Comparison of computer assisted and traditional education programs on fundamental movement skills in children

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Abstract

This study investigates the effect of eight weeks traditional education (TE) and computer assisted education (CAE) with controls on the development of fundamental movement skills in 22 boys and 33 girls aged 5-6 years. This study showed CAE had higher improvements than TE in the sub-dimension of locomotor contrary to the higher improvements of in the object control and Test of Gross Motor Development (TGMD-2) in males. CAE in females had higher improvements than TE in the means of locomotor, object control and TGMD-2. In conclusion, CAE is more effective in the means of sprint, hop, side gallop, catch, kick, throw and TE is more efficient in the means of leap and two hands strike in boys. CAE is also more efficient in the means of leap, side gallop, and two hands strike, catch, throw and TE is more efficient in the means of sprint, hop and kick in girls.

Keywords: Locomotor, object control skills, children, TGMD-2.

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1. Introduction

Fundamental movement education is necessary to develop skills needed in lifelong physical activity or sport performance. This education consists of fundamental movement skills, fundamental motor skills and sport specific skills. All motor and sport skills are built on fundamental movement skills including locomotor and object control abilities at the beginning of movement education (Balyi, 2001; Payne & Isaacs, 2002; Gallahue & Donnelly, 2003). Locomotor skills includes sprint, hop, leap and side gallop while object control skills comprises two hands strike, catch, kick and throw. Fundamental movement skills should focus on the building process, not the result of the skill. It is not important how fast or long a child runs, but whether he/she can perform that skill correctly by providing all the criteria.

It has been well known that information and communication technologies support positively the level of participation of physical education and sports students towards activities and provide free decision about learning styles (Stanescu, Stoicescu & Ciolca, 2011). In computer assisted education as a teaching method, an interactive and instant feedback can be obtained with many tools suitable to individual characteristics such as learning speed of the people, their readiness and visual and auditory learning styles. According to the views of authorities and school administrators, computer and instructional technologies have a positive influence on the quality of teaching and research (Lehmann, Freedman, Massad & Dintzis, 1999). Developing Computer-assisted education and virtual reality practices have begun to be used to provide sports, physical fitness and physical education knowledge (Silverman, 1997). Modelling is necessary in physical education because it allows learning by demonstration of a skill (Jambor, 1996). The majority of physical education teachers are attempting to use modelling instruction through video images (Darden & Shimon, 2000).The method of modelling through video display is based on the representation of the performance criteria of the exercises by another person (Schmidt, 1991). The person performing using modelling may be able to perform more proficiently than the students of the same age group (Carroll & Bandura, 1990). The diversity and importance of multimedia tools in physical education classes is increasing (Zhang, 2012). This study aims to investigate the effect of eight weeks computer assisted and the traditional education with playing games on the development of fundamental movement skills in children aged 5-6 years.

2. Material and Method

Data were collected from primary school first grade students aged 5-6 years including 22 boys and 33 girls were randomly assigned in this study. Three groups have been formed as the traditional education group (TEG), computer assisted education group (CAEG) and control group (CG). Traditional education and computer assisted training have been applied to the experimental groups as daily one hour two days per week for eight weeks training program. CG did not participate any activity program. Two skills were held each week, and at the end of weeks they were repeated one more time, accounting to four times of practice in total on the same skill. The activities presented in the book Fundamental Motor Skills: An Activities Resource for Classroom Teachers by Walkley, Armstrong and Clohesy (1998) were used in the preparation of the daily schedules and the games in it.

Fundamental movement skill levels have been determined by the Test of Gross Motor Development (TGMD-2 second edition). This test was developed by Ulrich (2000) and was adapted by Tepeli (2007) for Turkish population. The definitions of locomotor and object control skills are necessary for understanding to this study. Sprint is considered to be an extension of short-distance walking with

maximum effort, except for the flight phase where both feet are in the air. Hop as a continuous and asymmetrical skill with one leg lifting and placing on the ground requires greater leg strength and dynamic balance than leap, and only one foot and small support surface is used to push the body. Leap is a long step that takes place by taking off with one foot as the body increasingly moves upwards and forwards in the flight phase and landing on the ground with the other foot. Side gallop is a continuous displacement movement performed sideways as a combination of walking and leap. Throwing the ball with two-hand strike is the ability to hit the ball by using a part of the body or an object through swinging movement. Catch is to get the ball in front of the chest with two hands while the arms are extended towards the moving object and then quickly moved in the same direction with it, or when the arms are bent from the elbows. Kick is to move an object up and forward by applying force to the object with the foot. Throw is a strong swing forward of an object out of the hands . In the assessment of each skill, movement phases ranging from three to five in the scale constitute the performance criteria of the motor skills. Each of the motor skills is repeated twice and is coded as one point if the movements are done correctly or as zero point if the movements are done incorrectly. During the application of the test, each phase was recorded with the camera and a more detailed assessment was made in a more detailed manner, and the errors caused by the rating were reduced to the minimum. IBM SPSS 21 software program has been used for the calculations. Statistical significance level has been determined as $p<0.05$. After normality test, t tests and f tests were used for two and more than two groups, respectively.

3. Results and Discussion

Results of this study showed that there was no significant difference in the physical characteristics among TEG, CAEG and CG in both genders during pretest (Table 1).

No improvement was observed in the means of sprint, side gallop, catch and kick skills in male control group. But there were significant improvements in the means of hop, leap, two hands strike and throw skills in male control group. In males, both of TEG and CAEG showed the improvements in all variables. Male CAEG had higher improvements than TEG in the means of hop, side gallop, catch, kick and throw. On the other hand, TEG had higher improvements than CAEG in the means of sprint, leap and two hands strike in males (Table 2). No improvement was observed in the TGMD-2 score and sub-dimension of object control in the male CG. But there was significant improvement in the means of locomotor sub-dimension in male CG. In males, both of TEG and CAEG showed the improvements in all sub-dimensions including locomotor and object control. CAEG had higher improvements than TEG in the sub-dimension of locomotor. On the other hand, TEG had higher improvements than CAEG in the in the sub-dimension of object control and TGMD-2 score (Table 3).

No improvement was observed in the means of leap, and catch while significant improvements were observed in the means of sprint, hop, two hands strike, kick and throw in female CG. Both of TEG and CAEG in female showed the improvements in all variables. CAEG had higher improvements than TEG in the means of leap, side gallop, and two hands strike, catch and throw in female. On the other hand, female TEG had higher improvements than CAEG in the means of sprint, hop and kick (Table 4). No improvement was observed in the sub-dimension of locomotor but there were significant improvements in the means of object control sub-dimension and TGMD-2 score in female CG. Significant improvements were observed in both of TEG and CAEG in all sub-dimensions and TGMD-2 score. Female CAEG had higher improvements than TEG in the locomotor, object control and TGMD-2 score (Table 5).

The efficiency of computer assisted and the traditional education approaches on the development of fundamental movement skills was investigated in this study. Groups selected with respect to training groups were matched for age and anthropometric factors, as these might affect fundamental movement skills. Eight weeks training with playing games demonstrated that CAE is more effective in the means of hop, side gallop, catch, kick, throw and TEG is more efficient in the means of leap and two hands strike in boys. CAE is also more efficient in the means of leap, side gallop, and two hands strike, catch, throw and TEG is more efficient in the means of sprint, hop and kick in girls. Differences between two genders may be originated from sexual dimorphism leading male to having greater body height than female. Male CAEG had higher improvements than TEG in the sub-dimension of locomotor contrary to the higher improvements of in the object control and TGMD-2. Female CAEG had higher improvements than TEG in the means of locomotor, object control and TGMD-2. Although variations in body dimensions between males and females occur at the beginning of pregnancy, the basic anthropometric differences appear in adolescence. These variations until the beginning of adolescence are a result of low levels of sexual dimorphism (Bukowski et al. 2007; Wells 2007). Eight weeks training in our study is a critical factor in the observing the effectiveness of applied programs. Jandric (2010) examined the importance of physical activity in school children for children's normal growth and development. The results of Jandric's study demonstrated that a significant predictor of the differences between boys and girls in the level of physical activity was playing games or the amount of time spent outside. This means that games are a significant predictor of differences in physical activity between boys and girls. In our study, CAE seems to be more effective than TE in the development of fundamental movement skills for boys and girls. CAE was found to be more effective in teaching side gallop, catch and throw skills both in boys and girls. In general, CAE was more effective method than TE in TGMD-2 and its sub-dimensions of locomotor in both genders The superiority of CAE in object control was only observed in female. Differences between CAEG and TEG can be explained by positive effects of information and communication technologies motivate students towards physical and sportive due to providing free decision about learning styles (Stanescu, Stoicescu & Ciolca, 2011). The advantages of computer assisted education as a teaching method are an interactive and instant feedback obtained from many tools suitable to individual characteristics such as learning speed of the people, their readiness and visual and auditory learning styles. It was reported that educators and school administrators, computer and instructional technologies influence positively on the quality of teaching and research (Lehmann, Freedman, Massad & Dintzis, 1999). Silverman (1997) also reported that developing computer-assisted education and virtual reality practices have begun to be used to provide sports, physical fitness and physical education knowledge (Silverman, 1997). Researchers showed that there was the superiority of computer based in struction over traditional education methods in terms of fostering higher order learning such as critical thinking and problem solving (Safrit et al, 1988; Bowman, 1995). The diversity and importance of multimedia tools in physical education classes is increasing (Zhang, 2012).

It was concluded that CAE was more effective method than TE in TGMD-2 and its sub-dimensions of locomotor in males compared to the efficacy of CAE on both sub-dimensions in females. CAE was also found to be more effective in teaching side gallop, catch and throw skills both in boys and girls.

Further research is required to assess whether the effectiveness of different training programs on fundamental movement skills in large number of participants during short and long-term training programs.

Table 1. Comparison of physical characteristics among TEG, CAEG and CG in males and females during pretest.

		MALES						FEMALES					
Variables	**Group**	**N**	**M**	**SD**	**sd**	**F**	**Sig.**	**N**	**M**	**SD**	**sd**	**F**	**Sig.**
Age (Months)	**TEG**	6	78,00	4,52	2	1,190	,326	14	77,64	2,17	2	,713	,498
	CAEG	7	77,00	1,16				11	78,73	4,98			
	CG	9	79,78	4,24				8	76,63	4,27			
	Total	22	78,41	3,69				33	77,76	3,78			
Body Height (cm)	**TEG**	6	122,00	6,33	2	,628	,544	14	118,07	3,77	2	1,127	,337
	CAEG	7	118,71	4,75				11	119,55	4,53			
	CG	9	121,44	6,23				8	116,50	5,16			
	Total	22	120,73	5,73				33	118,18	4,40			
Body Weight (kg)	**TEG**	6	22,60	4,10	2	,266	,769	14	20,57	2,66	2	,666	,521
	CAEG	7	22,07	5,42				11	22,15	4,13			
	CG	9	23,87	5,35				8	21,03	3,66			
	Total	22	22,95	4,89				33	21,21	3,41			
Body Mass Index (BMI)	**TEG**	6	15,06	1,37	2	,326	,726	14	14,75	1,69	2	,524	,598
	CAEG	7	15,52	2,81				11	15,42	2,18			
	CG	9	16,09	2,69				8	15,41	1,62			
	Total	22	15,63	2,38				33	15,13	1,83			
TGMD 2	**TEG**	6	27,33	3,67	2	,497	,616	14	28,14	4,88	2	,424	,658
	CAEG	7	26,86	5,01				11	27,73	2,33			
	CG	9	29,22	5,74				8	26,63	2,83			
	Total	22	27,95	4,91				33	27,64	3,67			

Tablo 2. Comparison of locomotor and object control skill values among TEG, CAEG and CG during pre and posttest in males.

				Pretest		Posttest		Diff.	% diff	t value	p	Cohen's d
	Variables	**Group**	**N**	**M**	**SD**	M	SD					
Locomotor Skills	Sprint	**TEG**	6	3,00	1,10	4,67	1,86	1,67	55,67	-3,371	,020	1,093‡
		CAEG	7	4,14	1,46	5,29	1,80	1,15	27,78	-1,549	,172	0,702†
		CG	9	3,89	1,36	3,78	1,56	-0,11	-2,83	,244	,813	-0,075
	Hop	**TEG**	6	4,83	1,47	5,50	1,23	0,67	13,87	-1,195	,286	0,494†
		CAEG	7	4,29	1,50	6,00	1,63	1,71	39,86	-3,032	,023	1,092‡
		CG	9	4,22	2,33	4,78	1,56	0,56	13,27	-1,348	,214	0,282†
	Leap	**TEG**	6	3,33	0,82	4,33	1,03	1	30,03	-2,739	,041	1,074‡
		CAEG	7	3,57	1,27	4,71	1,11	1,14	31,93	-2,248	,066	0,956‡
		CG	9	3,78	0,67	4,22	1,20	0,44	11,64	-1,180	,272	0,453†
	Side Gallop	**TEG**	6	4,50	1,05	5,67	1,63	1,17	26,00	-2,445	,058	0,853‡
		CAEG	7	2,57	1,81	5,29	2,22	2,72	105,84	-2,955	,025	1,343‡

Object Control Skills		CG	9	3,78	1,56	3,78	1,48	0	0,00	,000	1,00	0,000
	Two hands strike	TEG	6	3,83	1,17	5,33	0,82	1,5	39,16	-4,392	,007	1,485‡
		CAEG	7	4,00	1,53	5,57	1,99	1,57	39,25	-1,416	,206	0,885‡
		CG	9	4,56	1,51	4,11	1,45	-0,45	-9,87	1,180	,272	-0,304†
	Catch	TEG	6	3,00	0,89	3,50	0,55	0,5	16,67	-2,236	,076	0,676†
		CAEG	7	2,86	0,90	4,14	1,35	1,28	44,76	-1,996	,093	1,116‡
		CG	9	3,78	0,83	3,78	1,20	0	0,00	,000	1,00	0,000
	Kick	TEG	6	4,17	0,41	5,00	1,41	0,83	19,90	-1,536	,185	0,799†
		CAEG	7	3,57	1,13	4,71	1,25	1,14	31,93	-1,549	,172	0,957‡
		CG	9	4,22	0,97	4,44	1,74	0,22	5,21	-,389	,708	0,156
	Throw	TEG	6	,67	0,82	1,33	1,97	0,66	98,51	-,933	,394	0,437†
		CAEG	7	1,86	1,22	4,00	1,63	2,14	115,05	-2,785	,032	1,486‡
		CG	9	1,00	1,12	1,56	0,88	0,56	56,00	-2,294	,051	0,556†

Note: **TEG** = Traditional education group, **CAEG** = Computer assisted education group, **CG**=Control group.

* Significant difference at 0.05 level, ** Significant difference at 0.01 level.
Effect size, Cohen's *d* . † $p < .05$. and ‡ $p < .001$.

Tablo 3. Comparison of TGMD 2 and its subscales' results between pre and post test values in males.

Variables	Group	N	Pretest		Posttest		Diff.	% diff	t value	p	Cohen's d
			M	SD	M	SD					
Locomotor	TEG	6	15,67	3,50	20,17	4,79	4,5	28,72	-4,258	,008	1,073‡
	CAEG	7	14,57	2,30	21,29	5,25	6,72	46,12	-3,608	,011	1,658‡
	CG	9	15,67	3,50	16,56	4,00	0,89	5,68	-,819	,437	0,237†
Object Control	TEG	6	11,67	1,03	15,17	2,04	3,5	29,99	-3,312	,021	2,166‡
	CAEG	7	12,29	3,50	18,43	3,87	6,14	49,96	-2,742	,034	1,664‡
	CG	9	13,56	2,70	13,89	3,33	0,33	2,43	-,535	,608	0,109
TGMD 2	TEG	6	27,33	3,67	35,00	3,46	7,67	28,06	-5,362	,003	2,151‡
	CAEG	7	26,86	5,01	39,71	8,30	12,85	47,84	-3,550	,012	1,874‡
	CG	9	29,22	5,74	30,44	6,78	1,22	4,18	-,854	,418	0,194

Note: **TEG** = Traditional education group, **CAEG** = Computer assisted education group, **CG**=Control group.

* Significant difference at 0.05 level, ** Significant difference at 0.01 level.
Effect size, Cohen's *d* . † $p < .05$. and ‡ $p < .001$.

Tablo 4. Comparison of locomotor and object control skill values among TEG, CAEG and CG during pre and posttest values in females.

Variables		Group	N	Pretest		Posttest		Diff.	% diff	t value	p	Cohen's d
				M	SD	M	SD					
otor	Sprint	TEG	14	3,79	1,122	5,21	1,251	1,42	37,47	-5,701	,000	1,195‡
		CAEG	11	4,00	1,41	5,09	1,70	1,09	27,25	-2,058	,067	0,698†
		CG	8	3,75	1,753	4,50	1,927	0,75	20,00	-1,342	0,22	0,407†
	Hop	TEG	14	4,86	1,406	6,64	1,216	1,78	36,63	-5,623	,000	1,354‡

Object Control Skills		**CAEG**	11	5,45	1,81	6,73	1,35	1,28	23,49	-2,106	,061	0,802‡
		CG	8	4,63	,916	5,13	1,126	0,5	10,80	-1,528	0,17	0,487†
		TEG	14	3,29	1,139	3,93	1,072	0,64	19,45	-3,229	,007	0,579†
	Leap	**CAEG**	11	3,36	0,51	4,00	0,78	0,64	19,05	-2,283	,046	0,971‡
		CG	8	3,88	,835	3,88	,835	0	0,00	,000	1,00	0,000
		TEG	14	4,21	2,225	5,14	2,070	0,93	22,09	-3,484	,004	0,433†
	Side Gallop	**CAEG**	11	3,64	2,06	5,18	2,04	1,54	42,31	-2,424	,036	0,751†
		CG	8	4,25	1,282	3,13	1,246	-1,12	-26,35	1,760	0,12	-0,886‡
		TEG	14	4,79	1,672	5,79	1,251	1	20,88	-3,606	,003	0,677†
	Two hands strike	**CAEG**	11	3,64	1,03	4,82	1,17	1,18	32,42	-2,550	,029	1,071‡
		CG	8	3,38	,744	4,25	1,282	0,87	25,74	-2,198	0,06	0,830‡
		TEG	14	3,14	,864	3,79	1,188	0,65	20,70	-2,090	,057	0,626†
	Catch	**CAEG**	11	3,64	1,36	4,36	0,81	0,72	19,78	-2,185	,054	0,643†
		CG	8	3,00	,756	2,88	,835	-0,12	-4,00	,314	0,76	-0,151
		TEG	14	3,36	1,216	4,29	1,267	0,93	27,68	-1,958	,072	0,749†
	Kick	**CAEG**	11	3,45	1,04	4,09	0,94	0,64	18,55	-2,283	,046	0,646†
		CG	8	3,13	1,126	4,00	1,069	0,87	27,80	-2,198	0,06	0,792†
		TEG	14	,71	1,069	1,29	,825	0,58	81,69	-2,280	,040	0,607†
	Throw	**CAEG**	11	,55	0,69	2,91	0,83	2,36	429,09	-8,480	,000	3,092‡
		CG	8	,63	,916	,38	,744	-0,25	-39,68	,798	0,45	-0,300†

Note: **TEG** = Traditional education group, **CAEG** = Computer assisted education group, **CG**=Control group.

* Significant difference at 0.05 level, ** Significant difference at 0.01 level.
Effect size, Cohen's *d* . † $p < .05$. and ‡ $p < .001$.

Tablo 5. Comparison of TGMD-2 and its subscales' results between pre and post-test in females.

Variables	Grup	N	Pretest		Posttest		Diff.	% diff	t value	p	Cohen's d
			M	SD	M	SD					
	TEG	14	16,14	3,920	20,93	4,122	4,79	29,68	-6,868	,000	1,191‡
Locomotor	**CAEG**	11	16,45	2,12	21,00	3,26	4,55	27,66	-6,330	,000	1,655‡
	CG	8	16,50	2,673	16,63	3,583	0,13	0,79	-,154	0,88	0,041
	TEG	14	12,00	2,287	15,14	2,878	3,14	26,17	-4,634	,000	1,208‡
Object Control	**CAEG**	11	11,27	2,37	16,18	1,78	4,91	43,57	-5,796	,000	2,343‡
	CG	8	10,13	1,727	11,50	2,390	1,37	13,52	-1,590	0,16	0,657†
	TEG	14	28,14	4,881	36,21	5,846	8,07	28,68	-7,498	,000	1,499‡
TGMD 2	**CAEG**	11	27,73	2,33	37,18	4,07	9,45	34,08	-7,972	,000	2,850‡
	CG	8	26,63	2,825	28,13	5,357	1,5	5,63	-1,288	0,24	0,350†

Note: **TEG** = Traditional education group, **CAEG** = Computer assisted education group, **CG**=Control group..

* Significant difference at 0.05 level, ** Significant difference at 0.01 level.
Effect size, Cohen's *d* . † $p < .05$. and ‡ $p < .001$.

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