K-6 teaching licensure in curriculum and instruction. Subjects were randomly divided into either a Treatment 1 group using multimedia-based CAI instruction (N = 45) or a Treatment 2 group learning via traditional lecture instruction (N = 52). The differential in group size is due to a reduction in the CAI group because of subjects dropping out after the start of the investigation. Prior to group assignments, subjects were oriented to the purpose of the study and the participant requirements. Following the orientation, informed consent was obtained from each subject.

Procedures
All subjects completed a pretest (see Figure 1) to determine knowledge of descriptive cues and components of three motor skills: (a) the overhand throw; (b) the catch and (c) the kick. The CAI group attended a training session in which the procedures for use of the multimedia-based CAI software were described. Participants in the CAI group were also given a handout of the procedures for using the multimedia CAI program. Both groups were to learn the cognitive information on descriptive cues and components of the three motor skills. The overhand throw was presented during the first week followed by the catch in the second week and the kick during the third week.

Subjects in each of the groups met for 10 minutes during each week of the instruction period. The multimedia-based CAI group received instruction from a program (McKethan & Everhart, 1997) available on the university’s computer server. The CAI group studied text information about the use of the skill, still pictures (with descriptions) of components, a video of a mature execution of the skill and learning cue descriptions of the skill. For purposes of participant accountability subjects in the CAI group were required to answer two of the self-check items on the program and send it via electronic mail to the investigators.

The lecture group met once a week for 10 minutes for instruction on each of the motor skills (one per week in the same sequence as the computer group). The two instructors from the Department of Health, Leisure, and Exercise Science received information on skill sequences, descriptive cues and lesson sequences prior to the start of the investigation. The two instructors lectured from the same outline taken from the computer program so that subjects from both groups received the same text information. Instead of still pictures and video, the lecture group received verbal information and modeling on skill components. Otherwise, the content was identical to that available on the computer. A post-test on all three motor skill components and learning cues was administered following the last week of motor skill instruction.

Data Collection and Analysis

Instrumentation
The researchers took the information for the CAI program, the lectures, and the tests from Lifelong Motor Development (Gabbard, 1992) and developed a scoring rubric for assessing the accuracy of subjects to list the skill components and cue descriptors of the motor skills. The scoring rubric was comprised of a scale which allocated one point for each key word included in the answers (see Figure 2). The investigators developed a list of key words included in the rubric from Gabbard’s (1992) text. This rubric was used
to evaluate subjects’ identified cue descriptions. Evaluations of subjects’ listing of skill component sequences was based directly upon the content material from the lecture and CAI instruction.

Selection of Components and Identification of Cues

Subjects were able to select the correct skill components from a list of 11 possible choices for five fill-in-the-blank answers for the overhand throw. In addition, the subjects were asked to describe each of the five listed components in more detail. An example of a description would be, “The elbow leads the forward movement of the arm in the delivery phase (component).” For the catch, the subjects were required to fill in four blanks for the skill components, choosing from a list of eight possible selections. For the kick, the subjects filled in three blanks from a selection list of eight choices. Also, subjects were asked to give more detailed descriptions for each of the four skill components in the catch skill and for each of the three components in the kick skill.

Evaluation of Cues

For all three skills, each of the listed components were to be described in more detail in the next column (labeled as “cue description”). Evaluation of subjects’ cue descriptions was based on identifying matches or synonyms of key words to the key words found in the rubric (see Figure 2).

Content validity was established by comparing the skill sequences to those found in the literature (Gabbard, 1992). The investigators also reviewed each question and answer to ensure that it was relevant to what was being measured.

Interobserver Agreement

To establish reliability between observers, the researchers independently used the scoring rubric to evaluate three pretests randomly selected from the sample. The percent of agreements (number of agreements divided by the number of agreements plus the disagreements multiplied by 100) between observers was calculated. A 90 percent agreement was established between two observers (raters) who scored each of the pre- and post-tests. The investigators assumed that observer drift, which might create a need for reliability checks, was not a problem since the pre and post-tests were scored on the same day.

Dependent Variables

Eight dependent variables were analyzed between the computer and lecture groups. The first four were the components of the skills and the total component score. The next four were the three cue descriptor groups and the total cue score. The variables were: (a) components of catch (COC); (b) components of kick (COK); (c) components of throw (COT); (d) components total (COTO); (e) cues of catch (CUC); (f) cues of kick (CUK); (g) cues of throw (CUT); and (h) cues total (CUT).

Results

A multivariate analysis of variance (MANOVA) with repeated measures was used to determine if significant differences existed between groups. Wilks’ Lambda was then used to test for significant differences between the groups’ centroids (p<.05; see Table 1).

Results showed differences between the lecture group and the multimedia CAI group in the knowledge of the general skill components for all three skills. The means for the groups can be seen in Table 1. Further analysis revealed that the lecture group scored significantly higher than the CAI group on the post-test on all of the component dependent variables: (a) component of the catch (COC) F = (2, 2) = 17.1, p<.014; (b) component of the throw (COT) F = (2, 2) = 20.2, p<.027; (c) component of the kick (COK) F = (2, 2) = 3.83, p<.025 and (d) total component score (COTO) F = (2, 2) = 116.5, p<.005. The above scores were all significant at a predetermined alpha level of .05.
There were no significant differences between groups in the description of cues for each of the components. The means for the groups can be seen in Table 1. It is important to report that the scores for both groups on the cue descriptors were extremely low. The upper limit for scores from the throw and catch skills were 20 and 13, respectively. However, neither of the two groups’ (except total scores) means were above 3 points (each key word was worth one point in the descriptors’ scale).

Discussion

Results from the testing showed that cognitive scores (listing skill components sequentially) by the traditional lecture group (Treatment 2) were significantly greater than those of the multimedia CAI group (Treatment 1). Significant differences were found between the lecture group and the multimedia computer group when examining scores of components from each of the three skills as well as the combined components of all three skills. No significant differences were found between groups on the descriptive cues scores.

The results from this investigation were parallel with the results reported in the literature. Some evidence suggests that the traditional method is superior to the CAI method while other evidence is contradictory. From a recent multimedia study in athletic training, Wiksten, et al. (1998) found that subjects receiving lecture instruction performed significantly better than the control and CAI groups. In other literature reported, the CAI method was found to be superior. Fisher-Stitt (1996) found that subjects receiving multimedia CAI performed significantly higher on written tests on ballet terminology. Also, others report no significant differences in a comparison of testing results between traditional methods and CAI. In earlier studies comparing the impact of CAI instruction and lecture instruction, Adams, et al. (1991) and Kerns (1989) found no significant differences in scores of tests in golf and tennis rules.

No significant differences were found between groups in describing the cues for each of the components of the skills. This may be simply an instance of an overload of material because the scores were low for both groups on the cue descriptors. It may be that the 10 minute lesson (for each skill) was inadequate for subjects to fully assimilate information on skill components, and cue descriptors. Another explanation for the low scores and no statistical differences, was that subjects were required to recall cue descriptors from the lesson whereas, subjects were able to select skill components from a list of components. Identification of cue descriptors took place following the identification and sequencing of skill components.

The results suggest that a traditional approach may produce greater learning outcomes, depending on the context. The differences between the treatment groups may have been due to a number of factors. The first factor relates to the available options found in the CAI program not available in the lecture instruction. Although, the multimedia CAI group was provided an orientation and a user’s guide to the program, there were additional areas of the program that could have been distracting to the user. Other factors may include subjects’ familiarity with the instructors delivering the lecture instruction and the familiarity of the lecture and demonstration format of the instruction.

Another consideration for the results include time limitations on instruction and use of the multimedia CAI computer program. With respect to time factors, subjects who were in the lecture group did not have to concern themselves with logging on to a computer program, navigating within that program and pacing their progress so as to remain within the 10 minute time frame.

Implications

It is possible that additional research is needed to study this problem with more stringent controls on the experimental group. Use a computer lab assistant to supervise the experimental group
members’ use of the multimedia CAI program may assure that subjects in the experimental group use only the areas of the program chosen for the investigation.

The results of this investigation and of investigations cited in the literature review show the need for additional studies comparing multimedia CAI instruction to other forms of instruction. Subsequent research with more attention to software design and validation may begin to show more consistent results in the use of CAI software. These results lend support to the supplemental role of CAI to more traditional instructional methods in the context presented in this investigation.

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