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QUALITATIVE ANALYSIS OF THE OVERHAND THROW BY UNDERGRADUATES IN EDUCATION USING A DISTANCE LEARNING COMPUTER PROGRAM [1]

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Summary.—The purpose was to (a) examine whether computer-based distance learning could enhance the qualitative analysis skills (error detection in the overhand throw) of undergraduates in education and (b) examine the effectiveness of several methods of information presentation (video file and text) on distance learning. Participants were randomly assigned to 1 of 4 groups, to detect errors in an incorrect throwing motion of a model on the computer screen. Group 1 ($n=13$) was the control; Group 2 ($n=13$) viewed a video of the appropriate throwing mechanics; Group 3 ($n=13$) viewed text information describing the appropriate mechanics of the overhand throw; and Group 4 ($n=16$) received a combination of video and text information. On Day 1 participants took a pretest. Treatment and testing occurred on Days 2 through 8. Then 5 days later participants took a retention test. One-way analysis of variance confirmed no significant differences between groups at Pretest (Day 1). An analysis of variance with repeated measures indicated learning over practice. Paired-sample *t* tests between Days 1 and 8 showed the video plus text group without significant change.

Knudson and Morrison (1996) defined qualitative analysis as "the systematic observation and introspective judgement of the quality of human movement for the purpose of providing the most appropriate remediation to improve performance" (p. 31). Hoffman (1983) stated that "whether considered as discrete units or members of a behavioral class, the motor responses of students comprise the basic data upon which physical education and sport skill teachers make major pedagogical decisions" (p. 35). They need to judge if (a) the learner performed the skill correctly and (b) if the performance is incorrect, what critical features are errors. This can be a difficult assignment given the dynamic environment of sports skills and the relatively small period of time teachers/coaches have to detect relevant cues to aid in their prescription.

Diagnosis

According to Dale (1973), accurate perception and retention of visual input tends to deteriorate rapidly when distracting displays are introduced

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into an observer's perceptual field. To identify critical features of a learner's performance and subsequent performance errors, the teacher must discriminate relevant aspects of the performance. Image retention and visual discrimination, complicated by distracting visual displays, become a major part of the observational task. It has been suggested (Kretchmar, Sherman, & Mooney, 1949; Barrett, 1977) that one needs to develop conceptual schemas or observational models to reduce the complexity of visual displays which motor performances provide the observer. This, in turn, could help a teacher handle the large amount of information during observation of motor performance.

Morrison and Reeve (1989) suggested that "The diagnostic phase of analysis requires matching an observed performance with a prototypic one. To analyze performance, the analyst must have a knowledge of a skill's critical features and their sequence and be able to identify these critical features and sequence in a performance" (p. 112).

Bayless (1981) examined the effect of exposure to prototypic skill (volleyball serve, spike, and block) and experience on 24 physical education majors' identifying performance error significantly. Biscan and Hoffman (1976) and Hoffman and Sembiante (1975) found that experience and familiarity with a specific motor pattern accounted for group differences when subjects were asked to match filmed presentations of a motor performance with a prototypic performance.

Although qualitative analysis of skill is considered important for physical education majors and teachers, research has shown that these groups do not have a generic ability to analyze skills (Biscan & Hoffman, 1976). In fact, competency appears to be based upon specific training with specific movements and is learnable (Bayless, 1981; Beveridge & Gangstead, 1984; Gangstead & Beveridge, 1984; Morrison & Harrison, 1985; Morrison & Reeve, 1986; Wilkinson, 1991). Wilkinson (1991) found that without specialized training, undergraduates in physical education could not analyze basic volleyball performance errors commonly observed during teaching and coaching. Gangstead and Beveridge (1984) reported that the performance of physical education majors on short-term retention of motor responses and knowledge of correct motoric patterns was enhanced by long-term analytical instruction based on a specific observational framework. If skill analysis is a cornerstone of instruction and there is a need for specific instruction in skill analysis, then a logical step would be to discover the most effective and efficient environment for learning qualitative skill analysis. One possibility is computer-assisted distance learning.

Observation Technology

Several studies (e.g., Kerns, 1989; Walkley & Kelly, 1989; Adams,

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Kandt, Throgmartin, & Waldrop, 1991; McKethan, Everhart, & Stubblefield, 2000; McKethan, Everhart, & Sanders, 2001) showed no significant differences when comparing computer-assisted instruction with a traditional teacher-directed method of instruction with regards to learning or instructional time requirements. Kerns (1989) conducted a study to assess the effectiveness of computer-assisted instruction in teaching tennis rules and strategies. She found that both groups (teacher-directed and computer-assisted) showed significant learning of tennis rules and strategics from pre- to posttest, but there was no significant group difference on the three tests. This suggested that computer-assisted instruction used outside of class would allow more time for instruction of tennis mechanics, more opportunity to practice skill, or more playing time.

Nonverbal instructional techniques such as videotape replay, television, and videodisc have been available for a number of years, but only recently has multimedia distance-based learning become an option. With the advent of software programs that allow an instructor to capture and use video files, provide written instructions, and receive test results via online transmission, the need for research into the efficacy of such treatments seems evident. One logical extension of the use of technology would be the use of computer-assisted distance learning to provide information needed to enhance undergraduates' qualitative analysis skills.

Kernodle, McKethan, Brantz, and Bridges (2002) examined the effect of a computer-based distance learning program on detection of errors in the overhand throw by undergraduates in education. They found that a combination of video files plus a viewable text resulted in significantly higher scores than did use of a video or text alone. Although no other studies were found examining the optimal use of video files in a computer-based distance learning environment, one might consider generalizing from the findings of research dealing with the use of videotape replay.

As videotape replay gives precise and almost immediate feedback, it was considered a suitable method of presenting kinematic information. Cooper and Rothstein (1981) noted higher achievement on the tennis serve among those using videotape versus a control group, and Rikli and Smith (1980) found that service form improved with use of videotape replay. However, when Emmen, Wesseling, Bootsma, Whiting, and Van Wieringen (1985) and Van Wieringen, Emmen, Bootsma, Hoogesteger, and Whiting (1989) compared performance and movement scores of novice and intermediate tennis players, respectively, there was no significant difference between those using and not using videotape. Walkley and Kelly (1989) found that an interactive videodisc in a qualitative assessment training program was as effective as a teacher-directed approach for the overhand throw and superior to a teacher-directed approach for the catch.

Newell and Walter (1981) suggested that the amount of information available via videotaped replay may be more than a student can effectively process. McGuire (1961) suggested that one way to alleviate the problem is to allow the subject three to five viewings of the videotape. Keele and Summers (1976) attributed the failure of many studies to reliance only on the videotape or the use of a model rather than a combination of the two. They argued that a model aided in the development of a template but provided inadequate performance feedback for comparison. Video of a learner, without an adequate template, is less effective because there is no standard of correctness against which to evaluate the feedback.

Rothstein and Arnold (1976) conducted an extensive literature review and suggested the lack of cue utilization to focus attention may have had the most significant effect on the use of videotape replay. Lack of attentional cues may have limited the learners' attention to relevant information and ignoring irrelevant stimuli. Several studies (e.g., Johansson, 1973; Ball & Sekuler, 1981; Kernodle & Carlton, 1992) have shown cue utilization reduces uncertainty, enhances motion detection and focuses learners' attention upon the minimal yet relevant aspects of the movement. A review of the literature by Rothstein and Arnold (1976) showed studies utilizing cues had a much higher ratio of success. Therefore, generalizing from research examining videotape replay, the use of video files within a computer-based distance learning paradigm should be augmented by providing a model, allowing more than one viewing of the performance, and using some attention-focusing mechanism.

Purpose

The purpose of this project was to (a) examine whether computer-based distance learning could enhance the qualitative analysis skills (error detection in the overhand throw) of undergraduate physical education majors and (b) assess the efficiency of several methods of information presentation (video file and text) on distance learning. It was hypothesized that a computer-based distance learning paradigm would (a) enhance the qualitative analysis skills of the overhand throw by undergraduates in physical education and (b) the video plus text group would be the only group who learned.

Method

Participants

Participants were 39 men and 16 women, ages 18 to 20 years, who were undergraduates in physical education. They were randomly assigned to one of the following four groups: control ($n=13$), video only ($n=13$), text only ($n=13$), and video plus text ($n=16$). The groups began with equal numbers

($n = 16$), but due to illness several participants had to drop out after data collection had begun. All participants signed consent forms and were treated in accordance with the "Ethical Principles of Psychologists and Code of Conduct" (American Psychological Association, 1992).

Apparatus

Software.—The instructional software was developed using Asymetrix (1993) Toolbook II Assistant for PC computers. The software used distance learning for instruction and testing. Participants used this instructional software from computer labs on campus, and submitted their test answers to an Internet site.

Video.—The model demonstrating the biomechanically correct and incorrect throws was a physical education major who previously hand modeled the overhand throw for other studies. Prior to videotaping, the model was required to practice 50 throws a day and receive error correcting instructions from an expert until the throwing motion exhibited the characteristics of a biomechanically correct throw. The parameters defining a correct throw were obtained primarily from Roberton's developmental sequence (1978). This procedure was followed prior to filming each phase of the correct throw: the preparatory phase (movements are directed away from the line of projection), the execution phase (movements are performed along the line of projection), and the follow-through phase (movements following release of the ball).

Specific errors were then introduced to selected components of the overhand throw. Seven different incorrect performances were videotaped after the model was trained until capable of demonstrating the specified errors.

The videotapes were recorded from a distance of 30 feet at a 45° on the model's dominant side (right side). Each of the tapes illustrated only the throw with limited video of the flight of the ball following release by the model.

Procedure

Prior to the implementation of the treatment procedures, participants took part in an orientation to the software using an IBM Thinkpad 390 E laptop computer in concert with an Epson 5000 series data projector. Participants were provided a copy of a User's Guide developed during the pilot study for the Kernodle, *et al.* investigation (2002) in addition to trouble shooting information, location and availability of academic computing labs, and a participation log designed to aid in maintaining the specified sequence for learning experiences.

Four treatment groups were employed. In accordance with McGuire's suggestion (1961) that three to five viewings would allow better retention of the information, the participants were provided three exposures to the treatment information on each day of the study. Group 1 received no treatment intervention ($n = 13$). Group 2 viewed a model performing a biomechanically correct throw three times (regular speed, slow motion, and regular speed) prior to taking the test ($n = 13$). Group 3 viewed text information describing the throw three times prior to taking the test ($n = 13$). Group 4 read the text and viewed the video in regular speed, read the text and viewed the video in slow motion, and read the text and viewed the video in regular speed ($n = 16$).

To reduce the load on the information processing system, information about the phases of the throw were systematically added over three days. On Day 2 Group 2 viewed only the preparatory phase, Day 3 the preparatory plus execution phases, and on Days 4 through 8 the preparatory plus execution plus follow-through phases. Group 3 read written information describing the throw three times prior to taking the test. On Day 2 the information was about the preparatory phase, Day 3 the preparatory plus execution phases, and on Days 4 through 8 the preparatory plus execution plus follow-through phases. Group 4 viewed the video at each speed and read the text prior to each replay. The presentation of information followed the previously mentioned pattern of preparatory phase on Day 2, preparatory plus execution phases on Day 3, and preparatory plus execution plus follow-through on Days 4 through 8.

All groups were pretested on Day 1 by viewing, identifying, and describing perceived errors depicted by the model. After exposure to the intervention, all groups followed the testing procedure utilized as the pretest for Days 2 through 5 and Day 7, and also Day 8. All groups were tested on Days 6 and 8 by viewing a model of the overhand throw with no errors. The requirement of three viewings was based upon McGuire's suggestion (1961) that three to five viewings would be optimal. The first and third viewings of the model were seen in regular speed. The second viewing required the participant to manipulate the slider bar on the media player to see the model in slow motion. There were five errors depicted during each test video, except for Day 6 and Day 8 when the modeled throw was biomechanically correct. Each participant was then required to identify the group, test number, and enter name and data by writing a description of the error, either in full sentences or phrases. This was submitted to the data collection website. This procedure was followed for each of the nine testing days.

The scores for the participants were awarded on the following basis. For all days except Day 6 and Day 8 participants were awarded one point for each error detected up to a maximum score of 5. Because no errors were depicted by the model on Day 6 and Day 8, one point was subtracted from a maximum of 5 each time an error was described by the participant.

Data Analysis

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Day	Control	
	M	*SD*
1	2.15	1.21
2	1.85	1.07
3	1.08	.86
4	1.15	1.21
5	2.31	1.18
6	3.62	.96
7	1.92	.86
8	3.15	1.07
9	.92	.95

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Group	*M*
1	1.23
2	.85
3	1.77
4	.13

Results

Data Analysis

Data analysis was conducted using the SPSS 9 statistical software package. The results of a one-way analysis of variance ($F_{3,51} = .79$, $p > .05$), conducted as part of a pretest showed no significant difference among groups.

A one-way within-subjects analysis of variance with repeated measures was conducted with the factor of method of instruction and the dependent variable being the pretest scores, daily posttreatment test scores, and retention scores. The means and standard deviations for the pretest scores and the retention scores are presented in Table 1. Analysis of variance indicated a significant time effect (Wilks $\lambda = .15$, $F_{8,24} = 31.09$, $p < .001$), as well as a significant time by group effect (Wilks $\lambda = .30$, $F_{8,24} = 2.77$, $p < .001$). Follow-up analysis using Tukey's Honestly Significantly Different (*HSD*) test showed no significant differences among groups.

TABLE 1
Instructional Groups and Test: Means and Standard Deviations

Day	Control		Video		Text		Text and Video	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
1	2.15	1.21	2.46	1.20	2.62	1.33	2.00	1.03
2	1.85	1.07	1.62	1.19	3.15	7.74	2.94	1.18
3	1.08	.86	1.00	.58	1.62	.65	1.44	.96
4	1.15	1.21	1.15	.99	1.69	1.32	1.69	.87
5	2.31	1.18	1.38	1.26	3.31	.75	2.19	1.33
6	3.62	.96	3.46	1.45	3.54	1.66	3.94	1.24
7	1.92	.86	1.23	1.01	1.38	1.04	2.00	1.03
8	3.15	1.07	3.77	1.30	4.23	1.09	4.62	.89
9	.92	.95	1.62	1.12	.85	.90	1.88	.96

A one-way analysis of variance conducted on the posttest scores showed a significant between-group difference ($F_{3,51} = 3.78$, $p = .02$). A follow-up analysis using Tukey's *HSD* showed significant differences between the video plus text group and the text group ($p = .04$).

Paired-sample *t* tests were conducted to evaluate whether there were significant differences (learning effect) between the pretest and retention

TABLE 2
Means and Standard Deviations For All Groups: Pretest and Retention Comparisons

Group	*M*	*SD*	*t*	*df*	*p*
1	1.23	.93	4.79	12	< .001
2	.85	1.21	2.51	12	.03
3	1.77	1.36	4.68	12	.001
4	.13	1.54	.32	15	ns

scores. Table 2 shows a significant decrease between the mean pretest and retention scores ($p < .05$) for Groups 1, 2, and 3 but not Group 4.

Paired-sample t tests also compared the group mean scores of Day 6 and Day 8 against the mean scores of each of the other tests (Days 1 through 5, Day 7, and Day 9). The values in Table 3 indicated that Day 6 mean scores were significantly different from each of the other mean test scores (except for Day 2) and Day 8 mean scores were significantly different from each of the other mean test scores (except Day 2).

TABLE 3

Means and Standard Deviations For All Groups on Days 6 and 8

Pair	Day 6			Pair	Day 8		
	$M_{Diff.}$	*SD*	*t*		$M_{Diff.}$	*SD*	*t*
Day 1/Day 6	−1.36	1.50	− 6.76	Day 1/Day 8	−1.69	1.54	− 8.15
Day 2/Day 6	− .73	4.09	− 1.32	Day 2/Day 8	−1.05	4.09	− 1.91
Day 3/Day 6	−2.36	1.47	−11.92	Day 3/Day 8	−2.69	1.35	−14.83
Day 4/Day 6	−2.22	1.38	−11.89	Day 4/Day 8	−2.55	1.42	−13.71
Day 5/Day 6	−1.36	1.60	− 6.31	Day 5/Day 8	−1.69	1.56	− 8.02
Day 7/Day 6	2.00	1.49	9.95	Day 6/Day 8	− .33	1.11	− 2.19
Day 8/Day 6	− .33	1.11	− 2.19	Day 7/Day 8	−2.33	1.54	−11.21
Day 9/Day 6	2.31	1.49	11.50	Day 9/Day 8	2.64	1.50	13.08

Discussion

The purpose of this project was to (a) assess whether computer-based distance learning could enhance error detection in the overhand throw of undergraduate physical education majors and (b) examine the efficiency of several methods of information presentation (video file and text) on distance learning. One possible limitation of this study might be the use of a model demonstrating contrived errors.

There was a significant time effect (learning) from the pretest to the retention test, with the exception of Group 4. The effects were significant decreases from the mean pretest scores to the mean retention test scores (see Table 1). A similar study by Kernodle, *et al.* (2002) examining undergraduate elementary education majors, showed the video plus text was the most effective method of information presentation. The rigor of the video plus text treatment in this study may explain why Group 4 was the only one not to show a significant decline.

There are several considerations which might explain the decline in performance. Many undergraduate physical education majors have prior experience with manipulative and sports skills, and the treatments took place in a setting without the presence of a teacher or authority figure. Barker, Frisbie, and Patrick (1989) suggested that the interactions of instructor and student strengthen the effectiveness of distance learning, while McCleary and Egan

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DAYS 6 AND 8

Day 8		
$M_{Diff.}$	*SD*	*t*
−1.69	1.54	− 8.15
−1.05	4.09	− 1.91
−2.69	1.35	−14.83
−2.55	1.42	−13.71
−1.69	1.56	− 8.02
− .33	1.11	− 2.19
−2.33	1.54	−11.21
2.64	1.50	13.08

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(1989) found that an on-site facilitator increased the effectiveness of instruction. Wiesener (1983) indicated that distance learning requires high motivation as often produced by contact with an instructor. According to Walkley and Kelly (1989), self-directed learning may not be the most effective way to develop qualitative assessment skills because it does not allow structure and immediate feedback. Also, participation was not mandatory which may have resulted in a lack of accountability.

Two other aspects of the study of interest were (a) changes in sophistication of language used in the description of the errors and (b) recognition of some of the more complicated components of the movement pattern. Group 1 showed no changes in either category. Group 2 became more proficient in detecting some of the less complicated errors such as (a) inappropriate follow-through, (b) stepping with the wrong foot, and (c) releasing the ball too late or too early. However, their use of the appropriate terminology such as (c) circular upward or circular downward backswing, (b) blocked versus differentiated rotation, and (c) homolateral versus contralateral step did not change. By Day 5, Groups 3 and 4 improved noticeably in recognition of errors and use of terminology, with Group 4 showing the most improvement, especially with more complicated components such as early rotation, type of rotation, and type of backswing. However, on Days 7 and 9 the use of appropriate terminology declined for both groups which coincided with the decline in the detection of errors. Again, there is no definite explanation for this occurrence, but lack of motivation may have been a factor.

One other aspect of the results that may be of interest is that participants across all groups were much more proficient at identifying a performance that contained no errors as opposed to identification of specific errors. This result is consistent with the findings of a study by Kernodle, *et al.* (2002) examining undergraduate elementary education majors. One might infer that success in identifying error-free performance lacks discrimination essential for determining that errors do not exist in a performance.

In summary, the results of this study suggest that this computer-based distance learning paradigm is not effective when attempting to train undergraduate physical education majors qualitative analysis of the overhand throw. However, research should include a similar paradigm including motivational factors such as the presence of an on-site instructor and profiles of learning preferences.

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