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THE EFFECTIVENESS OF COMPUTER-ASSISTED INSTRUCTION ON TEACHING THE SKILL OF SETTING IN VOLLEYBALL

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SUMMARY

The purpose of this study was to determine the effect of computer-assisted instruction (CAI) on learning the skill of setting in volleyball. The participants were 32 high school students of first and second grade, aged 12-14yrs old, who were randomly assigned to one of two teaching method groups: a) traditional instruction (TI) and b) computer-assisted instruction. Each group received nine 40min periods of instruction, on successive separate days. The subjects in the TI group experienced the skill of setting through a series of progressive skills accompanied with drill and repetition of practice which were presented by an instructor. The CAI group experienced the skill of setting through a series of progressive skills accompanied with drill and repetition of practice which were presented by a multimedia program. At the beginning and at the end of this study the groups were given a 10-item multiple-choice knowledge test and a skill test. The results indicate that there were no significant differences between the TI and CAI groups with regards to the knowledge and skill tests. The results suggest that using multimedia technology as a teaching aid is as effective and as profitable at teaching skills as the traditional method.

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INTRODUCTION

The educational technology era has arrived accompanied by major changes in both education and technology. Technological innovations and applications are becoming apparent in many facets of the education professions and as Gross (1995) suggested then, technology was set to continue to change rapidly in the following 10-15yrs. School technology became a big business in an attempt to provide the necessary technology to link schools and colleges to the information highway (West, 1995; 1996).

According to administrators' and faculty opinion, computers and instructional educational technology have a positive impact on the quality of teaching and research (Lehmann et al, 1999). Students indicate that the availability of electronic information has been helpful

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ABBREVIATIONS:
CAI computer-assisted instruction
TI traditional instruction

KEY WORDS:
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motor skill
multimedia technology
setting in volleyball
traditional instruction

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in their work (Goggin et al, 1997). Thus, there is agreement among colleagues and students that technology can be a useful tool for a successful teaching and learning environment. Research into the cost of instruction delivered via computer software, distance learning and teleconferencing, indicates that savings (i.e. in money, resources or time) are often achieved with no loss of effectiveness and may even broaden the learning environment (Castellan, 1993).

Future education and training need proper tools that are able to overcome space, time and performance demands. Such demands are highlighted by the increasing geographical distribution of education and training centres, the need for a continuous updating in technology-related information and the learning effectiveness provided by the integrated use of multiple forms of information. Such tools can be developed by the use of multimedia communication systems for educational and training purposes (Papandreou and Adamopoulos, 1998).

Computer-assisted instruction (CAI) is likely to grow in the next few years, as an outcome of the utilisation of technology in physical education. In their work, Mohnsen and her colleagues (Mohnsen, 1995; Mohnsen and Thompson, 1994-5; Mohnsen et al, 1996; Ross, 1994; McLean, 1996) reviewed a good number of CAI programs, providing phone numbers or URLs for retrieving the programs. Other studies suggest that CAI is a useful tool for disciplinary knowledge (e.g. Physics of Sports), sport activity (e.g. Volleyball Complete) and fitness (e.g. MacHeart Monitor), while there are also instructional uses of virtual reality (e.g. Virtual Racquetball Game) for teaching physical education (Silverman, 1997).

Although the use of CAI is growing, the research on the topic in the area of physical education is very limited (Gregger and Metzler, 1992). CAI can provide tailored instruction to an unlimited number of students on an individual basis. Given the move by many universities towards larger classes with integrated technology, multimedia instruction and interactive tutorials provide a convenient means to augment classroom instruction (Goggin et al, 1997). Specifically with interactive multimedia tutorials, a single faculty member could teach multiple, large sections of a course while providing convenient and tailored instruction for individual students. Students are likely to respond to the augmented instruction with greater interest,

comprehension and engagement. The software that is given to the instructor in order to monitor students, can manage data on student progress and the time spent on the program.

The professional literature provides evidence of the superiority of computer-based instruction over traditional education methods in terms of fostering higher order learning such as critical thinking and problem solving (Safrit et al, 1988; Bowman, 1995). For example, a health and fitness computer-based instruction simulation was found to improve the problem solving skills in undergraduate students at the Midwestern University (Safrit et al, 1988).

Other recent studies indicate that CAI is a viable and effective supplement to physical education instruction. These studies revealed that computer-assisted tutorials were as effective as TI in teaching motor skills (Steffen and Hansen, 1987; Ross, 1994; Summers et al, 1999) and knowledge learning (Kerns, 1989; Guthrie and McPherson, 1992; Deere et al, 1995; Nicol and Anderson 1999).

Since the majority of CAI research studies in a variety of academic areas reported significant improvements in cognitive learning, we considered it important to investigate whether CAI could facilitate learning in the motor skill domain. A multimedia program was designed to help students learn the skill of setting in volleyball as well as cognitive aspects of this specific sport activity.

The purpose of this study was to compare two different instructional methods by means of the skill test and knowledge test scores obtained from two groups of high school students. The tests assessed the learning of the setting skill in volleyball.

Method

Sample

Thirty-six high school students (17 girls and 15 boys) of first and second grade who were enrolled in the volleyball course and who were 12-14yrs of age (M=13) participated in this study. Subjects were randomly assigned to one of the two different teaching methods: TI and CAI. All subjects had no previous experience of learning the skill of setting in volleyball.

Procedure

Pilot Study. A pilot study was conducted to determine the reliability and validity of the knowledge test and the implementation of the software computer program in order to evaluate the effectiveness of the CAI. The subjects consisted of 16 third grade high school students. This population was chosen because these students had basic knowledge of setting in volleyball. For the pilot study subjects were given a two-class period of instruction and review about the setting skills in volleyball. The knowledge test was administered on the third day. This was a paper and pencil test consisting of 15 multiple-choice questions. The instruction took place in an indoor gymnasium in order to avoid complications associated with weather conditions.

Main Study. After the pilot study, a main study was conducted to compare the scores obtained by 32 first and second grade high school students for a skill test (Bradford and Rolayne, 1993) and a knowledge test. The experimental design consisted of a pre-test and a post-test, for both of the independent groups. Each subject was randomly assigned to one of two teaching method groups: a) TI and b) CAI. This created two independent groups of 16 subjects. Five Pentium II computers were used for the study. Instruction, practice and testing for this study were held on eight separate and successive weeks. The groups met for 40min, 2 times each week.

Traditional Instruction Method. The TI method incorporated a direct style of teaching. Subjects in the TI group received a series of progressive skills, performed in drill format, accompanied by verbal feedback in the form of positive reinforcement. Students were given verbal instruction for 15min and 15min of practice time following the formal instruction time. They were allowed to work alone or with a partner. The coach gave verbal instruction before every drill and knowledge performance every five trials during the 15min of practice time. There was a 10min warm-up at the beginning of the period and the remaining time of approximately 5min was for cool down and review.

Computer-Assisted Instruction Method. Subjects in the CAI group were allowed to work independently or with a partner. The students were given 15min of computer time on a Pentium II computer. A

multimedia program was developed for the purpose of this study which was based on hypertext, graphics, animation, media and video. The CAI program consisted of four topics, which corresponded precisely to theoretical and practical work. The students received 15min of physical practice time following the time spent on the computer. The practice session consisted of the same exercises which took place in the TI method. The instructor was present for organisation and management supervision only. The multimedia program offered verbal or visual instruction of any kind.

The pre-test scores used to determine initial setting ability in volleyball of each subject were obtained by calculating the mean of 20 trails prior to the beginning of class instruction. After 8 weeks, a post-test score measuring the setting ability in volleyball of all subjects was obtained by calculating the mean of 20 trails. The cognitive measurements were obtained from an 11-item, standardised knowledge test that was administered on the first and on the last day of the class instruction.

Measurements

Knowledge Test. The knowledge test for the pilot study consisted of a 15-item multiple-choice test. Questions that were included in the knowledge test fell into one of the following categories: i) six skill concepts and ii) nine general rules associated with the skill. Content validity for the knowledge test consisted of input from a panel of experts in volleyball coaching. An item analysis using the responses of the pilot study was conducted to determine the difficulty rating and index of discrimination (Kirkendall et al, 1980).

A listing of the results from the item analysis of the knowledge test in the pilot study can be found in Table 1. The pilot study knowledge test had a mean difficulty rating of 54%. When all the items were analysed, two questions, or 14% of the items, had unacceptable difficulty rating values. The pilot study knowledge test had a mean index of discrimination of 0.32. When all the items were analysed, three questions, or 21% of the items, yielded an unacceptable index of discrimination values. As indicated by the information in Table 1, five of the items were therefore deleted from the test for the main study.

TABLE 1: Means and standard deviations for pre- and post-test scores for the TI and CAI groups.

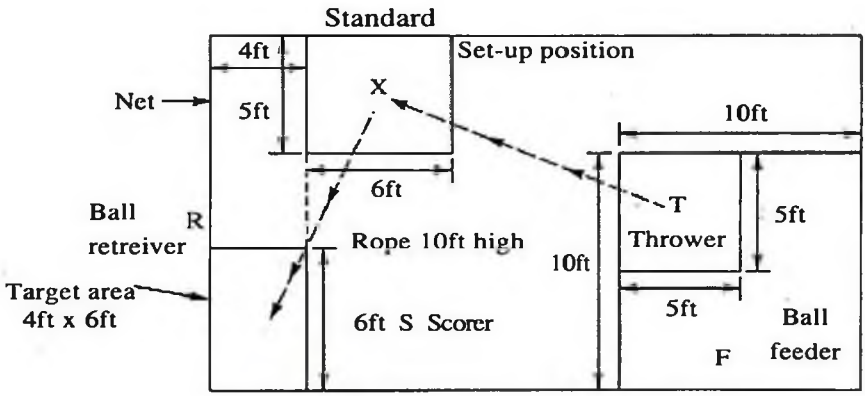
	Group	N	Mean	Std. Deviation
Knowledge Test 1st measurement	TI	16	8.88	1.50
	CAI	16	9.06	1.69
Knowledge Test 2nd measurement	TI	16	6.19	1.83
	CAI	16	5.25	2.14
Skill Test 1st measurement	TI	16	1.06	1.29
	CAI	16	0.75	1.24
Skill Test 2nd measurement	TI	16	1.94	1.98
	CAI	16	1.88	2.13

CAI: computer-assisted instruction.
TI: traditional instruction.

Skill Test. The AAHPER volleyball skills test (Bradford and Rolayne, 1993) was used to evaluate setting ability in volleyball. This skill test was appropriated for junior high school and senior high school students. A scorer, a timer, a tosser for passing and setting and student assistants were all needed for the successful completion of the test. Testing stations were prepared as shown in Figure 1. A rope was extended across the court 4ft from the net at a height of 10ft above the floor. A 5ft by 5ft tosser's zone was located near the back corner of the court. A 5ft by 6ft set-up zone was located near mid-court and next to the rope. A 4ft by 6ft scoring zone was located across the net near the sideline. An identical testing station was located on the other half of the same side court.

To begin, a thrower in the tossing area tossed high passes to a student in the set-up zone. The receiver set the ball over the rope into the scoring zone. Ten trials were given to the right and 10 to the left. Balls that touched the rope, the net or landed outside the scoring zone earned no points. One point was awarded for each set that landed in the marked scoring zones. The final score was the total points earned during the 20 trials.

FIGURE 1: Court marking for the AAHPER volleyball setting test.



Statistical Analysis. Homogeneity of variance was verified by the Box's Test. Initial differences between the two groups for the mean knowledge test scores were tested using one-way analysis of variance. Analyses of variances with repeated-measures on the last factor ANOVAs (2 x 2) were calculated to determine differences between groups and between measurements for knowledge and skill tests. Each variable was tested using an alpha level of significance of 0.05.

RESULTS

Means and standard deviation for the CAI and the TI groups in pre- and post-tests are presented in Table 1, while results of each analysis are presented separately below.

Knowledge Test

There were no significant initial differences between the two teaching method groups for the mean knowledge test scores ($F_{(2,30)}$=0.908, p>0.05). A significant main effect was noted for the measurement ($F_{(1,29)}$=84.227, p<0.05) but not for the group ($F_{(2,29)}$=0.466, p>0.05), while the interaction measure x group was also not significant ($F_{(2,29)}$=1.424, p>0.05). As shown in Figure 2, the post-test knowledge score was remarkably greater than the pre-test score for both groups.

Skill Test

No significant differences between the two teaching method groups were found for the pre-test mean skill scores ($F_{(2,30)}$=0.555, p>0.05). A significant main effect was noted for the measurement ($F_{(1,29)}$=16.279, p<0.05) but not for the group ($F_{(2,29)}$=0.039, p>0.05), while the interaction measure x group was also not significant ($F_{(2,29)}$=0.513, p>0.05). As shown in Figure 3, the post-test skill scores were remarkably greater than the pre-test skill scores for both groups.

FIGURE 2: The significant main effect for the measurement of the knowledge test, where the significant improvement of the groups is apparent.

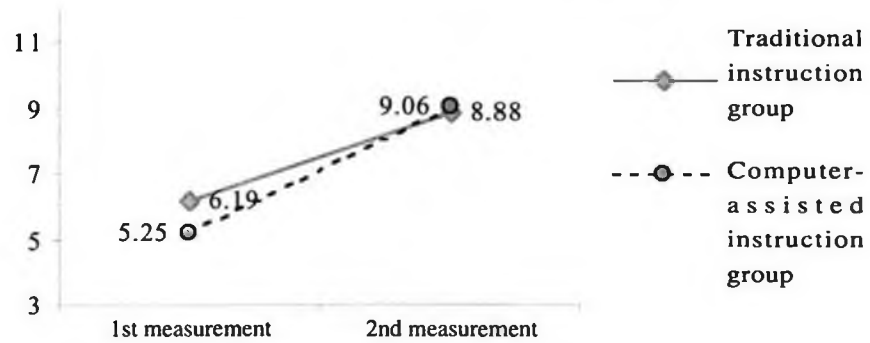
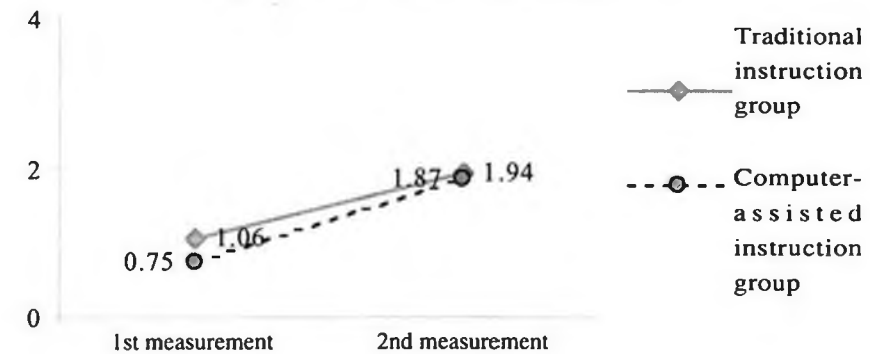


FIGURE 3: The significant main effect for the measurement of the skill test, where the significant improvement of the groups is apparent.



Discussion

The results of the present study indicate that CAI is a functional method in teaching the skill of volleyball setting to children aged 12-14yrs old and that it might be as effective as TI. The main finding is that both groups learned the rudimental elements of the setting skill in volleyball both in theory and in practice in the environment of the specific instruction methods. These results are in agreement with the findings of other studies (Steffen and Hansen, 1987; Kerns, 1989), that is, that CAI was designed to teach sport skills to college students as effectively as TI. However, the studies above focused on college students whereas the present study focused on high school students, that is the CAI method might also be effective in students of a younger age.

The significant improvement of the CAI group's knowledge test results highlights the contribution of information presented using a computer to knowledge gain. This is in agreement with Alvarez-Pons (1992) and Stein (1984) who claimed that rules, terminology and the basics of sports can be presented to students via computer programs. Additionally, the significant improvement of the above group's skill test results indicates that computer instructions might also be effective in teaching skill execution. Certainly, these results are limited to a simple skill, that is the setting volleyball skill which is examined in the present study. However, there are other relevant studies which support the claim that students can learn specific skills with the aid of a computer (Hathaway, 1984; Tsai and Pohl, 1977).

Improvements in knowledge and skill execution are apparent in both instructional method groups. These results coincide with a number of studies conducted in the field of education, which show that CAI, even though it does not surpass traditional teaching, is still as effective as TI (Lieber and Semmel, 1985; Schuelke and King, 1983). However, the introduction of computer systems into education has advantages over conventional instruction in terms of the instruction procedure and information transmission. Some of the advantages include the fact that information is presented in its most complete form; this information is reproduced in CAI by various means; training is geared towards the individual and there is speedy access to a large volume of information.

Since multimedia technology is as thriving and as effective an educational tool as TI, it can therefore handle the instruction of theoretical issues of physical education. Thus it offers an alternative solution releasing more time for exercise (Adams et al, 1989; Kerns, 1989). Nevertheless, to make such a form of instruction efficient, there are some other factors which must be determined, such as the quality of the programs, the reproduction systems and the learners' motives. The positive effect of the CAI method found in the present study might in part be due to the fact that the multimedia instruction program for the skill of setting in volleyball fulfills the conditions required for the effective transmission of the relevant information.

In conclusion, according to results of the present study, CAI is just as effective as TI for cognitive and motor learning of the setting skill in volleyball. However, these conclusions are limited to students aged 12-14yrs old. More research should be conducted to investigate the effect of CAI in different ages and for various sport activities. The development of more multimedia programs and the evaluation of their effectiveness should provide information about the application of the CAI method in schools and the academic curricula of physical education. In order to make this technology-assisted form of instruction a powerful educational tool, certain factors must be studied, such as the quality of the applications offered, the quality of the reproduction system, the content, the accessibility and the facilities.

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