

OBSERVATIONAL LEARNING OF FLY CASTING USING TRADITIONAL AND VIRTUAL MODELING WITH AND WITHOUT AUTHORITY FIGURE¹

MICHAEL W. KERNODLE, ROBERT N. MCKETHAN, AND ERIK RABINOWITZ

Appalachian State University

Summary.—Traditional and virtual modeling were compared during learning of a multiple degree-of-freedom skill (fly casting) to assess the effect of the presence or absence of an authority figure on observational learning via virtual modeling. Participants were randomly assigned to one of four groups: Virtual Modeling with an authority figure present (VM-A) ($n = 16$), Virtual Modeling without an authority figure (VM-NA) ($n = 16$), Traditional Instruction ($n = 17$), and Control ($n = 19$). Results showed significant between-group differences on Form and Skill Acquisition scores. Except for one instance, all three learning procedures resulted in significant learning of fly casting. Virtual modeling with or without an authority figure present was as effective as traditional instruction; however, learning without an authority figure was less effective with regard to Accuracy scores.

Approaches to instruction involving systematic computer applications began in the 1970s as a tool for educators in a wide variety of disciplines. In a short time, educators had developed a variety of instructional applications (Wresch, 1984). Instructions using these tools were often labeled as Computer Assisted Instruction or Computer Managed Instruction. These tools were limited by the computer capabilities of the time and consequently, by today's standards, were limited and rudimentary. In the 1990s, Computer Assisted Instruction was renamed Virtual Learning Environments and the internet-based technologies (Wilson, 1996) are called Virtual Learning Environments or Learning Management Systems. Characteristics of virtual learning are widely varied, depending upon the needs of the educator (Weller, Pegler & Mason, 2005). Functional descriptions describe these technologies as instructional tools in which learners and tutors participate in online interactions of diverse kinds including online learning. For the purposes of this study, the Virtual Learning Environment consisted of a Virtual Modeling module consisting of directions, video, and hyperlinked text to replicate the traditional model used to teach the fly-casting skill.

There is little information about the effective use of a model or observational learning of motor skills using virtual modeling; however, early Computer Assisted Instruction research suggested that virtual modeling may result in an effective learning experience. Several studies (e.g., Hosinski, 1966;

¹Address correspondence to M. W. Kernodle, Ph.D., Appalachian State University, ASU Box 32071, Boone, NC 28608-2071 or e-mail (Kernodlemw@appstate.edu).

Kerns, 1989; Walkley & Kelly, 1989; Adams, Kandt, Throgmartin, & Wal-drop, 1991) found no significant differences when comparing Computer Assisted Instruction with the traditional teacher-directed method of instruction, suggesting that Computer Assisted Instruction is an effective alternative to the teacher-directed method of instruction. Kulik and Kulik (1986) found that Computer Assisted Instruction reduced the required amount of instructional time, supporting Hosinski (1966) who found that traditional classroom procedures required twice the instructional class time. According to Walkley and Kelly (1989), an interactive qualitative assessment training program was as effective as a teacher-directed approach for the overhand throw and superior to the teacher-directed approach for the catch.

Observational Learning

Modeling, observational learning, and demonstration are terms frequently used interchangeably. Modeling can be defined as utilizing a demonstration that provides information relative to skilled performance, and observational learning can occur by observing the performance of the skill. Magill (1993) and McCullagh (1993) showed that the use of a model effectively enhances the observational learning of motor skills. Whiting, Bijlard, and den Brinker (1987) used a motion analysis system to measure the kinematic effects of providing a model when learning a skiing-simulation task. They found that performance was enhanced for those who viewed a model compared to those who did not. In addition, Magill and Schoenfelder-Zohdi (1996) suggested that the use of a model is most effective when acquiring a new pattern of coordination. Al-Abood, Davids, and Bennett (2001) examined the underarm dart throw using three groups. One group watched a point-light display, one group watched a video, and the control group did not see a demonstration. Only the control group failed to adopt the correct form.

Much of the initial information dealing with modeling or observational learning supports Bandura's (1969) social learning theory, suggesting that acquisition of action patterns is mediated by a common concept-matching process. This approach suggests that motor learning involves the construction of a conceptual representation that provides the internal model for response production, serving as the standard for response execution. The conceptual representation is constructed by transforming observed sequences of behavior into symbolic codes that are cognitively rehearsed to increase the probability of retention. Although most researchers agree that modeling or observation could positively affect learning, for some Bandura's theory does not completely explain how learners acquire skills through observation; research is needed on the information available within a demonstration (e.g., Newell, Morris, & Scully, 1985). In addition, some suggest (Scully & Newell, 1985; Scully, 1986, 1987; Horn & Williams, 2004) that a more effective method

would be an action-pattern variant parameters that movement characteristics derived by several researchers attaching light emitting diodes to demonstrate a specific movement to observers who only see the movement (Scully, 1973) showed that people can discern different gait patterns. Scully (1986) found that the most important factor in the ratio of the time of the upper to lower leg.

The results of the observational learning study involved in the movement patterns of a model and the observational learning. In a study by Scully (1986) should be provided evidence about the relative motion of the model and the learner. *Form Versus Skill Acquisition*

Feltz (1982b) used a study to find that form (movement) effects than movement effects. Quantitative methods were used to observe observational modeling dynamics (form), but not modeling and control. Wiese-Bjornstal and Wiese (1986) used an overhand softball throw of five practice trials. They found that form kinematics as they related to the outcome. A meta-analysis of observational modeling dynamics (form), particularly in discrete tasks. Concluding the form of a movement.

The results of other studies (Scully, 1986) found that a conceptual model produced better performance outcome as a model produced better

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would be an action-perception approach, in which observers perceived in-
variant parameters that identified the movement pattern and not specific
movement characteristics. The basis for this approach was information gath-
ered by several researchers utilizing point-light technology, which consists of
attaching light emitting diodes to the joints of a person who is filmed while
demonstrating a specific movement pattern. The film is then replayed for
observers who only see the pattern of the lights. Early results (Johansson,
1973) showed that people observing only the point-light display could dis-
cern different gait patterns such as walking and running. Hoenkamp (1978)
found that the most important characteristic for identifying gait patterns was
the ratio of the time duration between the forward and return swings of the
lower leg.

The results of these studies suggested that the most critical aspect of
observational learning is the invariant relationship among the components
involved in the movement. However, in a more recent article, Hodges, Wil-
liams, Hayes, and Breslin (2007) proposed that the motions of the end effec-
tors of a model and the task constraints are the mitigating factors in obser-
vational learning. In addition, they suggested that end-point information
should be provided early in the learning process followed by information
about the relative motion of the body as practice continues.

Form Versus Skill Acquisition

Feltz (1982b) used qualitative measures and a Bachman ladder task and
found that form (movement dynamics) provided a better indication of mod-
eling effects than movement outcomes. McCullagh and Little (1989) utilized
quantitative methods with the same task and found that participants exposed
to observational modeling exhibited a superior approximation of movement
dynamics (form), but found no statistically significant differences between
modeling and control conditions for measures of movement outcome.
Wiese-Bjornstal and Weiss (1992) examined the effects of practicing the un-
derhand softball throw when viewing a model prior to each of four blocks
of five practice trials. They found an improved correspondence of the model
to form kinematics as trials increased, but no differences in performance out-
come. A meta-analysis by Ashford, Davids, and Bennett (2006) found that
observational modeling is particularly effective for the acquisition of move-
ment dynamics (form), but less successful for movement outcome, particu-
larly in discrete tasks. Observational learning may be more effective in learn-
ing the form of a movement as opposed to producing an outcome.

The results of other research are somewhat contradictory. McCullagh
(1986) found that a control group seeing no model could reach the same per-
formance outcome as a group seeing a model, but did not exhibit the appro-
priate form. Sidaway and Hand (1993) also discovered that the use of a
model produced better outcome scores.

Authority Figure

Another area of interest was to examine the effect of having an authority figure present during the virtual learning process. Barker, Frisbie, and Patrick (1989) suggested that interactions between instructor and student strengthen the effectiveness of distance learning. McCleary and Egan (1989) found that an on-site facilitator increased the effectiveness of instruction, and Wiesener (1983) indicated that distance learning requires high motivation, which is often a result of contact with an instructor. In contrast, McKethan, Kernodle, Brantz, and Fischer (2003) found no significant performance gains when undergraduate physical education majors attempted to become more proficient in qualitative analysis of the overhand throw using computer assisted learning without an authority figure present. Thus, there is no conclusive evidence suggesting the need for an authority figure in the computer assisted learning environment. In addition, none of these studies were attempted in a virtual learning environment.

The purposes of this study were to compare traditional and virtual modeling when learning a multiple degree-of-freedom skill (fly casting), and evaluate the effects of the presence or absence of an authority figure on observational learning with virtual modeling.

METHOD

Participants

Sixty-eight undergraduate university students (ages 18 to 21 years) volunteered to participate. Participants were randomly assigned to one of the following four groups: Traditional Instruction ($n=17$), Virtual Modeling without an authority figure (VM-NA) ($n=16$), Virtual Modeling with an authority figure (VM-A) ($n=16$), and Control ($n=19$). All participants taking part in this investigation signed consent forms and were treated in accordance with the "Ethical Principles of Psychologists and Code of Conduct" (American Psychological Association, 1992).

Apparatus and Software

The apparatus and software for the virtual modeling and instruction via virtual monitoring consisted of laptop computers, earphones, and virtual modeling instructional software. Since the virtual treatment was an interactive process of receiving instruction and practicing the fly cast, the computers were placed in the rear of the fly-casting stations so that subjects were physically and visually isolated from others receiving information or practicing the fly-casting skill. The virtual environment was designed to replicate the learning environment utilized for the group receiving traditional instruction.

Unprocessed video of the model was recorded on a MiniDV tape in a digital format using a Canon ZR 30 video camcorder. The camera was placed

at a 45° angle to the 1 of the casting motion. tem was used to capt with a lapel micropho shoe of the ZR 30 cam

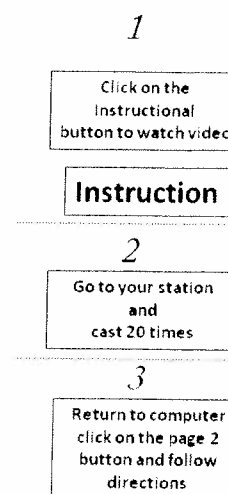


FIG.

The virtual model Sum Total ToolBook / screen (see Fig. 1) included the following directions: These directions: main area of the screen to view a pop-up of t filled the entire screen. consisted of four direction were arranged on the screen, the names of th casting skill were listed skill cue. Each skill cu when clicked, allowed audio. An exit button lower right side of Scre practice, all casts for ac

Pilot Study

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The camera was placed

at a 45° angle to the model at a distance of 30 feet to allow for a wide view of the casting motion. An Azden WLX-PRO, On-Camera VHF wireless system was used to capture verbal instructions. The model wore a transmitter with a lapel microphone and the wireless receiver was attached to the hot shoe of the ZR 30 camcorder.

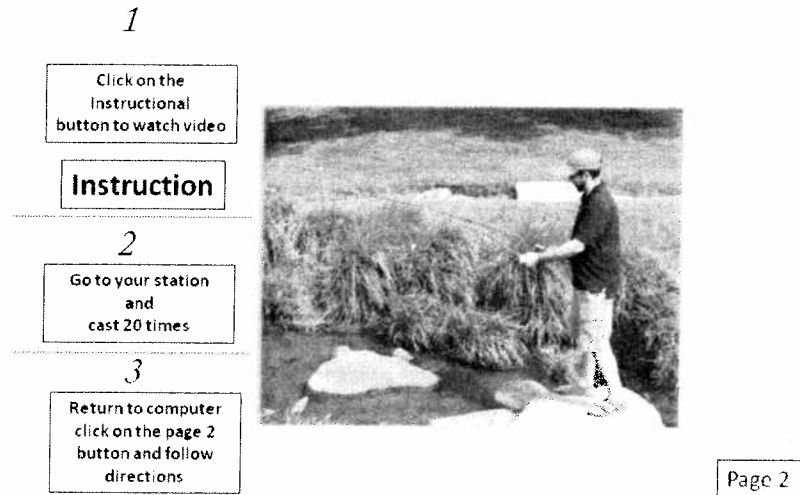


FIG. 1. Video instruction for fly-casting skill

The virtual modeling environment for this project was created using Sum Total ToolBook Assistant and was displayed on two screens. The first screen (see Fig. 1) included a sequence of directions for the participant to follow. These directions were arranged on the left side of the screen with the main area of the screen left blank. The participant first clicked on a button to view a pop-up of the model performing the entire skill sequence that filled the entire screen. The second page of the instructional software consisted of four direction sequences. Similar to the first screen, the directions were arranged on the left side of the screen. In the main portion of the screen, the names of the nine skill cues (see Fig. 2) that comprised the fly-casting skill were listed. A text description was located to the right of each skill cue. Each skill cue name functioned as an interactive trigger which, when clicked, allowed for a viewing of the model performing the skill with audio. An exit button and a button back to page one were located in the lower right side of Screen 2. Following interactive instruction and fly-casting practice, all casts for accuracy were recorded using the MiniDV.

Pilot Study

A pilot study was conducted to refine the project procedures such as

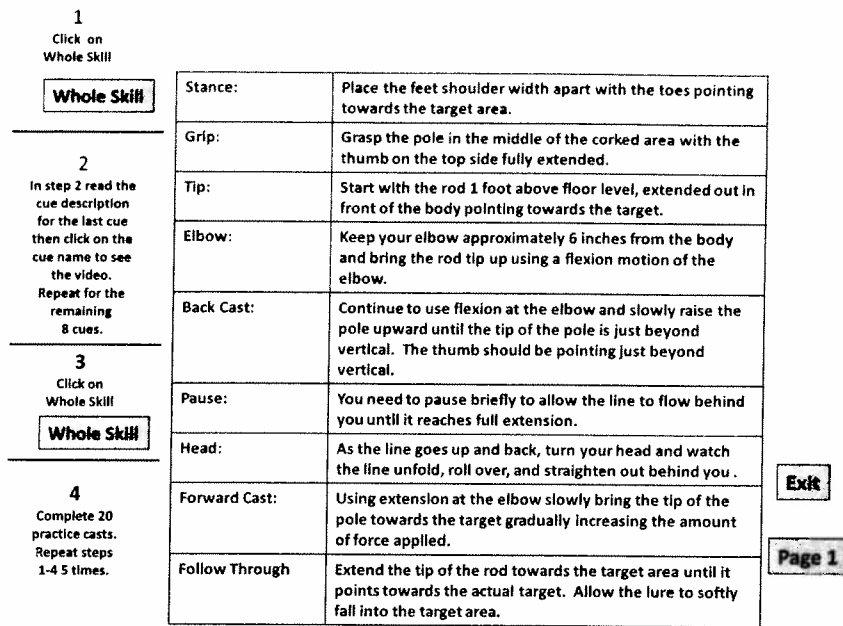


Fig. 2. Sequence of cues for skill learning

effective placement of the cameras, software functionality, on-site training for the model to become proficient with the introduction and modeling segments, and the arrangement of equipment. In order to achieve an acceptable interrater reliability coefficient, the observers scored 10 randomly selected test trials from videos acquired during the pilot study. A reliability coefficient was then tabulated and differences in the scoring measures were discussed. This procedure continued until the coefficient reached or exceeded .80. Prior to the scoring of the Skill Acquisition test trials, the observers established an interrater reliability of .88.

Procedure

On Day 1, the research team met separately with each group of participants to familiarize them with the environment and provide instructions explaining the experiment. Participants were then pretested by attempting 10 trials with the goal of casting a macromea lure into the center of a hula hoop located 35 feet directly in front of the casting position in a large indoor arena. This distance was selected after conversations with fly-casting experts who stated that 35 feet was considered an appropriate distance for the requirements of this study. Following the pretest the VM-A, VM-NA, and Traditional groups were provided an orientation to fly-fishing by a casting expert, excluding the cues and actual mechanics of the cast. Both Virtual

Modeling groups received instruction, while the Traditional expert. The fly-casting the live orientation, with

On Days 2-6, the formation. Each participant their own isolated virtual computer screen. The a physical presence appropriate procedure was to only information provided virtual model of the entire whole-part-whole needed as a whole, then narrating and explaining view the skill performance clicked on the cue for ing each part. Following casts and returned to the 80 casts were completed

Participants were in Traditional group viewed followed by the model describing cues, and ending by Modeling groups, this sequence completed and the participants received no treatment attention test with no intervention participants were allowed trials.

Measures

Each test trial was scored of 1 (inside) or 0 (outside inside the target). Therefore, in addition, an expert fly teaching observed video Likert-type scale to score 7: Excellent). To obtain grounds in teaching, video served video replay of based upon adherence to ment sessions. A score re

Modeling groups received this information via a virtual learning environment, while the Traditional group received the information directly from the expert. The fly-casting expert had been provided a script and trained until the live orientation, without notes, was the same as the virtual orientation.

On Days 2-6, the participants in all three groups received the same information. Each participant in the virtual Modeling groups was directed to their own isolated virtual learning station to observe the model on a 17" computer screen. The authority figure moved among the stations to establish a physical presence among the participants in the VM-A group. The appropriate procedure was taped to the table next to each computer. This was the only information provided to these two groups. Each participant viewed the virtual model of the expert demonstrating and explaining the fly cast using the whole-part-whole method. Participants initially viewed the skill performed as a whole, then navigated to a screen that showed the model demonstrating and explaining the nine sequential casting cues, and returned to view the skill performed as a whole. As illustrated in Fig. 2, participants clicked on the cue for each part and were able to view the model performing each part. Following the treatment, participants completed 20 practice casts and returned to the computer station. This sequence continued until 80 casts were completed (four sets of practice trials).

Participants were then tested on the last 10 trials (Trials 81-90). The Traditional group viewed a live model demonstrating the skill as a whole, followed by the model demonstrating and explaining the nine sequential casting cues, and ending by performing the skill as a whole. As with the Virtual Modeling groups, this sequence continued until 80 practice trials were completed and the participants were tested on Trials 81-90. The Control group received no treatment and was tested on 10 trials for scoring each day. A retention test with no intervention occurred five days after Day 6, whereby all participants were allowed five warm-up trials and then tested on the next 10 trials.

Measures

Each test trial was evaluated utilizing three measures. An Accuracy score of 1 (inside) or 0 (outside) was earned based upon whether the lure stayed inside the target. Therefore, scores ranging from 0 to 10 were possible. In addition, an expert fly fisherman with 10 years of on-site fly-fishing and teaching observed video replay of each participant's test trials and used a Likert-type scale to score each trial on the Form of the cast (1: Very poor to 7: Excellent). To obtain a Skill Acquisition score, two observers with backgrounds in teaching, video and qualitative analysis, as well as fly-fishing, observed video replay of each participant's test trials and scored each cast based upon adherence to the nine sequential cues provided during the treatment sessions. A score ranging from 0 to 9 could be achieved.

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RESULTS

SPSS Version 14 was utilized to compile statistical information. Means and standard deviations for Accuracy, Form, and Skill Acquisition are shown in Table 1. Analysis of variance confirmed no significant differences between groups on the pretest for Accuracy ($F=.24$, ns), Form ($F=.99$, ns), or Skill Acquisition scores ($F=1.14$, ns). Following this validity check, each of the dependent variables was examined using a 4×7 mixed design analysis of variance, with treatment as a between-subjects variable (3 experimental groups and 1 control group) and time as a within-subjects variable (a pretest, intermediate tests on 5 days throughout training, and a retention test). The sphericity assumption was not met, so a Huynh-Feldt correction was applied.

There were significant differences among groups for all dependent variables: Accuracy ($F_{3,65}=11.93$, $p<.0001$, $ES=.36$), Form ($F_{3,65}=21.48$, $p<.0001$, $ES=.51$), and Skill Acquisition ($F_{3,65}=15.47$, $p<.0001$, $ES=.42$). Bonferroni *post hoc* comparisons showed that all experimental groups differed from the Control group on all three dependent measures ($p<.05$ for the difference between the VM-A group and the Control group on Accuracy, and $p<.0001$ for all other group comparisons).

There were significant main effects of time for all dependent variables: Accuracy ($F_{6,390}=19.01$, $p=.0001$, $ES=.23$), Form ($F_{6,375}=67.69$, $p=.0001$, $ES=.51$), and Skill Acquisition ($F_{6,390}=45.58$, $p=.0001$, $ES=.41$). Repeated contrasts between adjacent days showed that the greatest performance gains on Accuracy were between Days 1 (pretest) and 2 ($F=20.79$, $p<.0001$, $ES=.24$), and Days 2 and 3 ($F=12.19$, $p<.001$, $ES=.16$). The greatest performance gains on Form were between Days 1 (pretest) and 2 ($F=94.79$, $p<.0001$, $ES=.60$), Days 2 and 3 ($F=30.06$, $p<.0001$, $ES=.32$), and Days 5 and 6 (posttest; $F=7.65$, $p=.007$, $ES=.11$). The greatest performance gains on Skill Acquisition were between Days 1 (pretest) and 2 ($F=36.14$, $p<.0001$, $ES=.36$) and Days 2 and 3 ($F=10.06$, $p=.002$, $ES=.13$). No other adjacent comparisons were statistically significant. No statistically significant differences were found between Days 6 (posttest) and 7 (retention test) for any of the groups on any of the dependent variables.

Statistically significant interactions between treatment and time were found for all dependent variables: Accuracy ($F_{17,359}=2.60$, $p=.001$, $ES=.11$), Form ($F_{12,256}=2.46$, $p=.004$, $ES=.11$), and Skill Acquisition ($F_{15,327}=3.69$, $p<.0001$, $ES=.15$). For Accuracy and Form, the interaction was such that the Traditional group experienced more gains across time than the two Virtual Modeling groups, whose scores seemed to reach asymptote earlier. For Skill Acquisition, the nature of the interaction was more complex but seemed to be, in large part, influenced by the dramatic gains achieved by the VM-NA group between Days 3 and 5.

TABLE 1
MEAN GROUP AND TASK

	Pretest	Day 2	Day 3	Day 4	Day 5	Posttest	Retention
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	Pretest		Day 2		Day 3		Day 4		Day 5		Posttest		Retention	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Accuracy														
VM-A	0.12	0.49	0.82	1.19	1.18	1.24	1.88	2.42	2.24	3.27	2.29	3.00	2.88	3.18
VM-NA	0.06	0.25	1.75	2.35	2.63	2.25	2.50	2.48	2.88	2.90	2.94	2.46	3.38	3.22
Traditional	0.18	0.52	1.47	2.32	3.53	2.88	3.59	3.12	3.82	2.94	4.06	2.79	4.12	2.87
Control	0.16	0.38	0.11	0.31	0.16	0.50	0.47	0.84	0.21	0.63	0.21	0.63	0.42	0.90
Form														
VM-A	2.37	0.90	3.33	0.70	3.48	0.69	3.85	0.81	3.86	0.96	4.08	0.83	4.15	0.99
VM-NA	2.24	0.94	3.30	0.70	3.67	0.73	3.55	0.65	3.83	0.85	3.93	0.80	3.79	0.55
Traditional	2.29	0.69	3.26	0.83	3.99	0.83	4.00	0.77	4.09	0.77	4.46	0.58	4.22	0.47
Control	1.96	0.62	2.33	0.56	2.73	0.81	2.77	0.42	2.77	0.45	2.89	0.51	2.65	0.48
Skill Acquisition														
VM-A	5.75	0.86	7.27	0.75	7.17	1.29	7.32	1.10	7.08	1.36	7.53	1.02	7.61	1.19
VM-NA	5.48	1.03	6.42	1.38	6.57	1.24	7.68	1.09	8.08	0.65	7.78	1.06	7.96	0.74
Traditional	5.66	1.17	5.66	0.90	7.71	1.09	7.58	1.03	7.63	0.92	7.81	0.88	7.94	0.78
Control	5.20	1.07	5.66	1.02	5.95	0.92	5.57	1.42	5.79	1.25	6.08	1.28	6.25	1.02

DISCUSSION

The overall main effect indicated that the three groups seeing a model showed significant increases in performance and learning on all dependent variables, while the Control group showed no significant increases for any dependent variable. These results are consistent with Feltz (1982a), McCullagh and Little (1989), Wiese-Bjornstal and Weiss (1992) and Ashford, *et al.* (2006). The comparisons of VM-A and Traditional groups suggest that observational learning via virtual modeling can produce positive results with regards to outcomes which are similar to those found by Sidaway and Hand (1993) and McCullagh (1986). This study found learning effects for the attainment of form in a serial skill, which adds to Ashford, *et al.*'s (2006) findings that observational modeling is particularly effective for the acquisition of form. In addition, Ashford, *et al.* (2006) reported less success for accuracy on a discrete task, while this study yielded similar findings on the fly-casting task for the Control and VM-A groups.

The presence of an authority figure (i.e., VM-A vs VM-NA) had no effect on groups' performance. This supports the findings of McKethan, *et al.* (2003) but is contrary to Barker, *et al.* (1989), McCleary and Egan (1989), and Wiesener (1983). However, the VM-A group scored significantly lower on Accuracy scores compared to the Traditional group.

In this study, virtual modeling provided an effective observational learning environment for the relatively complex skill of fly casting. This is contrary to Wiseman's (2006) suggestion that for a student to become proficient in a motor skill, interaction of the student with a teacher is crucial, and motor skill learning is compromised by an online instruction format due to the lack of teacher and/or feedback. In fact, virtual modeling was just as effective as traditional modeling in learning fly casting, and the presence of an authority figure was not necessary to gains in performance or learning. The results suggest that for all three experimental groups, significant performance gains on all dependent variables occurred during the first 190 trials and were maintained throughout the remainder of the trials. Also, all three groups showed significant performance gains on Form between trials 370 and 460, suggesting a performance plateau.

Educational Implications

The results of this study have implications in a number of areas including the sports-related instruction taught at all levels of public school physical education. In addition, the results may affect the way in which some traditional core physical activity programs are delivered in colleges and universities. Observational learning of motor skills may add alternative methods for public school education. Virtual schools are a recognized provider delivered either by state departments or education vendors contracted by state Depart-

ments of Education.² different from those physical education is included as a component education delivered in tive, the results of this and observational learning lead to a healthier life

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eltz (1982a), McCullagh
2) and Ashford, *et al.*
groups suggest that ob-
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ments of Education.² The curricular requirements for virtual schools are not different from those of traditional counterparts. In many states, a unit of physical education is a requirement for graduation, and physical education is included as a component of the virtual school curriculum. Although physical education delivered in a virtual school may never create an identical alternative, the results of this study suggest that students can use virtual modeling and observational learning to become competent in many skills that could lead to a healthier lifestyle which includes regular physical activity.

Many K-12 physical educators make some curricular choices based on their own perceived competencies, and consequently, K-12 students may not have access to basic instruction of some skills. Nontraditional education, including homeschooling, could benefit from curricula offered via virtual modeling embedded in web-based instruction. However, in order to make more definitive claims regarding the efficacy of virtual modeling in educational programs, additional research is needed. With the trends towards a lack of physical activity, and with obesity approaching epidemic proportions, the potential benefits of virtual modeling should be further examined. One possible example may be to examine the effects of a self-determined practice schedule, since this may be a normal procedure for learners in many virtual environments.

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