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Phi Epsilon Kappa
The Effects of Multimedia Software Instruction and Lecture-Based Instruction On Learning and Teaching Cues of Manipulative Skills On Preservice Physical Education Teachers

Robert McKethan, Brett Everhart and Renee Sanders

Abstract

The literature has shown inconsistent results in the use of Computer-Assisted Instruction (CAI). Teachers continue to use lectures as a commonplace mode for the delivery of information. Instructional experts suggest that a lecture format is not as effective as other formats due to the passive involvement of the learner (Shakarian, 1995), while the usefulness of computer-based instruction appears to be highly promising. This study examined the effects of a multimedia-based instructional strategy and lecture-based instruction on teaching cognitive components of manipulative skills to physical education majors in the Department of Health, Leisure and Exercise Science at a medium sized Southeastern university. Subjects were randomly assigned to the control group (N=13), a multimedia group (N=13) or a lecture group (N=18). The multimedia group received instruction on components of the overhand throw, catch and kick using a multimedia computer program while the lecture group received instruction via the traditional lecture method. The control group received no instruction on the selected skills. All subjects completed a pretest and posttest. A Multivariate Analysis of Variance with repeated measures indicated that significant differences existed between groups on a test of components and cue descriptors of manipulative skills. A series of one-way Analysis of Variance (ANOVA) followed by Tukey’s post hoc test indicated that differences in scores existed between groups. Continued investigations examining the merits of multi-media-based instruction are needed. As the computer continues to make inroads in the instructional arena, it is prudent to study CAI as it relates to subject content areas and instructional applications, as well the design of software.

Computers have served as a tool since the early 1980s to augment the instructional processes in elementary school, high school, and higher education. As computers become more powerful and less expensive, instructional processes using multimedia software are becoming increasingly popular. Although emerging computer technology commands the attention of educators, traditional methods of instruction, such as lecture, remain a valued mainstay of instructional processes in institutions of higher learning. In considering the use of instructional methods, teachers should attempt to use the method which best meets their instructional objectives.

In the last decade, some instructional experts suggest that a lecture format is not as effective as other formats due to the passive involvement of the learner (Shakarian, 1995). Others assert that the traditional lecture method is not suited for the ever-expanding educational objectives of today’s society, diversity of learners’ needs, and the increasing volumes of information (Meyers &
In today's society where there is an increasing emphasis on students to take ownership of learning processes, merits of the lecture approach to instruction is debatable while the usefulness of computer-based instruction appears to be warranted.

The relative effectiveness of lecture method of instruction as well other methods such as discussion, team teaching and peer teaching methods of instruction are discussed in the literature. McKeachie (1963) concluded that an evaluation of teaching methods must consider instruction goals. Kulik and Kulik (1979) and McKeachie (1963) both reviewed literature which compares the effectiveness of lecture and discussion methods of teaching on achievement as measured by the learning of factual information. These reviewers concluded that teaching by lecture is neither more nor less effective than teaching by the discussion method. Teachers continue to use lectures as a commonplace mode for the delivery of information.

In recent years, educators have used computer-assisted instruction (CAI) to promote greater student involvement in learning activities and to promote increased access to learning material. CAI is defined as the use of computers to present instruction to students. It is an interactive process designed to help students learn new material or improve knowledge of materials previously studied (Azarmsa, 1991).

Studies on the effectiveness of CAI have shown inconsistent results. The effectiveness of CAI appears to be dependent upon its purpose, the context of its use and the design of the software. However, research studies published in educational journals do not address software design and its impact on the learner. One study found CAI to be as effective as traditional reading instruction when using the Nelson Denny test as a benchmark (McCreary & Maginnis, 1989). Another study examined the effects of hands-on activities in science to a combination of hands-on activities and CAI as well as to text-based activities, and found the combination of methods produced higher achievement (Gardner, 1992). Stennett's (1985) review was favorable to the use of CAI. Kulik & Kulik's (1985) review and meta analysis of 199 studies involving instruction and test scores in high schools, institutions of higher learning, and adult education studies indicated that CAI increased reported test scores by .31 standard deviations. Although research supports the use of CAI as a supplementary tool to instructor-provided information, its effectiveness as an independent instructional tool is not conclusive. Three investigations show no favorable results when studying CAI as a sole instructional method when compared to traditional instructional methods (LaBonty, 1989, Morrell, 1992, Ruef & Layne, 1990).

Much of the research on CAI and related instructional strategies in physical education is in the area of biomechanics and kinesiology (Abraham & Barr, 1991; Boysen & Francis, 1982; Draper & Steele, 1985; Francis, 1984). Literature from biomechanics and kinesiology presents CAI as a favorable tool for teaching scientific concepts related to sport and physical education. Research comparing traditional lecture and CAI instruction in athletic training, tennis and bowling activities classes has generated inconsistent results (Deer, Wright & Solomon, 1995; Kerns, 1989; Skinsley & Brodie, 1990; Steffen & Hansen, 1987). Steffen and Hansen (1987) compared CAI and traditional instruction in bowling. Results showed that students receiving CAI instruction had significantly higher bowling scores. However, on tests of bowling knowledge CAI scores was not significantly different.

Although researchers have studied the effects of CAI on knowledge of sport rules, scoring procedures, and terminology (Alvarez-Pons, 1992) statistics for physical education majors (Whitaker, 1991), tennis rules and strategies (Kerns, 1989) and cognitive and psychomotor aspects of bowling (Steffen & Hansen, 1987), it is not clear that CAI is more effective in producing student achievement than more traditional methods of teaching in physical education. A
decade of successive and rapid improvements in computer technology has made its use both easy and motivating for students to complete assignments. In addition to processing data and software programs much faster, today’s computers have improved graphics and video quality as well as user-friendly graphical interfaces (Haggerty, 1997; Silverman, 1997). Consequently, an important area of inquiry might be multimedia software applications in physical education. It may be possible that cognitive outcomes and psychomotor outcomes as well as motor patterns of children may be affected differently by multimedia instruction. Also, there is much potential in the use of multimedia computer programming to train physical education majors to analyze motor skills. Due the large-scale and rapid incorporation of computer technology as an instructional tool, it is necessary to determine the contributions of multimedia programming to learning.

Research has shown that similar technology, such as video-based instruction, has produced significant results on outcomes in physical education (Morrison & Reeve, 1989; Sariscsany & Pettigrew, 1997; Walkley & Kelly, 1989; Wilkinson, 1996). Walkley and Kelly (1989) found that development of preservice and inservice physical education teachers’ motor skill proficiency at motor skill assessment was enhanced by the use of interactive videodiscs (IVD). The investigators examined the qualitative assessment of the overhand throw and catch for three groups: those interacting with video discs, those directed by a teacher, and those directed by self. The group using IVD performed better on both skills and the teacher-directed group was significantly greater on the overhand throw than the self-directed group. The self-directed group scored lower when compared to both IVD and teacher-directed instruction. These results suggest that self-directed groups may not be the most effective way to develop competency in assessing motor skills. Walkley and Kelly’s (1989) findings are supported by research which shows that video-based training to develop assessment skills is effective in analyzing motor skills by inservice and preservice physical education teachers. In light of the convenience and ease of using video within a multimedia software environment, educators must ask whether learning may be more efficient if the instructional tool incorporates digital video in multimedia programming. In a study of preservice elementary education teachers (McKethan and Everhart, 2000) lecture instruction was compared to a multimedia-based instruction using digital video. The results of this study showed that the traditional lecture instruction produced test scores that were significantly higher than scores produced from the multimedia-based instruction.

There are few studies which specifically address the acquisition of knowledge or skills in physical education through the use of the newer multimedia software programs. It may be that multimedia-based instruction is more effective than traditional methods of instruction. Investigations might also find that it is no more effective than traditional methods of instruction. Therefore, the purpose of this study is to determine the effects of a multimedia instruction and lecture-based instruction on physical education majors’ cognition of manipulative skill components and descriptive cues.

**Methods**

**Subjects and Setting**

Physical education majors from the Department of Health Leisure and Exercise Department at a medium-sized Southeastern university agreed to serve as subjects for this study. Subjects who participated in this study included sophomores, juniors and seniors. The subjects for this study were volunteers, recruited from different classes in physical education. All of the subjects were randomly assigned to either a control group (N=13), a lecture group (N = 18) or a multimedia group (N = 13). All subjects were informed of the study topic, research procedures
and participant requirements prior to signing an informed consent document. One might expect that the inclusion of subjects with different levels of education may introduce a variance in expected skill and knowledge levels and consequently influence scores on the critical cues and components. However, Kerlinger (1973) stated that the random assignment of subjects would equally disperse any variance to both the control group and instructional groups.

**Procedures**

All subjects completed a pretest to determine the critical cues and components of three motor skills: the overhand throw, the catch, and the kick. The control group received only the pretest and the posttest. Following the pretest, the lecture group and the multimedia groups received training on teaching cues and components of the three manipulative skills. One skill was presented each week over a three-week period. Sessions for teaching these skills lasted for approximately 10 minutes. Due to the differing complexity of the skills, the time required for the cue and components instruction varied slightly. A posttest was administered following the Instruction on the last skill (see Figure 1).

The procedures for teaching in the multimedia format and the lecture format were established so that the sequence of instruction would be the same from one format to the other (see Figure 2). The way in which skills were presented was modified between instructional groups. The lecture-based instruction incorporated a verbal description of the skill and skill elements. The verbal descriptions were supported with examples modeled by the instructor. Students in the lecture-based instruction were able to ask questions. The instructor responded to questions asking for clarification, to repeat a verbal description, or to repeat a demonstration. In the multimedia instruction group, students read information about the skill and skill elements. Students in the multimedia instruction group also viewed still pictures of skill components and a video of the entire skill sequence. Although the two instructional groups were sequenced similarly, the pacing in the lecture group was controlled by the instructor whereas in the multimedia group, pacing was determined by the individual student. Also, there were no controls on the multimedia instruction group on how often they could view the skill video. Information delivered in the lecture-based instruction was taken from text information in the multimedia program and presented by a teacher-educator trained in the sport skill content. The multimedia instruction was student-directed using an equivalent instructional protocol. In addition, one of the investigators was present at each of the multimedia instruction lessons. The multimedia instructional process utilized the computer program, Multimedia Analysis of Sport Skills (McKethan & Everhart, 1997).

**Data Collection and Analysis**

**Instrumentation**

Information used in the multimedia program, the lectures and data collection was acquired from *Lifelong Motor Development* (Gabbard, 1992). A rating system was developed for assessing the capability of students to list, in sequence, the skill components and develop cue descriptors for each of the skill components. The rating system was comprised of a scale which allocated a point for each key word included in the answers. Key words were taken from Gabbard’s (1992) text. The investigators then ensured that all key words would demonstrate the knowledge possessed by subjects as they identified components of each skill’s integrated movement. This process certified to the investigators that subjects had included all relevant information for the skills’ components and cue descriptors.

Subjects selected skill components from a list of 11 possible choices for five fill-in-the-blank answers for the overhand throw. In addition, the subjects described the elements of the five listed components in more detail. An example of a descriptor would be, “The elbow leads the
forward movement of the arm” in the delivery component. For the catch, subjects were required to identify four skill components, choosing from a list of eight possible selections. For the kick, subjects identified three components from a selection of eight choices. For all three skills, each of the listed components were described by the subjects in more detail in the next column labeled as “cue description.”

Separate scores were calculated for the listing of components and identification of key word(s) for each component description. For the components, one point was given for a correct answer. Also, one point was given listing the components in a correct sequence. For the component descriptions, one point was awarded for identification of key words found in the component descriptions.

**Interobserver Agreement**

In order to establish reliability between observers, the investigators separately evaluated three randomly selected pretests using the scoring system. The percent of disagreements (number of agreements divided by the number of agreements plus the disagreements multiplied by 100) between raters was calculated, establishing reliability as 85 percent agreement between the two raters who scored each of the pretests and posttests.

**Dependent Variables**

In this investigation, two groups of three dependent variables were analyzed. The first three were the components of the skills and the next three were the three cue descriptors of the skills. These variables included: (a) components of the catch (CACO), (b) components of the kick (KCKCO), (C) components of the throw (THRCO), (d) cues of the catch (CACU), (e) cues of the kick (KCKCU) and (1) cues of the throw (THRCU).

**Hypothesis**

The hypothesis of the investigators was that the multimedia group would show greater improvement on the cognitive knowledge of the components and cues as a result of the multimedia effect of video and graphics not present in the lecture or control groups.

**Results**

A Multivariate Analysis of Variance (MANOVA) with repeated measures was used to determine if there were differences between groups with repeated measures. Tukey’s HSD test was used to determine where significant differences existed between the scores on the variables among each of the two experimental groups and control group.

Results showed that significant differences did exist in the data between the pretests and posttests on selected skill components and cue descriptions. Differences were found between the control group and either the lecture group or the multimedia group. Specifically, significant differences were found between the control group and the multimedia group on the kicking components (KCKCO) $f(1, 2) = 5.599$, $p<.00$. Also, significant differences were found between the control group and lecture group on the kicking components (KCKCO) $f(1, 2) = 5.599$, $p<.002$. In addition, significant differences were found between the control group and the lecture group on the catching components (CACO) $f(1, 2) = 3.461$, $p<.007$.

Examination of the descriptive cues pretest and posttest showed significant differences. Significant differences in correct responses were found between the control group and the multimedia group on the kicking cues (KCKCU) $f(1, 2) = 7.203$, $p<.000$ and between the control group and the lecture group on the kicking cues (KCKCU) $f(1,2) = 7.203$, $p<.002$ (see Table 1).

**Discussion**

Results showed that scores (listing skill components sequentially) by multimedia and lecture groups were significantly greater than the scores generated by the control group. However, the results also show that there were no
and participant requirements prior to signing an informed consent document. One might expect that the inclusion of subjects with different levels of education may introduce a variance in expected skill and knowledge levels and consequently influence scores on the critical cues and components. However, Kerlinger (1973) stated that the random assignment of subjects would equally disperse any variance to both the control group and instructional groups.

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search project appears to be user-friendly, relevant, and contains elements parallel to elements typically found in textbooks. However, there has been no research to validate this software as a learning tool. Consequently, one cannot rule out the software design as a bias in the results of this project.

Implications

The results of this investigation do not support the hypothesis nor does the literature consistently support the results. It is possible that additional research may find more conclusive support for the use of multimedia as an instructional tool. Perhaps, a prerequisite area of investigation would be to examine the elements of software design for the effectiveness in learning. Subsequent investigations similar to one described in this study should incorporate designs that require lengthier treatments as well as use of novel skills. Another avenue for subsequent investigation is to examine the effect of CAI on learning where outcomes higher-order thinking skills are required. It is imperative that investigators continue to seek information about the use of multimedia software since multimedia software and computer technology is now an accepted instructional tool in physical education.

One might conclude from this investigation that multimedia as a learning tool is no better or no worse than the lecture approach to instruction when the instructional objective requires a recall of information. In that respect, we might conclude that multimedia instruction may be useful as one of a number of instructional approaches in one’s teaching repertoire.

REFERENCES


Dr. Robert McKethan is a faculty member in the department of Health, Leisure and Exercise Science at Appalachian State University.

Dr. Brett Everhart is a faculty member in the department of Kinesiology at the University of Texas, Arlington.

Ms. Renee Sanders is a graduate student in the department of Health, Leisure and Exercise Science at Appalachian State University.
Figure 1

Test of Learning Cues and Components for Three Motor Skills

Name______________________________

Circle Courses You Have Taken: PE 2556 PE 3000 PE 3001 PE 1556 PE 2015
(list names if you don’t know course numbers) PE 2020 CI 3141

Group: (do not mark - office use only) Control Computer Lecture

Instructions: Please look at the component list in the right column below. Select the components for the skill listed (There are more choices than answers for each skill). Choose the major components which you feel would best be sequenced in order to tell a child how to perform each of these skills. Under Skill Components list the sequence of skill components you selected in the order that they would occur when the skill is executed. Under Cue Description, describe how the child would move or stand during each component. Ten minutes is all that is allowed to complete this pretest.

Examples: For a basketball free throw component, “eyes on basket” one might put “the student should keep the eyes on the back of the rim while preparing to shoot” for the cue description. Another example for dribbling a basketball might have the component “eye contact” and the cue description would be “the student should look up to watch where he or she is going.”

<table>
<thead>
<tr>
<th>Overhand Throw</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Skill Components</strong></td>
<td><strong>Cue Description</strong></td>
<td><strong>Possible Component Choices</strong></td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td>Rotation</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>Eye Contact</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>Follow Through</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>Delivery</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Focus</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Catch</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Skill Components</strong></td>
<td><strong>Cue Description</strong></td>
<td><strong>Possible Component Choices</strong></td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td>Body Component</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>Reception</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>Preparatory Phase</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>Follow Through</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Kick</th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Skill Components</strong></td>
<td><strong>Cue Description</strong></td>
<td><strong>Possible Component Choices</strong></td>
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<tr>
<td>1.</td>
<td></td>
<td>Follow Through</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>Knee Bend</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>Run</td>
</tr>
</tbody>
</table>

Late Winter 2001
Lesson Plan Progression for
Analysis of Sport Skills

Multimedia Lesson

1. Present Objective - to examine components of skill and to examine teaching cues.
2. Invite students to take notes
3. Students look at digital video clip of skill
4. Read written description of skill component
5. Look at still picture of skill component
6. Repeat 3/4 for each component
7. Look at mature skill video
8. Read teaching cues for skill
9. Look at mature video - try to spot and name components

Lecture Lesson

1. Present Objective - to examine components of skill and to examine teaching cues.
2. Invite students to take notes
3. Instructor demonstration of entire skill
4. Give verbal description of skill component
5. Instructor demonstration of skill component
6. Repeat 3/4 for each component
7. Repeat instructor demonstration of entire skill
8. Give teaching cues for each skill
9. Look at modeled component - name the modeled component
Table 1
Mean Pre-test and Post-test Scores for Instructional Groups and Control Group

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Computer Pre</th>
<th>Computer Post</th>
<th>Lecture Pre</th>
<th>Lecture Post</th>
<th>Control Pre</th>
<th>Control Post</th>
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<tr>
<td>Components</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Throw</td>
<td>2.92</td>
<td>3.69</td>
<td>3.06</td>
<td>3.94</td>
<td>2.92</td>
<td>2.92</td>
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<tr>
<td>Catch</td>
<td>2.46</td>
<td>2.76</td>
<td>2.61</td>
<td>3.33*</td>
<td>2.46</td>
<td>2.23</td>
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<tr>
<td>Kick</td>
<td>1.69</td>
<td>3.15</td>
<td>1.50</td>
<td>3.39**</td>
<td>1.69</td>
<td>1.62</td>
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<tr>
<td>Cue Descriptors</td>
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<td></td>
<td></td>
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<tr>
<td>Throw</td>
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<td>1.92</td>
<td>1.56</td>
<td>1.92</td>
<td>1.54</td>
<td>1.08</td>
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<tr>
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<td>1.92</td>
<td>.83</td>
<td>2.11</td>
<td>.85</td>
<td>2.11</td>
</tr>
<tr>
<td>Kick</td>
<td>1.08</td>
<td>2.54*</td>
<td>.50</td>
<td>1.89*</td>
<td>.92</td>
<td>.46</td>
</tr>
</tbody>
</table>

*= p<.01; **= p<.001

Legend

THRCO = throw components
CACO = catch components
KCKCO = kick components

THRCU = throw cue descriptions
CACU = catch cue descriptions
KCKCU = kick cue descriptions