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Chapter 6

COMPARISON OF MULTIMEDIA COMPUTER-ASSISTED INSTRUCTION, TRADITIONAL INSTRUCTION AND COMBINED INSTRUCTION ON KNOWLEDGE ACQUISITION AND RETENTION OF SETTING SKILL IN VOLLEYBALL

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ABSTRACT

The purpose of this study was to examine the effect of multimedia computer - assisted instruction (MCAI), traditional instruction (TI), and combined instruction (CI) methods on learning the skill of setting in Volleyball. Additionally, a comparison of the students' attitudes towards the MCAI and TI methods was made. Forty-eight middle school students of seventh and eighth grade were randomly assigned into three teaching method groups: TI, MCAI and CI. Each group received ten 45-min periods of instruction divided into 3 sections: a) 5-min introduction, b) 30-min instructional time and c) 10-min questions and review. Students took pre-, post-, and retention written test covering rules and strategy of the games. Participants in the CI group also completed a post-test attitude survey towards the MCAI and TI methods. Two-way analysis of variances (ANOVA), with repeated measures on the last factor, were conducted to determine effect of method groups (MCAI, TI, CI) and measures (pre-test, post-test, re-test) on knowledge test. Paired samples t-test analyses were conducted to measure students' attitude towards the MCAI and TI methods. Post-test results indicated no significant differences between the groups concerning the written test. Nevertheless, the attitude test scores of the CI group were more favourable to MCAI method than the TI method. Retention test results showed that groups retained the knowledge acquisition. However, the combine method of instruction tended to be the most effective on cognitive learning.

Keywords: Instructional technology, multimedia software, traditional instruction, cognitive learning, attitude, volleyball.

INTRODUCTION

The importance of visual information in the learning process is well known. Consider that, on average, people learn 1% through what they taste, 1.5 % through what they touch, 3.5 % through what they smell, 11 % through what they hear, but 83 % through what they see. Research also finds that individuals retain 10 % of what they write, 20 % of what they hear, 30 % of what they see, 50 % of what they see and hear, and 70% of what they discuss (Simatos, 2000). Based upon these data, the future of learning points in the direction of interactive, multimedia computer assisted instruction (MCAI), and the ideal delivery medium for the masses is the next-generation broadband Internet.

So what then is "interactive multimedia?" Although there are many definitions, Akhtar (2003) described it as using many different media (print, audio, video, etc.) to present more comprehensive information than any medium alone can, accommodating children with different learning styles, and employing interactivity to stimulate children to become active, motivated learners.

The use of multimedia software is becoming more popular with the improvement in computer technology. But should it be used because it is popular or because it meets the instructional objectives? There is debate going on about the effectiveness of multimedia computer-assisted instruction (MCAI) versus the traditional instruction (TI) approach or teacher-led approach. The literature reports a considerable amount of research on the use of multimedia by educators and on their effectiveness in the learning process. Blok, Oostdam, Otter, & Overmaat (2002), for example, examined the effectiveness of computer-assisted instruction (CAI) programs in supporting beginning readers. Their review included 42 studies from 1990 onward, and they found the corrected overall effect size estimate was .19. Their findings were similar to earlier meta-analyses by Kulik and Kulik (1991) and Bangert-Drowns (1993), which also examined the effects of CAI and found it to have positive but small effects. Wiemeyer, (2003) 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, & Binru Huang, 2004) concluded that a very weak learning advantage for multimedia in empirical studies is based on uncontrolled instructional methods.

One area in which there have not been many meta-analyses and systematic reviews of the research is how teaching and learning with multimedia technology impacts student outcomes in physical education. This area is important because some studies have found that multimedia technology can change teachers' pedagogic practices from a teacher-centered or teacher-directed model to a more student-centered classroom where students work cooperatively, have opportunities to make choices, and play an active role in their learning. Antoniou, Derri, Kioumourtzoglou, & Mouroutsos (2003), for example, examined the effect of multimedia

computer assisted instruction (MCAI), traditional instruction (TI), and combined instruction (CI) on learning rule violations in basketball by university physical education students. Written test results indicated that students in all groups improved their knowledge of rule violations but only those in the TI and CI groups retained this knowledge. Also, the researchers found that TI group showed significantly greater retention than the MCAI group both in the written test and in total performance.

Wiksten, Spanjer, & LaMaster (2002), investigated the effectiveness of MCAI in an introductory athletic training laboratory class as a supplement to TI approach. The results showed no significant differences between groups on either the written or practical examination. Student attitudes toward the CD-ROM software were favorable, and the qualitative data suggest that students would use this type of educational resource. In another study that examined changes in physical activity and nutritional patterns of high school physical education students as a result of multimedia technology, Everhart, Harshaw, Everhart, Kernodle, & Stubblefield (2002) found that the year-long multimedia intervention did not affect physical activity or nutritional patterns of students significantly.

Vernadakis, Zetou, Antoniou, & 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. The results of this study showed that there were no significant differences between the TI and MCAI groups with regards to the knowledge and skill test. In another study Wilkinson, Hillier, Padfield, & 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 MCAI class had significantly better scores on the forearm pass, more successful passes/serve, set/serve, total contacts/serve and more sets than the TI class. However, no significant differences were found between the two classes in knowledge of rules. Survey results revealed that the majority of the treatment class felt that using the multimedia software helped improve their motor and cognitive skills.

More recently, Goran and Reynolds (2005) examined the efficacy of a computer-based interactive multimedia curriculum for promoting physical activity in fourth grade children. The researchers concluded that the interactive multimedia curriculum favored an improvement in obesity indices in girls and was associated with subtle changes in physical activity in girls and general improvement in psychosocial outcomes related to physical activity. In another study that examined the effective use of an Interactive Instructional Multimedia Software in the teaching process of alpine skiing, Antoniou, Moulelis, Siskos, & Tsamourtzis (2006) found that the multimedia assisted instruction method of teaching alpine skiing in beginners is more effective than the traditional method.

Finally, Si-min Li and Jin-hai Sun (2008) in an experimental research on multimedia teaching for sports aerobics found that: (1) the multimedia teaching for sports aerobics, which takes the students' study as the center, pays great attention to the learning environment design is helpful in making the student to establish the correct technical movement concept, and then raise the utilization rate of effective time in class, and increase the teaching information capacity the grades, (2) the sports aerobics received in the experiment group are better than those of the students in the opposite one, and (3) the multimedia teaching has its unique superiority in theoretical knowledge and the technical skill instruction aspects of sports aerobics compared to conventional teaching methods.

Taking these factors into consideration, it would be interesting to see the effectiveness of MCAI in a learning environment, more specifically in a physical education learning environment and then to point out the lacuna that needs to be filled. But first, it is important to find out how students feel about it as it is they who will be instructed through the whole gamut of the learning process.

Therefore, the purpose of this study was to compare three different instructional methods (MCAI, TI & CI) by means of the knowledge test scores, obtained from three groups of middle school students. Additionally, a comparison of the students' attitudes towards the MCAI and TI methods was made. The tests assessed the learning of the setting skill in volleyball. More specifically, the study was conducted to explore the following four research questions:

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

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 volleyball course. Participants were randomly assigned to one of the three different teaching methods: TI, CI and MCAI creating three independent groups of 16 students. All participants had no formal training on learning the skills of setting in volleyball. 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. The students should have returned the informed consent form signed by his/her parent or guardian in order to participate in the research.

Apparatus

Hardware. Ten 3.2 GHz Intel Pentium 4 class computers with an 800 MHz front side bus and Intel's new Hyper-Threading technology for increased performance during demanding operations such as complex multitasking running Windows XP professional SP2 were used. The computers equipped with 1024 MB RAM memory, a high-end nVidia GeForce Fx Go 5600 graphics controller with 128 MB of dedicated video memory, a 17-inch color LCD monitor, DVD-ROM, soundcard, microphone and small headset.

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. Systematic Instructional Design (SID) concept was used to design the multimedia learning material. 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 introductive 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 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. This was followed by "animated graphics" that showed the skill in a continuous movement pattern. 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.

Each section included different relevant material like text, sound, pictures, animated vector images, graphics and video. The video presented professional volleyball players performing the setting 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 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.

Knowledge Test. A knowledge test was developed to determine students' achievement on cognitive learning from the skill of setting in volleyball. A table of specifications was developed to reflect the interrelationship between the identified course content and the levels of learning. Initial drafting of questions for the instrument relied upon survey research handbook by McGee and Farrow (1987). Based on these specifications a 20-item, multiple-choice test was constructed. Each test item had four options in order to reduce the probability of guessing. The test

construction was based on the linear model which required that the test scores were obtained by summing the number of correct answers with equal weighting over the items. The questions were written on the basis of the learning objectives outlined in the Ministry of Education's Volleyball Curriculum Guideline.

After the questions were constructed as explained above, a panel of experts in volleyball teaching and coaching was used to evaluate and judge the content validity of the test instrument. This group reviewed the test items and established whether each item measured the target skill. Every time a set of changes was made, the questionnaire was reviewed again by the consultants, until the instrument was deemed adequate.

The revised version of the knowledge test consisted of a 15-item multiple-choice test. Questions included in the knowledge test fell into one of the following categories: a) six skill concepts and b) nine general rules associated with the skill. A pilot study was performed to access item difficulty and clarity of questions. Questions were scored one point for a right answer and no point for a wrong answer.

Attitude Questionnaire. To assess students' attitude, a questionnaire was used consisting of 12 bi-polar items, divided in two sections from the Teaching Method Attitude Questionnaire (TMAQ, Antoniou, Theodorakis, Kioumourtzoglou, 1999). Each section contained six-point Likert scale numeric indicators ranging from "5" (powerful) down to "0" (weak). The first section was referred in TI method and the second in MCAI method with a common point (0). This format allowed participants to select a response from "0" to "5" representing their disagreement or agreement on each section of the particular item respectively (Appendix B). The questionnaire addressed two aspects of attitude: (1) positive (Alpha=.74) and (2) negative (Alpha=.76). The sum scores of positive surnames, minus the sum scores of negative surnames indicated the students' attitude scores in each teaching method (MCAI, TI). The difference of these scores between the two teaching methods (MCAI, TI) represented the students' overall attitude scores. The TMAQ instrument was designed for understanding students' attitude toward MCAI and TI teaching method in a specific situation such as a classroom setting (Antoniou, Theodorakis, Kioumourtzoglou, 1999). This attitude questionnaire was given to CI group as post- test.

Procedure

When the MCAI 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 skill of setting in volleyball. 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 15 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 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 to measure participant's baseline performance on the selected setting skill. Procedures for the knowledge test were the same as the pilot test. There were five fewer questions, reducing the number of questions to ten (Appendix A).

On the third day, ten computers were set up in a blocked-off hallway adjacent to the gymnasium. Each computer had a volleyball skill CD-ROM created by the researchers. Computers were separated as much as possible to create individual workstations. Before the experiment started, the MCAI and CI 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 volleyball. Instruction, practice, and testing for this study were held on six 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. Students were given verbal instruction for 30-minute and they were able to ask questions. The instructor responded to questions asking for clarification, to repeat a verbal description, or to repeat a demonstration. Students were allowed to work alone or with a partner. There were 5-minute of introduction at the beginning of the period and the remaining time of approximately 10-minute was for questions and review.

Participants in the MCAI group were allowed to work independently or with a partner. The students were given 30-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 MCAI program consisted of four topics, which corresponded precisely to theoretical work. There were 5-minute of introduction at the beginning of the period and the remaining time of approximately 10-minute was for questions and review. The instructor was present for organization and management supervision only. No verbal or visual reinforcement of any kind was offered by the instructor.

The CI group followed the same procedure, while implementing both the multimedia program and the traditional instruction. In the first three weeks the students participated with the traditional method group, and the remaining weeks with the MCAI method group. The theoretical session consisted of the same instruction and text information, which took place in the TI and the MCAI methods. Material for the three method groups was taken from a volleyball coaching textbook (American Sport Education Program, 2001) consisting of four topics: a) history, b) rules, court and player's position, c) skill fundamentals, and d) skill exercises.

At the end of the treatment, the knowledge test that previously served as a pre-test was given to students and the following day the attitude test was given to CI group as a post-test. One week later, the knowledge test procedure was repeated on the re-test to measure the level of retention in the selected setting skill. During the experiment, the participants in the three groups had no access to multimedia or to traditional learning environments beyond what was utilized as part of the experiment. All groups had the same learning conditions, such as topics and principles introduced in the treatments, and equal opportunities to achieve their learning outcomes.

Design

Due to practical limitation, a field experiment instead of a laboratory experiment was conducted to test the research questions. The experiment on knowledge test was a factorial design with teaching method groups (MCAI, TI and CI) and repeated measurements (pre-test, post-test and 1-week retention test) as independent variables, and knowledge learning as dependent variables. The experiment on attitude determination was a factorial design with CI teaching method group and post-test measurement as independent variables, and student's attitude as dependent variable.

RESULTS

Homogeneity of variance and Sphericity was verified by the Box's M test, the Levene's test and the Mauchly's test (Green & Salkind, 2007). Initial differences between the three groups for the mean knowledge scores were tested using one-way analysis of variance. An item analysis using the responses of the pilot study was conducted to determine the difficulty rating and index of discrimination. In determining the internal consistency of the knowledge test, the alpha reliability method was used. Two-way analysis of variance (ANOVA), with repeated measures on the last factor, were conducted to determine effect of method groups (MCAI, TI, CI) and measures (pre-test, post-test, re-test) on knowledge test. Paired-Samples t-tests were conducted to compare students' attitudes (CI group) towards the MCAI and TI teaching methods. Each variable was tested using an alpha level of significance .05. A listing of the results from the item analysis of the knowledge test in the pilot study can be found in table 2. Means and standard deviation for the MCAI, TI and the CI group in pre-test, post-test and re-test are presented on table 1, while results of each analysis are presented separately below.

Item Analysis

The pilot study knowledge test had a mean difficulty rating of 54%. When all items were analyzed, one question, or 6.6% of the items, had unacceptable difficulty rating values. The utilization of a difficulty rating criterion of between 10% and 90% resulted in 93.3% of the items yielding an acceptable level of difficulty. The pilot study knowledge test had a mean index of discrimination of .32. When all items were analyzed, two questions, or 13.2% of the items yielded an unacceptable index of discrimination values. The acceptable value for index of discrimination was .20 or higher. Acceptable index of discrimination values were observed for 86.6% of the items. Finally two more questions, or 13.2% of the items, had unacceptable index discrimination and difficulty rating values. As indicated by the information in table 2, five of the items (5, 6, 9, 14 & 15) were therefore deleted from the test for the main study.

Reliability Analysis

Reliability measures for knowledge test and attitude questionnaire were assessed. An alpha reliability coefficient .73 was computed based on the inter-item correlation coefficients of the pilot study knowledge test. While the Cronbach a coefficients of the attitude questionnaire was .83 and .93 for the two aspects of attitude: (1) positive and (2) negative, respectively, with all > .70. According to Green, & Salkind (2007), the reliability coefficient should be at least .70 for the test to be considered reliable. Thus, the determination was made that the pilot knowledge test and the attitude questionnaire were reliable measurement instruments.

Table 1. Means and standard deviations for pre-test, post-test and re-test scores of the three groups on knowledge test.

	Group	N	Mean	Std. Deviation
Knowledge Test 1st measure	TI	16	6,19	1,83
	MCAI	16	5,25	2,14
	CI	16	5,38	1,45
Knowledge Test 2st measure	TI	16	8,88	1,50
	MCAI	16	9,06	1,69
	CI	16	9,44	1,15
Knowledge Test 3st measure	TI	16	8,81	1,47
	MCAI	16	8,87	1,54
	CI	16	9,31	1,08

Table 2. Summary of Item Analysis for pilot study knowledge test.

Questions	Index of discrimination	Difficulty rating	Results
1	.40	40%	Retained
2	.28	55%	Retained
3	.25	59%	Retained
4	.35	47%	Retained
5	.69	18%	Eliminated
6	.15	73%	Eliminated
7	.28	55%	Retained
8	.49	34%	Retained
9	.11	78%	Eliminated
10	.25	59%	Retained
11	.28	55%	Retained
12	.62	22%	Retained
13	.59	25%	Retained
14	.01	96%	Eliminated
15	.01	96%	Eliminated

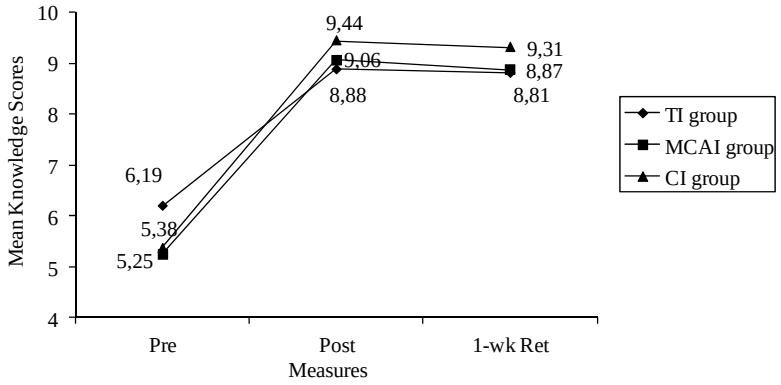

Figure 1. Performance of the three groups on all measures of the Knowledge Test.

Two-Way Repeated-Measures Analysis of Variance (ANOVA)

There were no significant initial differences between the three teaching method groups for the mean knowledge test scores, $F(2,45) = 1.234$, $p>.05$. A significant main effect was noted for the measurements, $F(1,45) = 92.623$, $p<.05$ but not for the group, $F(2,45) = .384$, $p>.05$, while the interaction measure X group was also not significant, $F(4,45) = 1.303$, $p>.05$.

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, $F(1,15)= 17.089$, $p<.05$ and between pre-test and re-test, $F(1,15)= 17.921$, $p<0,05$. Differences in mean rating of knowledge test in MCAI group were significantly different between pre-test and post-test, $F(1,15)= 25.948$, $p<.05$ and between pre-test and re-test, $F(1,15)= 30.190$, $p<.05$. Finally differences in mean rating of knowledge test in CI group were significantly different between pre-test and post-test, $F(1,15)= 65$, $p<.05$ and between pre-test and re-test, $F(1,15)= 78.502$, $p<.05$. As shown in Figure 1, 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.

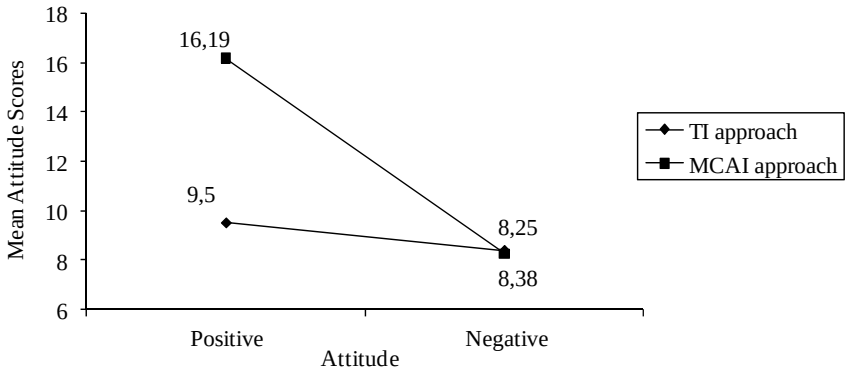

Figure 2. Profile plot of the positive and negative scores for each teaching approach.

Paired-Samples t Test Analysis

Paired-samples t test were conducted to evaluate whether CI group students were more favourable with TI or MCAI teaching approaches. The results indicated that the mean positive attitude (M=16.19, SD=6.54) was significantly greater than the mean negative attitude (M=8.25, SD=3.21) for the MCAI teaching approach $t(15)=5.277$, $p<.01$. No significant difference was found between the mean positive attitude (M=9.5, SD=4.75) and the mean negative attitude (M=8.38, SD=7.68) for TI teaching approach $t(15)=.649$, $p>.05$. Also, significant difference was found between the mean scores of the MCAI teaching approach (M=16.19, SD=6.54) and the mean scores of the TI teaching approach (M=9.5, SD=4.75) for the positive aspect of the questionnaire $t(15)=3.105$, $p<.01$. On the contrary, no significant difference was found between the mean scores of the MCAI teaching approach (M=8.25, SD=3.21) and the mean scores of the TI teaching approach (M=8.38, SD=7.68) for the negative aspect of the questionnaire $t(15)=.093$, $p>.05$. As shown in Figure 2, the CI group students were more favourable with MCAI teaching approach than TI teaching approach.

CONCLUSION

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. With regard to the knowledge test, all groups improved their cognitive learning in volleyball setting skill, after instruction. Post-test results indicated no significant differences between the groups concerning the written test. Nevertheless, the attitude test scores of the CI group were more favourable to MCAI method than TI method. Retention test results showed that groups retained the knowledge acquisition. However, the combine method of instruction tended to be the most effective on cognitive learning.

The significant improvements in knowledge test scores from the pre-test to the post-test for the TI group, the MCAI group and the CI group while not having significant differences between the groups on the learning variable are consistent with the results reported in the literature. Wiksten, Spanjer, & LaMaster (2002) did not find a significant learning difference between computer-assisted instruction and the traditional method of instruction in an introductory athletic training laboratory class on either the written or practical examination. Vernadakis et al. (2002) developed a multimedia application for the instruction of the setting skill in volleyball and reported that the study provided no evidence to indicate that the multimedia computer-assisted instruction application contributed significantly more to student learning when compared to the control group which had been instructed by traditional means. In earlier studies comparing the impact of MCAI and TI method, Adams, et al. (1991) and Kerns (1989) found no significant differences in scores of tests in golf and tennis rules.

On the other hand, there are previous studies in physical education supporting the view that computer assisted instruction is consistently superior to the traditional forms of instruction (Antoniou et al., 2006; Si-min Li and Jin-hai Sun 2008) while other evidence is contradictory. From a recent multimedia study on learning rule violations in basketball, Antoniou et al. (2003)

found that university physical education students receiving lecture instructions performed significantly better than the MCAI group. In other study, Siskos, Antoniou, Papaioannou, and Laparidis (2005) found that MCAI was superior to traditional classroom teaching in passing knowledge in health-related fitness and nutrition subjects.

The lack of significant differences from the post-test to the re-test for the three instructional method groups is inconsistent with the meta-analytic study (Cotton, 1991) which integrated the findings of 59 independent evaluations of computer-assisted instruction during the 1980s and reported that CAI as a supplement to traditional teacher-directed instruction produces maintenance scores superior to those obtained with traditional instruction alone. Research is inconclusive regarding the comparative effectiveness of conventional instruction alone and CAI alone. Antoniou et al. (2003), for example, found that traditional lecture instruction was superior to MCAI in the retention of basketball rule violations knowledge. On the contrary, Yildirim, Ozden, & Aksu, (2001) reported that multimedia applications increase the ability of information maintenance. Also, Vernadakis, Avgerinos, Zetou, Giannousi & Kioumourtzoglou, (2006) found no significant differences between post-test and re-test for the three instructional methods (TI MCAI & CI) in the long jump event knowledge test.

However, Mayer (2001) reported that well-designed multimedia applications increase the ability of information maintenance. In the current study the evaluation of the learning maintenance, showed that the three instructional method groups mean scores did decrease slightly from the post-test to the re-test, however the difference was not significant. The time period between the administration of the post-test and the re-test was short, 7 days. While the re-test mean scores indicated that learning may have been affected differently during this period for the tree instructional groups, long term retention differences would be purely speculative.

The attitude survey showed that the MCAI teaching method had a stronger positive effect on students' attitude, than the TI teaching method. Students did state that learning about volleyball setting skill on the multimedia application made the subject matter more interesting, which could imply that this method of teaching can be used effectively. Students rated the activities as intelligent, meaningful, and pleasant for learning and remembering, and they particularly valued the interactive nature of the learning experience and the visual nature of the presentation. They seemed to understand and comprehend the material better. In light of this, these findings reaffirm previous studies that concluded that the use of multimedia computer-based instructional programs improve students' attitude scores as compared to the use of traditional or regular methods of instruction (Astleitner and Wiesner, 2004; Goran and Reynolds, 2005; Kiboss and Ogunniyi, 2003; Liao, 1999).

However, Bernard, et al. (2004) in a comprehensive meta-analysis of 232 empirical studies conducted between 1985 and 2002, concluded that courses reporting high levels of student interest also tended to report lower levels of achievement. They also concluded that end of course measures of interest tended to be negatively correlated with end of course achievement. Thus, as achievement increased in multimedia studies, student interest and satisfaction decreased. They conclude that interest satisfaction may not indicate success but the opposite, since students may spend less effort learning, especially when they choose between multimedia education and regular courses for convenience purposes.

Evaluating the outcomes of the present research study, greater consideration needs to be given to those factors that might strongly affect students' learning. First, students were from one middle school of Thessaloniki. A larger and more diverse sample would provide a more stringent

test for cognitive learning on a MCAI program. Additionally, the results reported in this study are based on a single MCAI program. This is a case-specificity problem. It is possible that a different type of MCAI package covering different content would yield different results.

Secondly, the age of students might be critical when it comes to learning independently. Since the participating students were all around 13 years of age when this study was conducted, they might not possess the learning skills that are needed in order to work independently using individual computers. Besides, research has also found that first-time users of computers are often overwhelmed by the vast amount of materials and information that can be presented by multimedia courseware (Renshaw and Taylor, 2000). These types of differences between the three groups, therefore, might be reflected in the students' post-test and 1-week retention knowledge test scores.

Thirdly, no attempt was made to control possible differences in computer skills and multimedia experiences of the students or the effective learning time of the students' real engagement in multimedia learning. If these limitations have been controlled and the effective learning time had lasted longer, the researchers might have reported more precise results for the effectiveness of MCAI, TI, and CI methods on cognitive learning of the volleyball setting skill. For those reasons, further research may be needed to replicate this study.

Those limitations of the research learning environment may have significantly affected the experimental groups' ability to learn and to retain the knowledge acquisition of the volleyball setting skill. However, it would be difficult to be certain, that the MCAI group would have been more successful than TI and CI groups on cognitive learning if the above limitations could have been eliminated. In that sense, these results indicate that students can be taught through the use of multiple effective teaching techniques. Multimedia programs have been generally successful especially when it has been used in connection with regular classroom instruction (Vernadakis, Antoniou, Zetou & Kioumourtzoglou, 2004).

In conclusion, multimedia programs can be utilized to enhance the effectiveness of teaching strategies or techniques in physical education classes. Computers can be used for the teaching of the cognitive aspects of sports such as rules and scoring procedures, and to allow teachers to have more time to spend with students' motor skills. 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. Subsequent research with more attention to software design and validation may begin to show more consistent results in the use of MCAI software. These results lend support to the supplemental role of MCAI to more traditional instructional methods in the context presented in this investigation.

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APPENDIX

Appendix A: Knowledge test

Circle or underline the correct answer

1. How should the player's body be positioned in relation to the ball in hitting an overhand pass?

    a. the approaching ball should be in line with the arm and shoulder of the player's dominant side
    b. the approaching ball should be in line with the arm and shoulder of the player's right side
    c. the approaching ball should be in line with the midline of the player's body *

d. the approaching ball should be in line with the arm and shoulder opposite the intended flight of the ball

2. What parts of the hands should contact the ball in hitting the overhand pass?

a. the heels of the hands, finger pads, and thumbs
b. the finger pads and thumbs *
c. the palms of the hands, finger pads, and thumbs
d. the thumbs and finger pads of the first two fingers

3. Where should contact with the ball be made in hitting an overhand pass?

a. 6 inches to a foot directly above the head
b. 6 to 8 inches off the forehead *
c. 6 to 8 inches out from the nose
d. 6 inches to a foot out from the chest

4. What is the position of the elbows at the beginning of an overhand pass?

a. in close to the body at the waist
b. in close to the body at the chest *
c. away from the body at the waist level
d. away from the body at the shoulder level

5. What is the most important factor to remember in setting?

a. to move quickly to get the ball
b. to push the ball out and up
c. to position oneself under the ball
d. to place the ball in the proper spiking zone *

6. What is the approximate size of a volleyball court?

a. 30 by 30 feet
b. 30 by 60 feet *
c. 60 by 60 feet
d. 60 by 90 feet

7. How many players may be on a team including substitutes?

a. 8
b. 10
c. 12 *
d. 15

8. If a ball is not hit on a block, how many times may a team contact the ball before it must go over the net into the opponent's court?

   a. one
   b. two
   c. three *
   d. four

9. How many substitutions is a team allowed each game in international competition?

   a. 4
   b. 6 *
   c. 10
   d. 12

10. How many games must be played to make a match in international play?

    a. two
    b. best two out of three
    c. best three out of five *
    d. best four out of seven

APPENDIX B: POST-TEST ATTITUDE SCALE

Express your feeling with the following statements on a 0-5 scale where 0=weak and 5=powerful by comparing TI and MCAI teaching methods.

TI	←										→	**MCAI**
good	5	4	3	2	1	0	1	2	3	4	5	good
bad	5	4	3	2	1	0	1	2	3	4	5	bad
foolish	5	4	3	2	1	0	1	2	3	4	5	foolish
intelligent	5	4	3	2	1	0	1	2	3	4	5	intelligent
meaningful	5	4	3	2	1	0	1	2	3	4	5	meaningful
meaningless	5	4	3	2	1	0	1	2	3	4	5	meaningless
unattractive	5	4	3	2	1	0	1	2	3	4	5	unattractive
attractive	5	4	3	2	1	0	1	2	3	4	5	attractive
ugly	5	4	3	2	1	0	1	2	3	4	5	ugly
beautiful	5	4	3	2	1	0	1	2	3	4	5	beautiful
unpleasant	5	4	3	2	1	0	1	2	3	4	5	unpleasant
pleasant	5	4	3	2	1	0	1	2	3	4	5	pleasant