

# The Engineering of Sport 6

Volume 3  
Developments for  
Innovation



Edited by  
Eckehard Fozzy Moritz  
Steve Haake

 Springer

# The Effects of Multimedia Computer-Assisted Instruction on Middle School Students' Volleyball Performance

Nicholas Vernadakis<sup>1</sup>, Eleni Zetou<sup>1</sup>, Andreas Avgerinos<sup>1</sup>, Maria Giannousi<sup>1</sup> and Efthimis Kioumourtzoglou<sup>1</sup>

<sup>1</sup> Democritus University of Thrace, Department of Physical Education and Sport Science

**Abstract.** The purpose of this study was to examine the effect of multimedia computer - assisted instruction (MCAI), traditional instruction (TI), and mixed instruction (MI) methods on learning the skill of setting in Volleyball. Forty-eight middle school students of seventh and eighth grade were randomly assigned into three teaching method groups: TI, MCAI and MI. Each group received ten 40-min periods of instruction divided into 3 sections: a) 5 min warm-up, b) 30-min main practice time and c) 5-min cool down and review. TI group participants experienced the setting ability through a series of progressive skills accompanied with drill and repetition of practice presented by an instructor. The MCAI group experienced the setting ability through a series of progressive skills accompanied with drill and repetition of practice presented by a multimedia program. The mixed group experienced the same procedure, practicing through the multimedia program as well as through traditional instruction. All students completed pre-, post-, and retention skill test. Two-way analysis of variances (ANOVA), with repeated measures on the last factor, were conducted to determine effect of method groups (TI, MCAI, MI) and measures (pre-test, post-test, re-test ) on skill test. Post-test results indicated no significant differences between the groups concerning the skill test. Retention test results showed that groups retained the skill learning. However, the mixed method of instruction tended to be the most effective for skill development.

## 1 Introduction

Research on multimedia and related instructional technologies over the past years has been characterized by inconsistent findings about their effects on learning. There are many studies reporting that MCAI can have a positive impact on learning. A meta-analysis by Liao (1998), for example, examined 35 studies and concluded that MCAI is superior to traditional instruction. However, it is notable that 10 of these 35 studies showed the opposite, namely, that traditional instruction is superior to multimedia. A subsequent meta-analysis of 46 studies (Liao, 1999) confirmed the overall positive effect of MCAI on student achievement, but found that it largely depends on what type of instruction it is being compared with. Similar results have been reported by Wiemeyer, (2003), who reviewed nine meta-analyses of earlier and different

multimedia issues and suggested that multimedia learning can be more effective and efficient than traditional learning. But this effect depends on many factors like the features of the learners, the teachers, the learning stuff, the type of learning, the features of the study, etc. Further, a meta-analysis of 167 studies (Bernard, Abrami, Lou, Borokhovski, Wade, Wozney, Wallet, Fiset and Binru Huang, 2004) concluded that a very weak learning advantage for multimedia in empirical studies is based on uncontrolled instructional methods.

Since most of the reported research findings comparing MCAI with the TI approaches have demonstrated increased learning in the cognitive domain. Only few studies have been conducted to determine if MCAI improve motor learning in the area of physical education. Vernadakis, Zetou, Antoniou, and Kioumourtzoglou (2002) reported that MCAI is a functional method in teaching the skill of volleyball setting to children aged 12 – 14 year old and is as effective as traditional teaching. In another study Wilkinson, Hillier, Padfield, and Harrison (1999) found that junior high school girls in both classes (TI and MCAI) significantly improved in their knowledge of volleyball rules and in performance of most skills (pass, set, and underhand serve) during the 16-day unit.

The effectiveness of physical education software on student achievement has yet to be determined especially through the use of the newer multimedia programs. In this study an attempt was made to compare three different instructional methods by means of the skill test scores, obtained from three groups of middle school students. The tests assessed the learning of the setting skill in volleyball. The research questions of this study was the following: a. Do students, on average, report differently on skill test using the TI, the MCAI and the MI teaching approaches? b. Do students, on average, report differently on skill test for the pre-test, post-test and re-test measurements? c. Do the differences in means for skill test between the TI, MCAI and MI teaching method groups vary between the pre-test, post-test and re-test measurements?

## **2 Method**

### **2.1 Participants**

Forty-eight (n=48) middle school students (25 girls and 23 boys) of seventh and eighth grade, 12-14 years of age (M=13, S.D. =1.01), selected for this study by random sampling method, enrolled in the volleyball course. Participants were randomly assigned to one of the three different teaching methods: TI (9 girls and 7 boys), MI (8 girls and 8 boys) and MCAI (8 girls and 8 boys) creating three independent groups of 16 students.

### **2.2 Software**

A multimedia program was created and programmed in Asymetrix ToolBook to administer experimental events including 163 screens; 5 screens were introductory, 1 was main menu, 48 were information, 40 were practice, 57 were feedback, and 12 were help. Material for the multimedia application was taken from a volleyball

coaching textbook (American Sport Education Program, 2001) and modified for this study. The application consisted of four sections: a) history, b) rules, court and player's position, c) skill fundamentals, and d) skill exercises. Two choices menus, one for the termination of the program and one for help, were also included at the bottom of the screen and were always available. The help menu contained a description of the active picture-buttons and suggestions for the program use. The program started with an introductory video of international volleyball federation (FIVB). The main menu with four active picture-buttons which serve as links to the other sections of the program followed.

The first two major sections addressed basic knowledge of the volleyball game pertaining to vocabulary used, history of the game, rules, court dimensions, names of positions, and rotating positions. The skill fundamental and skill exercise sections introduced basic setting skills and exercises for practical work in terms and levels that were appropriated for beginning volleyball players. A step by step instructional format that was accompanied by an exceptional graphic and video simulation depicting proper form of setting skill at different stage was included in these sections. A discussion of possible errors, what causes these errors, and what may be done to correct these errors was provided in the description of setting skill. When the user had seen enough of the setting skill, he could supplement a short quiz (multiple choices, true/false) regarding the technique and concepts that were presented. Audio was used to explain each action and give execution cues to help focus the attention of the user. The user navigated through the sections from the menu that appeared on each screen. At the end of the program, a screen with the title of the program, the names of the author and the institution were presented.

### 2.3 Skill Test

The AAHPER volleyball skills test (Strand and Wilson 1993) was used to evaluate setting ability in volleyball. Scorer, timer, tosser for passing and setting, and student assistants to retrieve and set ball were needed for the successful completion of the test. Testing stations were prepared as shown in figure 1.

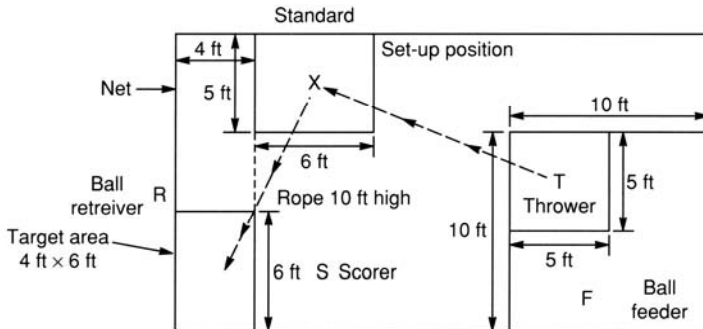


Fig. 1. Court markings for the AAHPER Volleyball Setting Test.

To begin, a thrower in a tossing area, tossed high passes to a student in the set-up zone. The receiver sets the ball over the rope into the scoring zone. Ten trials were

given to the right and 10 to the left. Balls that touch the rope, the net, or hit outside the scoring zone earned no point. One point was awarded for each set that lands in the marked scoring zones. The final score was the total points for 20 trials.

## 2.4 Procedure

When the multimedia program was developed, the researchers gave it to an instructional technology specialist, a subject-area expert, and three subject-area teachers for evaluation. Researchers revised and improved the multimedia application according to the feedback received from those experts.

The skill test was administered on the first day of the experiment to measure participant's baseline performance on the selected setting skill. On the second day, ten 1.8 MHz Pentium III class computers equipped with a 17-inch color monitor, CD-ROM, soundcard and small headset, running Windows 2000 were set up in a blocked-off hallway adjacent to the gymnasium. Each computer had a volleyball skill CD-ROM created by the researchers. Before the experiment started, the MCAI and MI groups were given a 40-minute introductory session on how to use the multimedia application prepared for this study. Then the physical education instructor gave a 40-minute lecture to all participants introducing the unit of volleyball. Instruction, practice, and testing for this study were held on ten separate and successive weeks. Each group received ten 40-min periods of instruction divided into 3 sections: a) 5 min warm-up, b) 30-min main practice time and c) 5-min cool down and review.

The TI group received a series of progressive skills, performed in drill format, accompanied by verbal feedback in the form of positive reinforcement. They were allowed to work alone or with a partner. The physical education instructor gave verbal instruction before every drill and knowledge performance every five trials during the 30-minute of practice time. Participants in the MCAI group were asked to learn the setting ability via the multimedia program. They were allowed to work independently or with a partner. The instructor was present for organization and management supervision only. No verbal or visual reinforcement of any kind was offered by the instructor. The MI group followed the same procedure, while implementing both the multimedia program and the traditional instruction. In the first five weeks the students participated with the traditional method group, and the remaining weeks with the MCAI method group.

At the end of the treatment, the skill test that previously served as a pre-test was given to students as a post-test. One week later, the same procedure was repeated on the re-test to measure the level of retention in the selected setting skill. During the experiment, each group received an equal amount of instructional time and was provided with the same instructional materials and assignments.

## 2.5 Design

The experiment was a factorial design with teaching method groups (TI, MCAI and MI) and repeated measurements (pre-test, post-test and re-test) as independent variables, and skill learning performance as dependent variable.

### 3 Results

Two-way analysis of variances (ANOVA), with repeated measures on the last factor, were conducted to determine effect of method groups (TI, MCAI, MI) and measures (pre-test, post-test, re-test) on skill test. A significant main effect was noted for the measurements,  $F(1,45) = 17.343, p < 0.05$ .

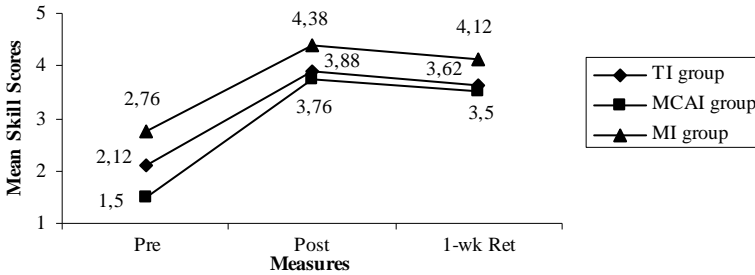


Fig. 2. The significant main effect for the measure on Skill Test

Difference and repeated contrasts were conducted to follow up the significant measurements main effect. Differences in mean rating of skill test in TI group were significantly different between pre-test and post-test,  $F(1,15) = 6.622, p < .05$  and between pre-test and re-test,  $F(1,15) = 6.818, p < 0.05$ . Differences in mean rating of skill test in MCAI group were significantly different between pre-test and post-test,  $F(1,15) = 6.106, p < .05$  and between pre-test and re-test,  $F(1,15) = 7.136, p < 0.05$ . Finally differences in mean rating of skill test in MI group were significantly different between pre-test and post-test,  $F(1,15) = 4.884, p < .05$  and between pre-test and re-test,  $F(1,15) = 4.233, p < 0.05$ . As shown in “Fig. 2”, the post-test and re-test skill scores were remarkably greater than pre-test skill scores for the three groups.

### 4 Discussion

Research on the effects of teaching in the skill test showed a significant increase in the performance for the three instructional method groups. This increase indicates that all the instructional methods used improved the skill execution of students, regarding the setting ability in volleyball. Previous studies report equal improvement in learning with TI, MCAI (Summers, Rinehart, Simpson, and Redlich 1999; Vernadakis et al. 2002) and MI method (Vernadakis, Antoniou, Zetou, and Kioumourtzoglou 2004). The re-test measurement used to evaluate the maintenance of learning one week after the end of the educational process, showed a reduction of performance in the skill test for the three instructional method groups, which was not significant. This result is in agreement with Antoniou, Derri, Kioumourtzoglou, and Mouroutsos (2003), who supports that in a multimedia program, the combination of video, text, sound and graphics facilitate the retention ability of information.

The effectiveness of MCAI method in teaching a motor skill may have been due to a number of factors. The first factor might be that the students could practice im-

mediately after seeing the skill on the CD-ROM. The researchers can only speculate that the worksheets provided for the MCAI group succeeded to bridge the images from the computer to the different environment. Other factors may be that students would physically imitate skills they saw on the screen. This ability to see skills over and over at the students' leisure seemed to be an advantage. Also, having the students work in pairs at the computer seemed to be helpful. Gros (2001) indicated social skill benefits occur from collaborative assignment to computer-based tasks.

In conclusion, according to the results of the present study, the MI method as a teaching aid tended to be the most effective teaching method for skill development of the setting ability in volleyball. However, these conclusions are limited for students aged 12 – 14 years old. More studies should be conducted to investigate the effect of MCAI in different ages and for various sport activities. Also, it is critical to continue researching into how students learn in different technological environments, since the researchers have only begun to explore the uses and practicality of MCAI.

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