

The Effectiveness of a Web-based Motor Skill Assessment Training Program

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Abstract

The purpose of this study was to evaluate the effectiveness of a web-based, interactive video assessment program on teaching preservice physical education majors to assess the motor skill of kicking. The program provided component specific feedback through tutorial, guided practice, and competency training options. The 72 participants were randomly assigned to one of four groups: Teacher-Directed, Web-based with Time constraint, Web-based with No Time constraint, and No-Training. Analysis of the data revealed that both the web-based groups performed significantly better than the no-training group, but were not significantly different from each other or the teacher-directed group. It was concluded that web-based assessment training offers a viable way to provide preservice physical educators with 24/7 access to individualized assessment training.

Keywords: physical education, teacher training

States, schools, and physical educators are facing increasing demands for more accountability. These changes are in response to the ever-changing demographics of our schools, the cost of education, and concerns over equity and quality issues. In response to these changes the federal government has enacted legislation to address these concerns. Two of the more notable pieces of legislation in recent years have been the Individuals with Disabilities Education Act (IDEA) and No Child Left Behind (NCLB). The IDEA was enacted to ensure that students with disabilities received a free and appropriate education. The NCLB was enacted to improve the performance of the nation's schools by establishing curriculum standards and linking school accreditation to the achievement of these standards. As a result of these trends, physical educators are faced with larger more diverse classes of students, increasing demands to justify their time and resources, and more accountability to provide evidence that their teaching and programs are effective and making a difference. This is in light of the trend that today's youth are increasingly more overweight (McDowell, Fryar, Ogden, & Flegal, 2008) and less physically active (Lowry, Wechsler, Galuska, Fulton, & Kann, 2002) than they have been in the past.

Three deductions can be drawn from these current trends. First, instruction must be defined in terms of a curriculum that clearly defines standards of what students will be able to demonstrate at set points over time and that culminate in the attainment of specific goals. Second, instruction must be assessment-based in order to address the specific needs of the students and data are available to document that student learning is occurring and the curriculum standards are being achieved. Third, that school's are accountable for addressing and documenting the achievement of all their students.

To achieve these ends, schools need standards-based curricula, assessments that measure the curricula standards, and teachers who can administer the assessments, interpret the assessment results, design instruction based upon the assessments, implement their instructional plans and then evaluate them (Kelly & Melograno, 2004). In physical education, one of the critical skills in this process is the teachers' ability to accurately assess "how" students perform motor skills (Davis, 1984; Gallo, Seehy, Patton, & Griffin, 2006; Horvat, Block, & Kelly, 2007; Wright & van der Mars, 2004). This form of assessment is typically characterized as criterion-referenced assessment where a performance is evaluated by comparing it to an established set of standards or qualitative descriptors, which define how a skill should be performed. The role of qualitative assessment in understanding, evaluating, and developing motor skills has been addressed by numerous authors (Barret, 1979; Brown, 1982; Hoffman, 1977; Horvat, et al., 2007; Kelly, Reuschlein, & Haubenstricker, 1989, 1990; Kelly, Wessel, Dummer, & Sampson, 2010; Lewko, 1976; Lounsbury & Coker, 2008; Thomas & Thomas, 1983). The performance criteria for qualitatively assessing a kicking skill, for example, would measure whether the student demonstrated the following behaviors:

- a. Stand squarely behind the ball, weight evenly distributed on both feet, feet shoulder width apart, eyes on the ball.
- b. Step forward with non-kicking foot landing next to the ball.
- c. Swing kicking leg back with hip extension and knee flexion.
- d. Swing kicking leg forward with controlled force, contacting below the center of the ball with instep of the foot.
- e. Forward swing of arm opposite the kicking leg.
- f. Weight shift first to the non-kicking foot and then back to the kicking foot.
- g. Follow through of kicking leg toward the goal, toes of kicking leg pointing down.
- h. Smooth integration (not mechanical or jerky) of the previous focal points. (Kelly, et al., 2010).

There are two approaches for developing qualitative assessment skills in preservice teachers: the visual discrimination model (Wilkinson, 1991; 1996) and the skill specific model (Cloes, Premuzak, & Pieron, 1995; Morrison, Reeve, & Harrison, 1992; Walkley & Kelly, 1989), which this study employed. In this model teachers must first know the qualitative components of the motor skill to be evaluated and have a mental image of the correct performance of each component. They then must practice observing students performing the target motor skill, make judgments on the correctness of the performance of the components, and then receive feedback on the accuracy of their judgments. The major disadvantage in this process is the time required of the instructor to give individualized feedback to the teachers based upon their assessment judgments. Previous research has shown that many physical educators are not being adequately trained in qualitative assessment (Lounsbury & Coker, 2008). Veal (1988) reported that physical educators lacked both the content knowledge and skills

needed to measure achievement. Gallo, et al. (2006) found in their sample of 53 physical educators that major barriers to conducting assessments were conflicts with grading, time, and class size. Walkley and Kelly (1989) found in their sample of 27 preservice and 27 inservice teachers that on average they were only 63% accurate in assessing the qualitative performance of students throwing and catching. Finally, Behets (1996) concluded from his study of 40 preservice and 16 inservice teachers that both groups could benefit from special programs to enhance their observational skills.

Given the large number of motor skills physical educators are responsible for teaching, most assessment training focuses on teaching the concept of how to assess rather than actually training teachers to competently assess each of these skills (Kelly & Melograno, 2004). While students can learn the qualitative components of skills independently, they must have access to immediate feedback regarding the accuracy of their judgments. This can come from either an expert or other sources such as a video tape or DVR with an answer key to learn how to accurately judge these components (Stroot & Oslin, 1993). Assessment is traditionally taught using a group instructional method where the instructor shows a video of a child performing a skill, the students observe and record their assessment, and then the instructor reveals and discusses the correct assessment. Instructor time is a crucial element in training preservice physical education majors how to assess motor skills (Nielson & Beauchamp, 1992).

There is a wealth of evidence showing that computer-based instruction (CBI) based on behavioral learning principles, which was commonly referred to as computer assisted instruction (CAI) in the 1980's, can be as effective if not more effective than traditional teacher-directed instruction in teaching foundational knowledge skills (Jenks & Springer, 2002). Kulik and Kulik (1991) performed a meta analysis of 254 non-physical education studies involving CBI and found that CBI generally produced positive results (i.e., a moderate but significant effect size of 0.30) for all participants ranging in age from kindergarten through adult. Similar positive outcomes have been reported in two meta analyses in health education and on interactive video instruction. Cohen and Dacanay (1992) compared 47 studies in health professions and found CBI generally superior (medium effect size of 0.41) to other conventional methods of instruction. McNeil and Nelson (1991) reviewed 63 studies involving interactive video instruction and cognitive achievement and found an overall mean effect size of 0.530. Physical educators can be trained using this media and in fact the use of CBI was as effective (Kerns, 1989; Williams & Tannehill, 1999) and in some cases more effective than traditional teacher directed instruction (Walkley & Kelly, 1989). The problem with the technology used in these early studies was that it was unique and expensive. Each application was implemented on a component system built around a unique computer, interactive laser video player, graphic card, touch screen, and software program. In order for the application to be used by others the entire system had to be duplicated which made it prohibitively expensive to bring to scale. Over the years the speed and memory capacity of computers has continued to increase. As a result, it is now possible to develop an interactive video application employing streaming video that can be supported on a host server and used by anyone who has access

to a computer with internet access.

Given the recent advances in web-based technology and the previous evidence on the effectiveness of CBI, the purpose of this study was to evaluate the effectiveness of a web-based interactive video assessment program, called the Motor Skill Assessment Program (MSAP), in training preservice physical education majors how to assess the motor skill of kicking. This study replicated the research design used by Walkley and Kelly (1989) with the exception that it used two versions of MSAP. The two MSAP applications were compared to the traditional teacher-directed (TD) training approach and a no-training (NT) group which served as a control. Two versions of MSAP were used to control for user access and time. One MSAP group had access and control of all the MSAP program options, but could only use the program during the same three hour block that the TD and NT groups received their training. The second MSAP group was given the same access and control as the first MSAP group but was given a week to use the program when it was convenient for them for a maximum of three hours. The null hypothesis was that there would be no significant differences between the four group's post-training motor assessment scores. The MSAP was developed based upon behavioral and adult learning theory and used the instructional design created by Kelly, Walkley, & Tarrant (1988) for creating an interactive videodisc application that was modified to take advantage of the recent advances in web-based technology.

Method

Sample

Participants for this study were 72 preservice physical education majors attending a university in the northeastern United States. Participants were recruited via an invitation e-mail that was sent to their department and then distributed to all the physical education majors. Majors interested in participating were informed when and where to meet for the study.

Instrumentation

MSAP was designed to provide individualized assessment training and was the primary intervention used in this study. MSAP was a web-based application that could be accessed by anyone via the internet that had the appropriate URL, account, and password. The program had three main options: Tutorial, Guided Practice, and Competency Assessment. The Tutorial was designed to teach the participant the focal points of the skill. For the purposes of this study, kicking a stationary ball as defined in Everyone CAN (Kelly et al., 2010) was used as the skill. In the tutorial the participants were taught the focal points of the skill and then shown video clips of the correct performance of each focal point to learn and develop a mental image of exactly how each focal point should be performed. The tutorial also provided video clips of common errors that participants might see when assessing each focal point. The guided practice option allowed the participants to practice assessing video clips. Under the guided practice option, participants could view a given clip an unlimited number of times and in either real speed or slow motion before entering their assessment. After they entered their assessment, the program provided immediate feedback on the accuracy of their assessment of each focal point, gave an explanation of the correct assessment, and the option to

view the clip again to see their errors. After every five practice clips the participants were provided a report that summarized their overall performance as well as their performance by focal point. Suggestions were then provided based on their performance of how to maximize the efficiency of their remaining practice. A dedicated pool of clips was used for the guided practice option and five clips were selected at random for each practice set. The competency assessment option allowed the participants to evaluate their ability to assess under conditions similar to assessing in the schools. Under this option, the participants were shown 10 clips of students performing the target skill. They could only view each of these clips three times and only in real speed. After 10 clips were evaluated, they were provided summative information regarding their competency. For this study, the competency assessment served as the post-test for all conditions and could only be taken once by each participant at the end of their treatment. The clips used in the competency assessment were the same clips used in the pre-assessment.

The design of MSAP was based on behavioral and adult learning theory. Behavioral learning theory was used because it was determined to be the best match between the nature of the content to be learned (i.e., foundational knowledge involving learning facts, paired associations, discrimination, and associations) and the strengths of this theoretical approach (Jonassen, 1991; Smith & Ragan, 1993). This match can be illustrated by applying the basic principles of operant conditioning (i.e., the relationship between antecedents, operant responses, and consequences) to shaping the learner's ability to observe the correct performance of the focal points of motor skills. For example, the focal points of the skill are defined and shown to the learner in the tutorial part of the program (i.e., antecedent cues). The learners then observe a student performing the skill and make a response by indicating whether they think the student performed a given focal point correctly or not (i.e., operant responses). The program then provides them immediate feedback on their response, either reinforcing their judgment if they were correct or providing them corrective feedback if they were incorrect (i.e., consequences). Adult learning theory proposes that adults have different learning needs than children and accumulate knowledge and skills best when they play an active role in the process and have choices in the learning process (Cercone, 2008). The most cited adult learning theory is "Andragogy" developed by Knowles (1968). Andragogy outlines five assumptions for designing instructional applications for adult learners: (1) adults are independent, self-directed and desire autonomy over their learning, (2) adults bring a wealth of experience which can enhance their ability to learn, (3) their readiness to learn is related to changing social roles, (4) their orientation to learning is problem-centered and based on immediate application of knowledge, and (5) they are internally motivated to learn (Knowles, 1968; 1980; Merriman, 1987; 2001). MSAP was designed to capitalize on the strengths of both of these theoretical approaches by engaging the learner individually not only by presenting the content in a highly motivating fashion (e.g., use of video clips) and providing immediate feedback to their judgments but by also providing the learner control over the pace (e.g., how much time they have to review the definitions of the focal points or how many times or at what speed they watch the

performance before making a judgment) and the learning sequence (e.g., the ability to move back and forth between the program options). This user control operationalizes what Skinner (1968) described as the role of the learner. The learner "does not passively absorb knowledge from the world around him but must play an active role" (p.5) ... "learning by doing emphasizes the response; learning from experience, the occasion upon which the response occurs; and learning by trial and error, the consequences" (p.8).

Procedures

When the participants arrived at the designated time and place for the study, they read and signed an IRB consent form and then were randomly assigned to one of four groups. Each group was then taken to a separate classroom where their treatment was explained and implemented. The four treatment conditions were: Teacher-Directed (TD), Web-based with Time constraint (WT), Web-based with No Time constraint (WN), and No-Training (NT). At the start of each condition, the participants completed a pre-assessment and a 10-item survey. The pre-assessment involved watching and evaluating 10 video clips of students kicking. The 10 item survey collected descriptive information about the sample's education and experience in physical education related to assessment. After completing the pre-assessment and survey, the intervention was applied

The TD group received three hours of group instruction on how to assess kicking using the same behavioral learning principles used in the MSAP program. They followed the same sequence and viewed the same video clips as the web-based groups (e.g., tutorial, guided practice, competency assessment). The only difference was that movement through the program options was controlled by one of the investigators who served as the teacher and guided instruction based upon the group's performance. For example, the investigator would show the video for the correct performance of one of the focal points and then ask the group if they were ready to move on or would they like to see the video again.

The WT and WN groups were given access to the MSAP program and were allowed to use the program independently. The only difference between these two groups was that the WT was taken to a computer lab and given only three hours (i.e., time constrained to match the TD group) to use the program while the WN group was encouraged to use the program for approximately three hours but was allowed to use the program when they wanted for one week (i.e., no time constraint). One of the potential advantages of web-based instruction is that students can choose when it is optimal for them to learn. The WN group was added to evaluate the impact of not constraining when the students used the program, which was the case for the WT group.

The NT group was used to control for the participants learning about the concept of qualitative assessment. The participants in this group attended a three hour lecture that focused on why teachers needed to be competent in qualitative assessment. During this session the participants reviewed and discussed two articles on qualitative assessment and viewed some sample video clips of students kicking to illustrate the assessment process, but were not provided any training or practice on how to actually assess the focal points of the kick.

After each group completed their assigned treatment, they

completed a post-test evaluation. The post-test was the same as the pre-test and involved evaluating the same 10 clips of students kicking.

Data Collection

Pre and post assessment data were collected using the Everyone CAN (Kelly et al., 2010) motor skill assessment item for kicking a stationary ball. This item consisted of eight focal points that defined the key components of the skill each of which was rated on a binary scale (1 or 0) depending upon whether the focal point was correctly performed or not. Since the kick assessment item was composed of eight focal points and there were a total of 10 clips in the pre and post assessments, the maximum score that could be achieved on each test was a score of 80. The participants' scores were calculated by dividing the number of focal points assessed correctly by 80 and then multiplying the quotient by 100. The pre and post assessments for the WT and WN groups were administered by MSAP and the data were captured and recorded electronically. For the NT and TD groups the pre and post assessments were conducted in the treatment groups by one of the investigators. For these groups the MSAP competency assessment program was used with a ceiling mounted projector in each classroom to display the video clips. The participants watched the clips in their respective groups and recorded their individual responses for each clip on paper and pencil score sheets.

A pre and post assessment accuracy score was calculated for each participant by comparing their ratings against the criterion ratings assigned to each clip by a panel of five motor assessment experts. The criterion assessment was created prior to the study by having the panel of experts independently rate each of the clips using repeated slow-motion and real speed analysis. The results were then compiled, viewed, and discussed with the experts. After the review the experts were asked to rate the clips again which produced an over agreement of 98% for the clips.

Data Analysis

Descriptive statistics were calculated for all variables included in the study. The post-assessment performance of the four groups was analyzed by one-way fixed effects ANCOVA using the pre-assessment scores as the covariate. Tukey post hoc tests were used to interpret a significant main effect for group and the Cohen d statistic was calculated to determine effect sizes. An alpha level of .05 was used for all statistical analyses.

Results

Descriptive characteristics of the sample are shown in Table 1. All of the participants reported they were majoring in physical education with 71 reporting they were pursuing their bachelor's degree and one reported pursuing a master's degree. Participants were asked several questions to describe their experience related to teaching and using technology. With regard to the number of hours of teaching experience, 27.8% reported 0-20 hours, 13.9% reported 21-50 hours, 45.8% reported 51-100 hours, and 12.5% reported more than 100 hours. When asked about the number of hours of formal training in assessment, 29.2% reported none, 44.4% reported 1-10 hours, 18.1% reported 11-25 hours, and 8.3% reported more than 25 hours. When asked how important the

participants felt it was for physical educators to be competent in assessing, 15.3% said it was important and 84.7% said it was very important. When asked how competent they felt they currently were in assessing, 1.4% reported they were not competent, 38.9% reported they were somewhat competent, 15.3% reported they were unsure, and 44.4% reported they were competent. In terms of their comfort level using technology, 1.4% reported not being comfortable, 13.9% reported being somewhat comfortable, 5.6% were unsure, 45.8% were comfortable, and 33.3% were very comfortable. When asked about their preference for learning new skills via a computer, 18.1% reported low, 16.7% reported unsure, 47.2% reported high, and 18.1% very high.

Table 1. Sample Descriptive Characteristics

Age	Years of college completed				Gender	
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Ranges	Freq. (%)	# Years	Freq. (%)	Option	Freq. (%)	
18-20	24 (33.3)	1	6 (8.3)	Male	38 (52.8)	
21-23	41 (56.9)	2	16 (22.2)	Female	34 (47.2)	
24-26	1 (1.4)	3	30 (41.7)			
27-29	3 (4.2)	4+	20 (27.7)			
30+	3 (4.2)					
Totals	72		72		72	

Pre and post training assessment accuracy scores were obtained for all participants. Table 2 shows the group (NT, TD, WT, WN) pre and post assessment performance means and standard deviations. The hypothesis tested was that there was no significant difference between groups on their motor skill post assessment accuracy scores. Even though the participants were randomly assigned to groups, pre-assessment scores were used as a covariate to control for any potential differences on the pre-assessment performance and adjusted post means were used to interpret the results of the statistical analyses. A one-way fixed effects analysis of covariance was applied to the participants' post assessment scores.

Table 2. Pre and Post Mean (Standard Deviation) Unadjusted Assessment Accuracy Scores by Treatment Group

Group	N	Pre	Post
No-Training	18	57.50 (4.40)	58.22 (5.45)
Teacher-Directed	20	57.40 (4.55)	59.50 (4.98)
Web-Timed Constraint	17	58.06 (5.77)	62.76 (5.14)
Web-No Time Constraint	17	58.82 (4.75)	62.63 (6.01)

Results of the ANCOVA revealed a significant main effect for group: $F(3,66) = 2.80, p = 0.047$. To determine which groups differed significantly from each other, Tukey post hoc tests were employed on the adjusted post assessment means of the groups. Post hoc results of the Tukey analyses, shown in Table 3, revealed that the WT group (adj. mean = 62.75) was significantly better than the NT group (adj. mean = 58.39; $d = 0.82$) but not different from either the TD group (adj. mean = 59.71; $d = 0.60$) or the WN group (adj. Mean = 62.32; $d = 0.08$). The WN group (adj. Mean = 62.32) also performed significantly better than the NT group (adj.

mean = 58.39; $d = 0.68$) but not different from the TD group (adj. mean = 59.71; $d = 0.47$). The results also revealed that there was no significant difference between the NT (adj. mean = 58.39) and TD (adj. mean = 59.71) groups, $d = 0.25$.

Table 3. Post Hoc Tests Comparing Treatment Group Adjusted Means

Mean Differences (Significance)				
	No-Training	Teacher-Directed	Web-Timed	Web-Not Timed
Adjusted Means	58.39	59.71	62.75	62.32
No-Training	-----	-1.31 (.44)	-4.36 (.015)*	-3.88 (.033)*
Teacher-Directed			-3.04 (.079)	-2.57 (.146)
Web-Timed				0.476 (.793)
Web-Not timed				-----

*Significant ($p < .05$)

Discussion

The present results indicate that the use of the web-based treatments resulted in significantly greater assessment competency gains than the NT condition ($ES = .82$ and $.68$ respectively for WT and WN groups) and approached significance when comparing the web-based timed ($p = .079$, $ES = .60$) and the web-based untimed ($p = .146$, $ES = .47$) conditions to the teacher-directed approach. Given the known limitations related to instructor time in the teacher-directed approach (Nielson & Beauchamp, 1992) and the access advantages of web-based training this is an important finding. Knowing that preservice students can learn as effectively, if not more effectively given the magnitude of the effect sizes, would support that web-based training via MSAP is a viable way to address the development of assessment competency in preservice students.

The medium to large (i.e., $0.47 - 0.82$) effect sizes found for the web-based groups in this study are also consistent with the findings reported in previous meta analyses on CBI in non-physical education applications. Small to medium effect sizes documenting the superiority of CBI have been reported by Kulik and Kulik (1991) $ES = 0.30$, Cohen and Dacanay (1992) $ES = 0.41$, and McNeil and Nelson (1991) $ES = 0.53$. The current findings are also consistent with previous research using CBI in physical education (Walkley & Kelly, 1989) and non-computer based assessment training (Gangstead & Beveridge, 1984; Morrison & Harrison, 1985; Morrison & Reeve, 1986, 1988; Neilsen & Beauchamp, 1992; Wilkinson, 1996) that have shown that generally specialized training leads to improvement in teachers' ability to qualitatively assess and/or detect errors in motor skills.

While significant, the current results should still be interpreted cautiously due to the small performance gains achieved by the participants in the treatment groups. It is important to note that the goal of the treatment phase of this study was not to train the students to full competency, but to evaluate the effectiveness of the different treatments over a specified period of time. Based upon previous research (Walkley & Kelly, 1989) it was shown that teachers made measureable gains in assessment competency after 2-5 hours of training using a computer assisted training program

that focused on throwing and catching. The current study limited the amount of time the students had to develop their competency to approximately three hours. For three of the groups (TD, WT, NT) the investigators terminated the training after three hours. For the WN group, that was allowed to use MSAP independently, they were asked to use the program for only three hours. Within this three hour time period, all the students also had to read and agree to the IRB consent agreement, take the pre-assessment test, complete the demographic survey, and take the post-assessment evaluation. In addition, the two web-based groups had to learn how to use and navigate around the MSAP program, learn the process of qualitative assessing, and develop competency in assessing the kick. Additional research is therefore warranted to determine the amount of time needed to train students to an established competency level (e.g., 80%) using this web-based application. Research is also needed to investigate how much time is spent learning to use MSAP versus the time needed to understand the assessment process and then develop competency in assessing the motor skill being learned.

Given the number and scope of skills physical educators need to develop competency in assessing, web-based instruction offers many potential advantages over traditional teacher-directed training. Some of these advantages are: 1) it is available 24/7 when it is convenient for the learner; 2) it can provide the learner with controls over both the rate and in many cases the path of instruction; 3) it can provide both immediate formative feedback after each trial as well as summative feedback across practice trials; 4) it can be performed in a environment compatible with the learners needs; and 5) it can automatically collect and manage the performance data of the learners. Given these advantages, equivocal results found in this study between web-based instruction and traditional teacher directed instruction actually favors web-based instruction. Web-based instructional applications appear to offer the potential for the delivery of relatively low cost assessment training applications that can be easily accessed by both preservice and inservice teachers via the internet. Additional research is warranted to evaluate the effectiveness of this medium with additional motor skills controlling for skill complexity and skill type (e.g., locomotor, body management, physical fitness). Additional research is also needed to investigate the degree to which competency developed with web-based training transfers to assessing students in actual teaching settings.

Given the current economic constraints being placed on state and local governments and the subsequent impact on public schools and universities, there is likely to be an even greater emphasis in the future on developing and implementing various forms of computer-based distance education courses and programs. Using technology may initially appear to be a quick fix for this problem, but comes with a host of challenges (Pepi & Scheurman, 1996; Silverman, 1997; Van Dusen & Worthen, 1995). While this movement will hopefully stimulate the development of innovative electronic teaching applications, it is imperative that we field evaluate and validate these new tools to ensure quality control over future preservice and inservice instruction provided online. The development and validation of applications like MSAP is a promising first step in addressing these emerging needs.

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