

COMPARISON OF THREE DIFFERENT INSTRUCTIONAL METHODS ON TEACHING THE SKILL OF SHOOTING IN BASKETBALL

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SUMMARY

The purpose of this study was to determine the effect of traditional instruction (TI), computer - assisted instruction (CAI) and mixed instruction (MI) methods on learning the skill of shooting in basketball. The participants were 48 middle school students of seventh and eighth grade, aged 12-14 years old, who were randomly assigned into three teaching method groups: TI, CAI and MI. Each group received ten 45min periods of instruction. A 10-item multiple-choice knowledge test and a skill test were utilised to measure learning. The result indicated: a) all the instructional groups performed similarly with significant learning from pre-test to post-test, b) there were no significant differences between the groups concerning the knowledge and skill test, c) the mixed method as a teaching aid tended to be the most effective for cognitive learning and skill development. However, no significant differences were indicated between methods of instruction on this particular shooting ability.

INTRODUCTION

Technology is a popular issue in higher education and will continue to play a major role during the next century (Goggin et al, 1997). Many institutions are devoting time and resources to its development with a view toward enhanced educational effectiveness. Data in 1995 suggested that 20% to 30% of instructors are using some form of instructional technology in higher education course delivery, having computers as basic tools (Ward, 1994).

Similarly, physical education instructors are using computers when performing management or administrative responsibilities. Software programs have been developed to assist the physical education instructor in taking attendance, grading, tests and handouts, making nutritional analyses and wellness reports, developing fitness norms and keeping

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ABBREVIATIONS:

CAI computer-assisted instruction
MI mixed instruction
TI traditional instruction

KEY WORDS:

basketball shooting
instructional technology
motor skill
multimedia application
traditional instruction

REPRINTS:

prices on request from

*Teviot-Kimpton Publications
8A Randolph Crescent
Edinburgh EH3 7TH
United Kingdom
Fax: (+44) 131 538 2821
E-Mail: teviotscientific@aol.com*

track of inventory (Hurwitz, 1985; Silverman, 1997). In addition, computers have been used in cognitive instruction of students by the use of drill and practice software programs, thus freeing the instructor to spend more time with other students needing additional help in physical education (Cicciarella, 1983; Lynch et al, 2001). The computer has also been used to help develop skills of problem solving, decision-making and an understanding of the concepts of sequence, logic and efficiency (Hurwitz, 1985; Bazillion and Braun, 1998). All of the preceding uses of the computer have involved assisting the instructor to develop the cognitive and effective areas of an individual. One of the areas lacking in research as well as in software availability are computer programs to assist in the development of a physical skill.

Major instructional uses of computers in schools during the last few years were computer-assisted instruction (McKethan et al, 2001). The term, computer-assisted instruction (CAI), refers to the interaction of a learner with a computer in a direct instructional role. CAI addresses course content in a variety of formats, with or without the direction of a teacher (Lockard et al, 1997). CAI programs allow students to progress at an individual rate, keep them actively involved, provide immediate feedback and reinforcement and maximise success while minimising failure. Most importantly computers and CAI are accepted as instructional tools by the students, thus creating a positive motivational environment, which is important in learning process (Beichner, 1994; Upton, 2001).

Computer-assisted instruction effectiveness is well documented in other academic areas, but little research has been conducted in physical education (Adams and Waldrop, 1985). However, the study that does show significance to this investigation was conducted by Steffen and Hansen (1987). The purposes of their study were to compare psychomotor and cognitive bowling skills following traditional and CAI methods with 90 students enrolled in college bowling classes. Results of the bowling scores were significantly higher for the CAI group. However, no significant differences were found between the groups in cognitive test scores. The CAI group tended to have a more favorable perception of their instructional process than did the traditional instruction group (TI).

Another recent research in physical education examined the volleyball skills of 69 junior high school girls in response to using a

volleyball CD during a 16-day volleyball unit. Two 9th grade classes taught by the same teacher were selected. Students took pre and post skills tests and written tests covering rules and strategy of the game. Game play was videotaped during the tournament, and successful and unsuccessful trials were recorded. Results showed that all students in both classes significantly improved in the following: forearm pass, set, and underhand serve. The treatment class had significantly higher gain scores in the forearm pass. In game play there were significantly more successful passes/serve, sets/serve, and total contacts/serve for the treatment class. The treatment class attempted more sets in game play. Survey results revealed that the majority of the treatment class felt that using the CD helped improve their motor and cognitive skills (Wilkinson et al, 1999).

Vernadakis et al (2002) reported that using multimedia technology as a teaching aid was effective and profitable in teaching skills as the traditional method. The researchers investigated the effect of TI and CAI method on learning the skills of setting in volleyball. Participants were 32 middle school students of seventh and eighth grade, aged 12-14 years old. The result indicated that all the instructional groups performed similarly with significant learning from pre-test to post-test and there were no significant differences between the groups concerning the knowledge and skill test.

Research on student learning in physical education is somewhat sparse (Wandzilak et al, 1994), even though the student learning experience continues to be recognised as a fertile ground for research in other academic disciplines (Breen and Lindsay, 1999). There are few studies that specifically address the learning of knowledge or skills in physical education through the use of the newer CAI programs. It may be that CAI method is more effective than TI and mixed instruction method (MI). Investigations might also find that it is no more effective than TI and MI methods.

Therefore, the purpose of this study was to compare three different instructional methods by means of the skill test and knowledge test scores, obtained from three groups of middle school students. The tests assessed the learning of the shooting skill in basketball. More specifically, the study was conducted to explore the following research questions:

1. Should one or more items on knowledge test be deleted or revised to obtain a better measure of shooting skill in basketball?
2. Do students, on average, report differently on knowledge and skill test using the TI, the CAI and the MI teaching approaches?
3. Do students, on average, report differently on knowledge and skill test for the pre-test, post-test and re-test measurements?
4. Do the differences in means for knowledge and skill test between the TI, CAI and MI teaching method groups vary between the pre-test, post-test and re-test measurements?

METHOD

Participants

To obtain permission for conducting the field experiment, the researchers contacted local middle schools in a northern city of Greece. All school principals expressed their willingness to participate. The private school Dellasal of Thessaloniki, having an indoor gymnasium and essential network equipment, was chosen for the experiment. 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 basketball course. Participants were randomly assigned to one of the three different teaching methods: TI, MI and CAI creating three independent groups of 16 students. All participants had no formal training on learning the skills of shooting in basketball. Prior to group assignments, participants were orientated to the purpose of the study and participant requirements. Following the orientation, informed consent was obtained from each participant.

Apparatus

Hardware. Ten 800 MHz Pentium III class computers equipped with a 17-inch color monitor, cd-rom, hard disk drive, soundcard and small headset, running Windows 98 were used.

Software. A CAI program was created and programmed in Asymetrix ToolBook to administer experimental events including 159 screens; 6 screens were introductory, 1 was main menu, 51 were information, 32 were practice, 60 were feedback, and 9 were help. Material for the multimedia application was taken from a basketball shooting textbook (Burrall and Patrick, 2001) and modified for this study. The application consisted of five topics: a) court and player's

position, b) history, c) rules, d) skill fundamentals and e) skill exercises. The first three major topics addressed basic knowledge of the basketball game pertaining to vocabulary used, history of the game, rules, court dimensions, and names of positions.

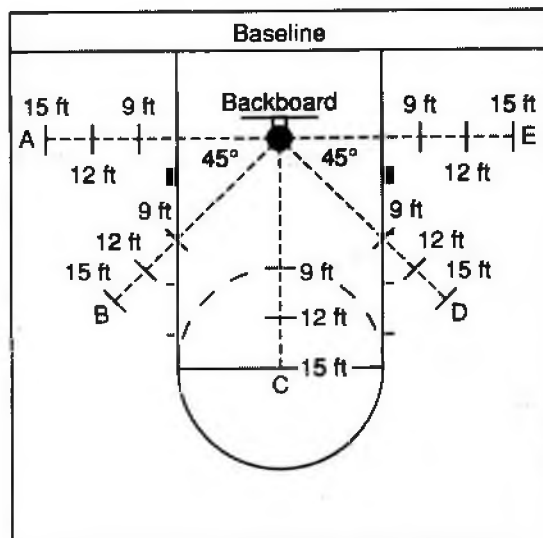
The skill fundamental and skill exercise topics introduced basic shooting skills and exercises for practical work in terms and levels that were appropriated for beginning basketball players. The CAI program included the use of text, sound, pictures, animated vector images, graphics and video. The video presented professional basketball players performing the shooting skills. Each skill was demonstrated several times and was shown from different angles. Close-up shots revealed the details of important points such as hand or foot position. Audio was used to explain each action and give execution cues to help focus the attention of the user. The user navigated through the topics from the menu that appeared on each screen. At the end of the program, a quiz was given that contained multiple-choice questions on the material.

Knowledge Test. The knowledge test for the pilot study consisted of a 14-item multiple-choice test. Questions included in the knowledge test fell into one of the following categories: a) nine skill concepts and b) five general rules associated with the skills. Content validity for the knowledge test consisted of input from a panel of experts in basketball teaching and coaching. An item analysis using the responses of the pilot study was conducted to determine the difficulty rating and index of discrimination (Green and Salkind, 2003). In determining the internal consistency of the knowledge test, the alpha reliability method was used. This method was based on inter-item correlation coefficients for all test questions.

Skill Test. The AAHPERD basketball test (Strand and Wilson, 1993) was used to evaluate the shooting ability in basketball. This skill test was appropriated for middle school and high school students. One tester was needed for the successful completion of the test. Testing stations were prepared as shown in figure 1. Five markers, from which students had to shoot, were placed on the floor. Students shot from 12-foot marks. Shooting spots A and E were measured from the middle of the backboard; those for B, C and D were measured from the center of the basket. Each shooting spot marker was 2 feet long and 1 inch wide.

During the test, the student had basketball in hand, stood behind

FIGURE 1: Court marking for the AAHPERD Basketball test.



the shooting spots. On the “ready, go” signal, the student shoots, retrieves the ball, dribbles to another spot and shoots again. The student must attempt at least one shot from each of the five spots and must have at least one foot behind the marker on each shot. Four lay-up shots may be attempted, but not two in succession. The student continues the attempt to score until “stop” is called. All students had three trials of 60 seconds each; the first trial was a practice trial.

Two points were awarded for each shot made, either a shot from behind the shooting mark or a lay-up. One point was awarded for any unsuccessful shot that hits the rim from above, either initially or after rebounding from the backboard. No points were awarded if a shot was preceded by a ball-handling infraction. If two lay-ups occurred in succession, the second got no points. Only four lay-ups were attempted; any lay-up in excess of four scored as zero. Failure to attempt shots from all designated shooting spots voided a trial. Voided trials had to be repeated. The test score was obtained by totaling the two trials.

Procedure

When the CAI 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.

A pilot study was followed to determine the reliability and validity of the knowledge test. Participants consisted of 24 seventh and eighth grade middle school students. This population was chosen to keep the pilot study similar to the main study regarding participant's age. The method of instruction used for the pilot study was TI, which incorporated a direct style of teaching such as lectures, demonstrations, teacher questions and student questions. Participants were given two 45-minute class periods of instruction and review concerning the shooting skills in basketball. This was done to take into account the fact that participants had not received formal instruction pertaining to this particular skill for almost one year. The knowledge test was administered on the third day on a paper and pencil test consisting of 14 multiple-choice questions. The instruction took place in an indoor gymnasium in order to avoid complications associated with weather conditions.

After the pilot study, a main study was conducted to compare the scores obtained by 48 seventh and eighth grade middle school students for a skill test (Strand and Wilson, 1993) and a knowledge test. The experimental design consisted of a pre-test, a post-test and a re-test for the three of the independent groups. The knowledge test was administered on the first day and the skill test was given on the second day to measure participant's baseline performance on the selected shooting skills. Procedures for the knowledge test were the same as the pilot test. There were four fewer questions, reducing the number of questions to ten.

On the third day, ten computers were set up in a blocked-off hallway adjacent to the gymnasium. Each computer had a basketball skill CD-ROM created by the researchers. Computers were separated as much as possible to create individual workstations. Before the experiment started, the CAI and MI groups were given a 45-minute introductory session on how to use the multimedia application program prepared for this study. Then the physical education instructor gave a 45-minute lecture to all participants introducing the unit of basketball.

Instruction, practice, and testing for this study were held on ten separate and successive weeks. The groups met for 45-minute, 2 times each week in an indoor gymnasium.

The TI method incorporated a direct style of teaching including lectures, demonstrations, teacher questions and student questions. Participants 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 15-minute as well as 15-minute of practice time following the formal instruction time. 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 15-minute of practice time. There were 10-minute of warm-up at the beginning of the period and the remaining time of approximately 5-minute was for cool-down and review.

Participants in the CAI group were allowed to work independently or with a partner. The students were given 15-minute of computer time on a Pentium III 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 five topics, which corresponded precisely to theoretical and practical work. Students received 15-minute of physical practice time following the time spent on the computer. There were 10-minute of warm-up at the beginning of the period and the remaining time of approximately 5-minute was for cool down and review. The instructor was present for organisation 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 CAI method group. The theoretical and practice sessions consisted of the same instruction and exercises, which took place in the TI and the CAI methods. Material for the three method groups was taken from a basketball shooting textbook (Burrall and Patrick, 2001) consisting of five topics: a) court and player's position, b) history c) rules, d) skill fundamentals and e) skill exercises.

At the end of the treatment, the knowledge was given and the

following day 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 shooting skills. During the experiment, the participants in the three groups had no access to multimedia or to traditional learning environments beyond what was utilised as part of the experiment.

Design

Due to practical limitation, a field experiment instead of a laboratory experiment was conducted to test the hypotheses. The experiment was a factorial design with teaching method groups (TI, CAI and MI) and repeated measurements (pre-test, post-test and re-test) as independent variables, and knowledge learning and skill learning performance as dependent variables. The design is illustrated schematically in the following diagram:

Group A:	R	O ₁	X ₁	O ₂	O ₃
Group B:	R	O ₁	X ₂	O ₂	O ₃
Group C:	R	O ₁	X ₃	O ₂	O ₃

Note: R = random assignment of students; X₁, X₂ and X₃ = experimental treatments; O₁, O₂ and O₃ = pre-test, post-test and re-test, respectively.

The hypothesis of the researches was that the CAI group would show greater improvement on knowledge and skill test of basketball shooting in all measures as a result of the multimedia effect.

Participants in the three groups were tested immediately before and after the ten-week experiment, following a re-test one week later. The first ($n=16$) and the second ($n=16$) experimental groups of students were taught by the CAI method and the mixed instruction method respectively, whereas the comparison group of students ($n=16$) received the traditional instruction method. During the ten-week period, each group received an equal amount of instructional time and was provided with the same instructional materials and assignments. All groups had the same learning outcomes, such as topics and principles introduced in the treatments, and equal opportunities to achieve their learning outcomes.

RESULTS

Homogeneity of variance and Sphericity was verified by the Box's *M* test, the Levene's test and the Mauchly's test (Green and Salkind, 2003). Initial differences between the three groups for the mean knowledge and skill test scores were tested using one-way analysis of variance. Two-way analyses of variances (ANOVAs), with repeated measures on the last factor, were conducted to determine effect of method groups (TI, CAI, MI) and measures (pre-test, post-test, re-test) on knowledge and skill test. Each variable was tested using an alpha level of significance 0.05. A listing of the results from the item analysis of the knowledge test in the pilot study can be found in Table 1. Means and standard deviation for the TI, MI and the CAI group in pre-test, post-tests and re-test are presented on table 2, while results of each analysis are presented separately below.

TABLE 1: Summary of Item Analysis for pilot study knowledge test.

Questions	Index of discrimination	Difficulty rating	Results
1	.50	50%	Retained
2	.38	65%	Retained
3	.75	55%	Retained
4	.40	52%	Retained
5	.45	16%	Eliminated
6	.25	73%	Retained
7	.38	61%	Retained
8	.07	44%	Eliminated
9	.31	79%	Retained
10	.25	59%	Retained
11	.08	93%	Eliminated
12	.53	32%	Retained
13	.49	45%	Retained
14	.02	67%	Eliminated

Item Analysis

The pilot study knowledge test had a mean difficulty rating of 57%. When all items were analysed, one question, or 7.1% of the items, had unacceptable difficulty rating values. The pilot study knowledge test had a mean index of discrimination of 0.35. When all items were analysed, two questions, or 14.2% of the items yielded an unacceptable index of discrimination values. Finally one more question, or 7.1% of the items, had unacceptable index discrimination and difficulty rating values. As indicated by the information in Table 1, four of the items were therefore deleted from the test for the main study.

TABLE 2: Means and standard deviations for pre-test, post-test and re-test scores for the TI, MI and CAI groups.

	Group	N	Mean	Std. Deviation
Knowledge Test 1st measure	Traditional	16	4.50	2.25
	M.I.	16	6.06	1.65
	C.A.I.	16	6.00	2.22
Knowledge Test 2nd measure	Traditional	16	7.75	2.57
	M.I.	16	8.81	1.11
	C.A.I.	16	8.31	1.20
Knowledge Test 3rd measure	Traditional	16	7.69	2.52
	M.I.	16	8.75	1.13
	C.A.I.	16	8.19	1.11
Skill Test 1st measure	Traditional	16	2.38	1.67
	M.I.	16	2.25	1.65
	C.A.I.	16	1.56	1.71
Skill Test 2nd measure	Traditional	16	3.25	1.91
	M.I.	16	3.31	1.54
	C.A.I.	16	2.44	1.75
Skill Test 3rd measure	Traditional	16	3.06	1.77
	M.I.	16	3.31	1.54
	C.A.I.	16	2.38	1.78

Reliability Analysis

An alpha reliability coefficient 0.73 was computed based on the inter-item correlation coefficients of the pilot study knowledge test. According to Green and Salkind (2003), the reliability coefficient should be at least 0.70 for the test to be considered reliable. Thus, the determination was made that the pilot knowledge test was a reliable measuring instrument.

Knowledge Test

There were no significant initial differences between the three teaching method groups for the mean knowledge test scores, $F_{(2,45)}=2.951$, $p>0.05$. A significant main effect was noted for the measurements, $F_{(1,45)}=80.237$, $p<0.05$ but not for the group, $F_{(2,45)}=2.596$, $p>0.05$, while the interaction measure X group was also not significant, $F_{(2,45)}=.904$, $p>0.05$.

Difference and repeated contrasts were conducted to follow up the significant measurements main effect. Differences in mean rating of knowledge test in TI group were significantly different between pre-test and post-test, $F_{(1,15)}=53.936$, $p<0.05$ and between pre-test and re-test, $F_{(1,15)}=73.819$, $p<0.05$. Differences in mean rating of knowledge test in CAI group were significantly different between pre-test and post-test, $F_{(1,15)}=10.752$, $p<0.05$ and between pre-test and re-test, $F_{(1,15)}=13.939$, $p<0.05$. Finally differences in mean rating of knowledge test in MI group were significantly different between pre-test and post-test, $F_{(1,15)}=33$, $p<0.05$ and between pre-test and re-test, $F_{(1,15)}=39.611$, $p<0.05$. As shown in figure 2, the post-test and re-test knowledge scores were remarkably greater than pre-test knowledge scores for the three groups, while the difference between the post-test and re-test was not significant.

Skill Test

No significant differences between the three teaching method groups were found for the pre-test mean skill scores, $F_{(2,45)}=1.088$, $p>0.05$. A significant main effect was noted for the measurements, $F_{(1,45)}=50.847$, $p<0.05$ but not for the group, $F_{(2,45)}=1.257$, $p>0.05$, while the interaction measure X group was also not significant, $F_{(2,45)}=.601$, $p>0.05$.

Difference and repeated contrasts were conducted to follow up the significant measurements main effect. Differences in mean rating

FIGURE 2: The significant main effect for the measure on Knowledge Test, where the significant improvement of the groups is apparent.

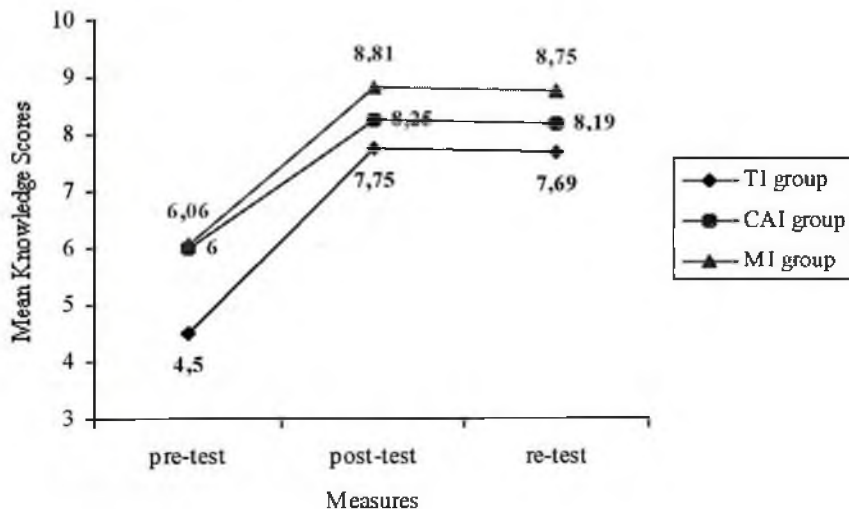
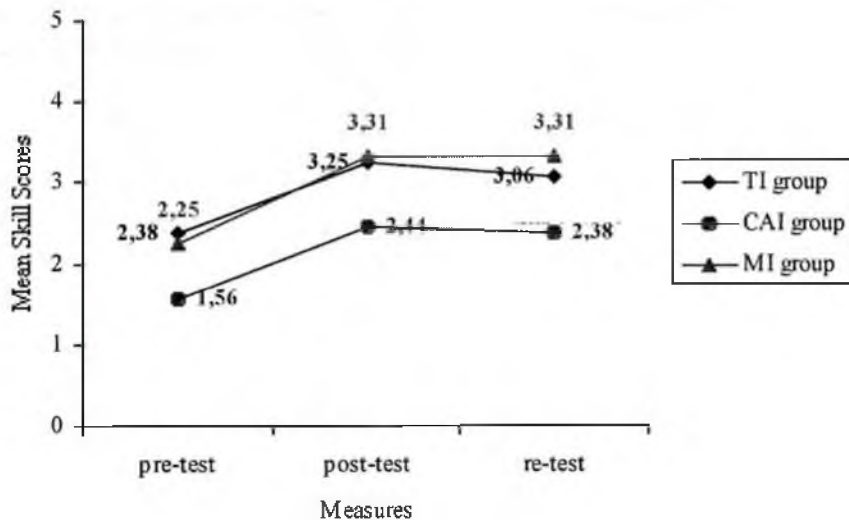


FIGURE 3: The significant main effect for the measure on Skill Test, where the significant improvement of the group is apparent.



of skill test in TI group were significantly different between pre-test and post-test, $F_{(1,15)}=9.304$, $p<.05$ and between pre-test and re-test, $F_{(1,15)}=15$, $p<0,05$. Differences in mean rating of skill test in CAI group were significantly different between pre-test and post-test, $F_{(1,15)}=23.710$, $p<.05$ and between pre-test and re-test, $F_{(1,15)}=19.286$, $p<0,05$. Finally differences in mean rating of skill test in MI group were significantly different between pre-test and post-test, $F_{(1,15)}=24.771$, $p<.05$ and between pre-test and re-test, $F_{(1,15)}=25.312$, $p<0,05$. As shown in Figure 3, the post-test and re-test skill scores were remarkably greater than pre-test skill scores for the three groups, while the difference between the post-test and re-test was not significant.

DISCUSSION

The present study was designed to examine differences that may occur when individuals learn a motor skill under different instructional teaching methods and replicated previous findings by showing differential performance dependent on teaching methods. The reported findings are not consistent with the hypotheses that CAI group would exhibit better performance on both the post-test and the re-test. In fact, all the instructional groups performed similarly with significant learning from pre-test to post-test but with no significant differences between the groups on either the post-test or the re-test. The results indicated that CAI is a functional method in teaching the skill of basketball shooting to middle school students and might be as effective as TI. Those results are consisted with the related literature.

Knowledge Test

Research on the effects of teaching in the knowledge test showed a significant increase in the performance of the participants. This increase indicates that all the teaching methods, improved the knowledge of students, regarding the shooting ability in basketball. Previous research, that used the capabilities of multimedia applications, does not report difference between the CAI method and the TI method in the result of knowledge control (Wilkinson et al, 1999; Vernadakis et al, 2002). Other research reports differences in the performance for the CAI method (Steffen and Hansen, 1987; McKethan et al, 2000).

The CAI group improved learning in the knowledge test from pre-test to post-test. This result is in agreement with Kulik et al (1980), who reported that when the computer undertakes entirely the education

of a student it shows positive results, without being superior to the traditional instruction methods. However, according to Adams and Waldrop (1985), Bucholtz (1998) and Schitteck et al (2001), the computer has greater educational value when it is applied as supplemental rather than when it tries to replace other methods. 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 knowledge test for the three instructional method groups, which was not significant. The results are similar to Dezzi et al (2002), who reported no significant differences between post-test and re-test for the two instructional methods (TI and CAI) in the basketball rules knowledge test and disagree with Kerka (1990), who reported that multimedia applications increase the ability of information maintenance.

The TI group did not have to face the unknown instructional environment of computers, since elementary school students have experienced classroom instruction for roughly 6 years. The CAI method of instruction, according to Rogers (1983), has the disadvantage of requiring prior experience of the educational process from the user. In the present study the unknown instructional environment of computers did not directly affect the improvement of learning in CAI and MI groups.

Many researchers report that CAI is generally successful, particularly when it is implemented with the TI method (Atkinson, 1984; Okamoto et al, 2001). In the present study the improvement of learning in the MI group, which had better results in all measurements, confirms the potentials of the integrated instruction method for middle school students. Therefore it appears that the method of CAI and specifically the multimedia applications covered in the best possible way the instructive unit and replaced successfully the traditional instruction method (Neal, 1993). These findings are similar to the views of Adams and Waldrop (1985), Bucholtz (1998), and Schitteck et al, (2001), for a more efficient participation of the computers as a supplement of the educational process.

Skill Test

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 shooting ability

in basketball. Previous studies report equal improvement in learning with both the TI method and the CAI method (Summers et al, 1999; Vernadakis et al, 2002). Other studies support differences in the performance for the CAI method (Kulik, 1981).

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 Kerka (1990), who supports that in a computer instructional program, the combination of video, text, sound and graphics improves the retention ability of information.

In conclusion, according to the results of the present study, the mixed method as a teaching aid tended to be the most effective teaching method for cognitive learning and skill development of the shooting ability in basketball. However, these conclusions are limited for students aged 12–14 years old. More studies should be conducted to investigate the effect of CAI 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 computer-assisted instruction.

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