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The effect of iPad apps on creative thinking among preschoolers in Jordan

[1] Mohammad Ahmad Abdelaziz Al-Zu'bi, [2] Mohd Sofian Omar-Fauzee, [3] Amrita Kaur

[1, 2, 3] Education Department, University Utara Malaysia, Malaysia
[1] Ministry of Education, Jordan

Abstract
The present study examined the effectiveness of iPad as an educational technology tool on creative thinking based apps from apple store. Data from a total of 67 preschool children from one kindergarten in Amman city was included in this quasi-experimental investigation in which students in the experiment group used early creative thinking reinforcing through use iPad apps to complement their traditional way delivered early creative thinking education, within kindergarten classroom.
The researchers used test of thinking creatively in action and movement (TCAM) at pre and post-test, the duration of the current study was 13 weeks one session weekly included pre and post-tests. The TCAM scores demonstrated that preschool children in the experiment group show greater gains on creative thinking skills of fluency, originality and imagination. Additional gender variable was examined in an effort to better understand the impact of the iPad intervention.

Keywords: preschool children, creative thinking, iPad apps

Introduction
According to Isenberg and Jalongo (2014) [25], the preschool children have an able to creative thinking, as well as Garaigordobil and Berrueco (2011) [19]; Torrance (1981, 1990) [45] confirmed that preschoolers have great potential to achieve high levels of creative thinking if it is supported through suitable programs (Garaigordobil & Berrueco, 2011; Torrance, 1981, & 1990) [19, 45]. In addition, Isenberg and Jalongo (2014) [25] mentioned that many intervention treatments among preschoolers are shown to improve and increase the levels of creative thinking.
Furthermore, Goodman and Sianesi (2005) [20] identified that the intervention programs which it used to improve the level of creative thinking are shown to contribute to achieve a positive outcomes in next education stages, as well as to produce long-term improvements for example an increase the level of educational achievement. Moreover, through the results of number of studies (*e.g.* Farnes & Noller, 1973; Isaksen & Parnes, 1985; Rose & Lin, 1984; and Torrance, 1974) [45, 24, 38, 44] that creative thinking skills led to improve and increase the individual problem-solving ability. Hence, the intervention programs of creative thinking are indeed to be useful for preschoolers. Moreover, Garaigordobil and Berrueco (2011) [19] suggested to further studies are needed on creative thinking at the preschool stage.
The use of iPad as an educational technology tool in education have already increased during the last seven years, this is proving the benefit and impact to using iPad apps in education (Cubelic & Larwin, 2014; Cubelic, 2013; Cumming, *et al.*, 2014; Fagan & Coutts, 2012; Hatherly & Chapman, 2013; Reichenberg, 2014; Oladunjoye, 2013) [11, 12, 13, 16, 21, 36, 34]. Moreover, there are many studies (*e.g.* Beschorner & Hutchison, 2013; Clark & Luckin, 2013; Spencer, Coutts, Fagan, & King, 2013; Kitchner, 2012; Fagan & Coutts, 2012) [40, 9, 5, 29, 16] which suggested to use iPad as an educational technology tool in multiple ways to support the education among young children in classrooms, as well as with great effectiveness at classrooms. The results of the previous studies confirmed the impact of iPad to improve many of educational aspects as well as skills which needed to achieve a successful among students, especially preschoolers.
According to many of studies (*e.g.* Clark & Luckin, 2013; Spencer, *et al.*, 2013; Kitchner, 2012; Fagan & Coutts, 2012) [9, 16, 40, 16], iPad is conssidered a powerful tool for engagement in education as well as the facilitation of seamless learning. In addition, the studies of Cubelic and Larwin, (2014) [12] and Oladunjoye (2013) [34] are suggested that the iPad an excellent educational technology tool through explore and enhance the creative thinking, as well as the iPad is shown as an excellent tool to create fun and bring out the creative in preschool education stage. In addition, the studies that use iPad in education were to learn and improve the levels of literacy and Mathematics (*e.g.* Cubelic & Larwin, 2014; Cubelic, 2013; Cumming, *et al.*, 2014; Hatherly & Chapman, 2013; Reichenberg, 2014; Oladunjoye, 2013) [11, 12, 13, 21, 36, 34]. In addition, Al-Zu'bi *et al.* (2017) [3] suggested to conduct a qualitative research and an experimental study, over a period of time to develop the level of creative thinking through using IPad as a new educational technology tool among preschool children, to know how IPad influences children's creativity.
In summary, According to above, it is clear that the use of iPad as an education technology tool has a major role in education process, particularly among preschool children. However, with closer scrutiny reveals that this use is in helping and supporting to learn and improve literacy and mathematics (Cubelic & Larwin, 2014; Cubelic, 2013; Reichenberg, 2014; Oladunjoye, 2013; Hatherly & Chapman, 2013; Beschornerl & Hutchson, 2013) [11, 12, 21, 36, 34, 5]. Other interest point, Oladunjoye (2013) [34] observed that researches are limited to improving the level of literacy among preschoolers, with scope available to exploring the using of technology on cognition and behaviors among preschoolers.
The above leads to the conclusion that the iPad as an educational technology tool will improve and enhance the creative thinking

during learning creative thinking process among preschoolers. This leads to the problem statement of the study:

1. To investigate the effect of iPad as an educational technology tool on developing creative thinking among preschoolers.
2. To address the gender effect amongst preschoolers in the use of iPad, in creative thinking.

Research questions

1. Is there any difference between the experimental and control groups at pre-test and post-test on Creative Thinking?
2. Is there any gender difference between the experimental and control groups at pre-test and post-test on Creative Thinking?

IPad as an educational tool

The iPad as a new educational technology tool is considered an ideal tool due to great characteristics such as small and lightweight as well as iPad gives an easy access to apps (Young, 2010) [50]. According to Bush and Cameron (2011) [7]; Byno (2014) [8]; Cooper (2012) [10]; Friess, (2012) [17]; and Tomassini (2012) [42], there are a number of features to iPad which it support the education in school such as using an Email as well as web browsing. The academic apps which it are used from Apple store could be also augmented through adding the word processing program and spreadsheet numbers program by Apple Inc. The feature of these apps are the possibility to design and construction as well as to modernization and development according to what we need to do at the academic process (Bennett, 2011) [4].

The Effectiveness of iPad in Education

Since 2010, the use of iPad as a new educational technology tool has increased as well as the studies that addressed iPad have already increased whith positive impact and effectiveness in various aspects of the educational process (Linskens, 2013) [30]. There are an evidence of research which confirmed to the effectiveness and impact of iPad in education aspects as well as being a tool that can enhance the learning experience due the many of features which iPad is offered. Furthermore, many studies such as Van der Meer *et al.* (2015) [48] investigate the iPad as an educational technology tool to increase the level of academic skills, as well as the study achieved successful results.

IPad and literacy

Most studies that addressed iPad among preschoolers (*e.g.* Beschorner & Hutchison, 2013 [5]; Hatherly & Chapman, 2013; Oladunjoye, 2013) [21, 34] explained that touch-screens makes literacy learning (reading and writing) have focused on literacy (reading and writing). Literacy is considered an important at pre-school stage as well as it provides ample scope for research. Furthermore, the studies which addressed iPad (*e.g.* Reynolds-Blankeship, 2013) [37] are indicated to use of apps which support and improve the literacy skills allowed preschoolers to enhance learning. Those studies (Beschorner & Hutchison, 2013; Hatherly & Chapman, 2013; Oladunjoye, 2013) [5, 21, 34] explained that touch-screens makes literacy learning (reading and writing) interestingly. Therefore, iPad will become an ideal tool to learn a literacy for many in school and kindergarten. In addition, the tremendous interaction possibilities in iPad will attract preschool children to the application (Beschorner & Hutchison, 2013; Hatherly & Chapman, 2013; Oladunjoye, 2013) [5, 21, 34].

IPad and creativity

According to study of Ireland and Woolerton (2010) [23], iPad as a new educational technology tool encouraged the use imagination and creativity at educational process, through touch screen will make it very exciting to experiment as compared to other education tools.

As well as some researchers found that the way to leverage iPad is to allow children to experiment and apply with a novel ideas. This is, iPad has enough of applications which allow children to increase and improve their own education by themselves (Morrone, Gosney & Engel, 2012) [33].

Creative Thinking and Preschool Children

According to many studies that addressed creative thinking, they confirmed that children between 5 and 6 years think in creatively with more freedom than older other children. In addition, preschoolers in 5 years are in that upper period of cultivate the creative thinking (Breckenridge & Murphy, 1963; Dacey, 1989; Ford & Harris, 1992; Khatena, 1971; Meador, 1992) [6, 14, 18, 28, 31]. Several studies are focused on offering the opportunities as well as showing how creative thinking can be taught in school, as well as the using well-organized materials, educational tools and techniques, creative thinking could be increased and developed among children (Slabbert, 1994; Torrance, 1964; Suwantra, 1994) [39, 43, 41].

Research Methodology

The Population and Sampling of the Study

The present study was used the pre and post-test quasi-experimental design aimed at examine the effectiveness of iPad apps on creative thinking among preschool children in Jordan.

The population of the current study was all preschool children in Amman city in Jordan. Moreover, the researchers chose one kindergarten from Amman city randomly, then the researchers chose the KG2 children at the kindergarten where the age of preschool children 5 years old. In addition, the number of preschool children in the kindergarten were 330. The reason to choose only one kindergarten is because of the nature of research design, i.e. quasi-experimental intervention. It is not possible to conduct experimental intervention in multiple kindergarten because of the rigour and care that is required by the intervention (Mertens, 2010; Heppner, Wampold, & Kivlighan, 2008; and Wright, 2014) [32, 22, 49]. Then, the researchers selected 2 classrooms from same kindergarten (class C was the experimental group with 33 children and class H was the control group with 34 children) which were 67 children from 330. Therefore, a sample of 67 children were selected from one kindergarten in Amman City in Jordan.

Instrumentation

To answer to the research questions of the current study, one instrument was used: Thinking Creatively in Action and Movement TCAM. The test was built by Torrance (1981) [45], as well as the test involved four activities: Activity 1 - How Many Ways? This evaluate two dimensions of TCAM fluency and originality; Activity 2 - Can You Move Like? This evaluate imagination dimension; Activity 3 - What Other Ways? This evaluate two dimensions of TCAM fluency and originality; and finally Activity 4 - What Might It Be? This evaluate two dimensions of TCAM fluency and originality.

The inter-rater reliability coefficients were extracted by Torrance (1981) [45] the results were 0.90 to 0.99 Cronbach

alpha. In addition, Al-Zu'bi *et al.* (2017) [3] extracted the reliability to TCAM, and determined the reliability for the test through using Cronbach's alpha. 110 preschool children were administered the test in the same kindergarten in Jordan. The results from Cronbach's alpha shows an acceptable value (0.84).

Intervention Program to Learn Creative Thinking using iPad

The training program at the present study was based on learning through using of iPad. The major target of this intervention is to teach creative thinking to pre-school children. The intervention program involved a twelve sessions, one session weekly the duration to each session was a 30 minutes. Four apps from the apple store were selected. These are specialized apps to teach pre-school children creative thinking ('fun my audios apps', 'Lazoo: Squiggles', 'Super Mosaic for kids', and 'History repeats itself').

Procedure

The researchers have chosen one kindergarten from Amman city in random way to be a participate in the current study. Then, the researcher obtained the approval from kindergarten to conduct the current study.

Further, the researcher selected 2 classrooms from kindergarten with non random (class C was the experimental group with 33 children and class H was the control group with 34 children). Then, the researchers explained to teachers that will participate at the current study the aims of the study, as well as the teacher that will apply the intervention was trained on how she will conduct the intervention by the researchers. Furthermore, the study needs 13 weeks to complete with pre and post-tests.

Data Analysis

The aim of the current study is to examine the effectiveness of iPad apps on creative thinking among preschool children in Amman City in Jordan. For this purpose, the data was analyzed using Paired-Samples t Tests and ANCOVA.

Results

Test first hypothesis: the first hypothesis of the current study is "There is no significant difference between experimental and control groups in terms the difference between pre-test and post-test scores on total of creative thinking scores (TCAM)".

Paired t test is the suitable statistic test which it used to find out the difference in normal distributed dependent variables for same subjects at different times of experiment group. According to the results of Paired t test there was significant difference found in total score of creative thinking (TCAM) between pre and post-test in experiment group, where higher means of creative thinking scores observed with post-test than pre-test. In addition, about Control group there was no significant difference found in total score of creative thinking (TCAM) between pre and post-test, as shown in Table 1.

Table 1: Summary of Paired-Samples t Tests for the experimental and control Groups Pre-and Post-Intervention Dependent Variables in creative thinking

Group	Paired Differences	Mean	SD	T	Df	p	N
Experimental	Pre-test	49.61	10.26	-19.67	32	.00	33
	Post-test	77.30	8.55				
Control	Pre-test	49.68	7.04	-1.95	33	.06	34
	Post-test	51.44	7.81				

Next figure illustrated the higher means of total score of creative thinking of experimental group than in control group in post-test, while no difference observed in pre-test**.**

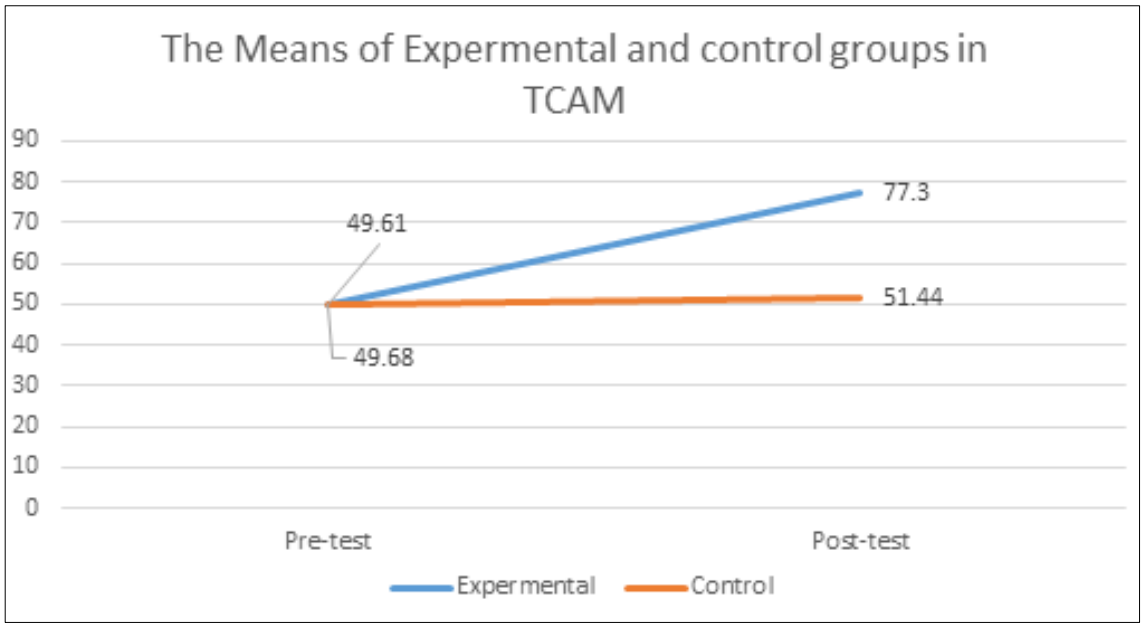

Fig 1: Means of Experimental and control groups in TCAM.

In order to evaluate the statistical significance of the difference in the mean scores, a one-way analysis of covariance (ANCOVA) was conducted at a significance level of .05. The independent variable, Group, includes two groups: Experimental and Control. The dependent variable is the participants' post-test scores (creative thinking score TCAM) and the covariate is the participants' pre-test scores. The results are shown in Table 2 and 3.

Table 2: ANCOVA results and descriptive statistics for contrast by group and post-test scores to TCAM

Groups	Pre-test Score		Post-test Score		N
	Mean	SD	Mean	SD	
Experiment group	49.61	10.26	77.30	8.55	33
Control group	49.68	7.04	51.44	7.81	34
Sources	SS	df	Ms	F	Sig.
Corrected Model	13308.18a	3	4436.06	124.45	.00
Intercept	1603.8	1	1603.8	44.99	.00
Group	718.68	1	718.68	20.16	.00
TCAM .pre	2068. 62	1	2068.62	58.03	.00
Group * TCAM .pre	96.96	1	96.96	2.72	.10
Error	2245.67	63	35.65		
Total	291524.00	67			
Corrected Total	13308.18a	3	4436.06	124.45	.00

Note: a. R Squared = .856 (Adjusted R Squared = .849), b. Computed using alpha = .05.

Table 3: Pairwise Comparisons to the experimental and control Groups at Post-test of SAS scores

Group	Mean Difference	Std. Error	Sig.[a]	95% Confidence Interval for Difference	
				Lower Bound	Upper Bound
Experimental VS. Control	25.91*	1.46	.00	22.99	28.83

Based on estimated marginal means. *. The mean difference is significant at the .05 level, a. Adjustment for multiple comparisons: Bonferroni.

One-way ANCOVA results shown that there were statistically significant differences among groups at post-test, indicating a significant main effect for intervention program (Table 3 and 4). Multiple comparisons revealed significant differences between the control group and experimental group. However, the mean difference between the experimental group and control group was a statistically significant (Table 3 and 4). Moreover, The Means shown that participants in the experimental group performed best, with participants in the control group performing worst.

The results shown that the two groups had significant difference in their performance at post-test. The experimental group outperformed the control group in identifying the contrast, indicating that the intervention of CBT had a significant effect on performance in identifying the contrast. Hence, the null hypothesis predicting that there would be no significant differences among groups' performance at post-test is rejected. The experimental group outperformed the control group in identifying the contrast, indicating that the intervention of CBT had a significant effect on performance in identifying the contrast.

Test second hypothesis: the second hypothesis of the current study is "There is no significant interaction effects between genders in terms of post-test scores on total of Creative Thinking scores (TCAM)."

According to Paired t test is statistical test, there was a significant difference found in score of TCAM scores between pre and post-test of Female, where higher means of TCAM scores observed with post-test than pre-test. Similarly, about Male there was a significant difference found in score of TCAM scores between pre and post-test, as shown in Table 4.

Table 4: Summary of Paired-Samples t Tests for Male and Female at Pre-and Post-Intervention Dependent Variables

Gender	Paired Differences	Mean	SD	T	df	p	N
Male	Pre-test	49.97	9.57	-5.77	31	**.00**	32
	Post-test	65.97	17.57				
Female	Pre-test	49.34	7.96	-5.64	34	**.00**	34
	Post-test	62.54	13.04				

Next figure shown the means of score of TCAM was increased to male and female in post-test.

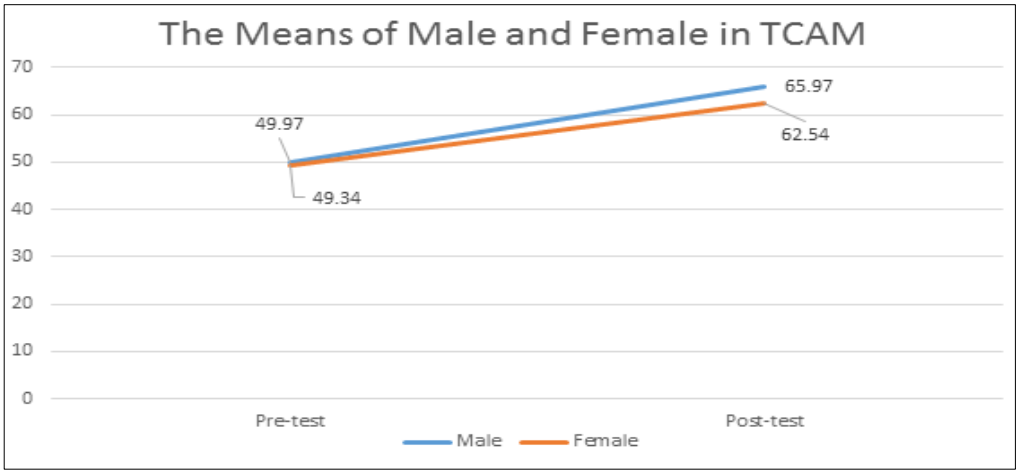

Fig 2: The Means of Male and Female in TCAM.

In order to evaluate the statistical significance of the difference in the mean scores, a one-way analysis of covariance (ANCOVA) was conducted at a significance level of .05. The independent variable, Gender, includes Male and Female. The dependent variable is the participants' post-test scores (creative thinking score TCAM) and the covariate is the participants' pre-test scores. The results are shown in Table 5 and 6.

Table 5: ANCOVA results and descriptive statistics for contrast by gender and post-test scores to creative thinking

Gender	Pre-test Score		Post-test Score		
	Mean	SD	Mean	SD	N
Male	49.97	9.57	65.97	17.57	32
Female	49.34	7.96	62.54	13.04	34
sources	SS	df	Ms	F	Sig.
Corrected Model	2445.23a	3	815.08	3.92	.01
Intercept	2376.51	1	2376.51	11.42	.00
Gender	239.93	1	239.93	1.15	.29
creative thinking .pre	1686.56	1	1686.56	8.11	.01
Gender * creative thinking .pre	319.05	1	319.05	1.53	.22
Error	13108.62	63	208.07		
Total	291524	67			
Corrected Total	15553.85	66			

Note: a. R Squared = .157 (Adjusted R Squared = .117), b. Computed using alpha = .05

Table 6: Pairwise Comparisons to the experimental and control gender at Post-test of creative thinking scores

Gender	Mean Difference	Std. Error	Sig.[a]	95% Confidence Interval for Differencea	
				Lower Bound	Upper Bound
Male VS. Female	3.05	3.53	.39	-4.00	10.11

Based on estimated marginal means. *. The mean difference is significant at the .05 level, a.
Adjustment for multiple comparisons: Bonferroni.

One-way ANCOVA results shown that there were no statistically significant differences among gender at post-test, indicating a not significant effect for iPad intervention program (Table 5 & 6) multiple comparisons revealed not significant differences between the Male and Female. Moreover, The Means shown that Male and Female participants was a same performed.

The results shown that the both gender had not significant difference in their performance at post-test. The Male did not outperformed the Female in identifying the contrast, indicating that the intervention of iPad Apps had not a significant effect on performance in identifying the contrast. Hence, the null hypothesis predicting that there would be no significant differences among gender' performance at post-test is accepted. Male did not outperformed Female in identifying the contrast, indicating that the intervention of iPad Apps had not a significant effect on performance in identifying the contrast.

Discussion

The results of the first hypothesis of the present study refer that there are a significant difference between experimental and control groups in terms the difference between pre-test and post-test scores on total of creative thinking scores. The results consistent with previous studies such as (Khadir, & Bishara, 2011; Suwantra, 1994) [41, 27] which it increase and improve the level of creative thinking through using a good intervention programs. In details of the results of the present study is consistent with previous studies that address iPad as an educational tool (*e.g.* D'Agostino *et al.*, 2015; Turkestani, 2015) [15, 47] these studies consistent that the iPad as an educational tool are considered an Ideal tool to improve many of educational

aspects such as literacy (D'Agostino *et al.*, 2015) [15] and School Preparedness (Turkestani, 2015) [47]. Further, these studies identified that iPad as an educational tool have many features which it contribute to facilitate the learning process among preschool children (D'Agostino *et al.*, 2015; Turkestani, 2015) [15, 47].

Therefore, in the present study, the results are confirmed that the visually perceiving is considered a feature of iPad that facilitate learning process. This what the researcher noted during carried out the intervention program of the present study, where students become more creativity due iPad opened up new horizons to students through more thinking about things. As well as iPad apps were also contributed to encourage the motivation to creativity through the interested which children appeared during the iPad sessions, and this point leads to achieve high level of educational performance during educational session. Hence, this is considered an evidence to effectiveness of iPad as an educational technology tool in education process.

The results of the second hypothesis of the present study refer that there are no significant interaction effects between genders in terms the difference between pre-test and post-test scores on total of Creative Thinking scores (TCAM). The results consistent with previous studies such as (Al-Ameri, 2007; Al-Jaberi, 2011; Jarwan & Al-Abbadi, 2010; Turkestani, 2015) [47, 1, 2, 26] which it no significant interaction effects between genders in creative thinking scores. The results of Al-Ameri (2007) [1] and Jarwan and Al-Abbadi (2010) [26] were confirmed that no significant gender effect on creative thinking where the researchers mentioned that both of gender have same skills to acquisition and learn creative thinking. and this what Piaget (1958) confirmed that preschool children can use symbols and internal thought to solve problems. Moreover, their thinking is still tied to concrete objects and the here and now. They are fooled by the appearance of things (Piaget, 1958).

Moreover, in studies of Al-Jaberi, 2011 (2011) [2] and Turkestani (2015) [47] they confirmed that the gender did not significantly influence the experimental group's level of performance. Games that were downloaded on the children's devices did not differ between the sexes. The nature of downloaded programs was general and had no specific characteristics that would create different mental thought processes between sexes. This finding may reflect the lack of difference between them in the development of the social, motor and language skills, which also might explain the similarity between them (Al-Jaberi, 2011 & Turkestani, 2015) [47, 2]. In addition, the present study did not find any differences between genders refer to creative thinking or any diminutions of creative thinking (fluency, originality and imagination).

Limitation

The main issue faced in this study is that more kindergartens could not be applied because of logistics limitations. Therefore, the number of kindergartens which applied the iPad intervention program was limited to just one kindergartens in Amman City, Jordan due the nature of the experimental design. Another study should focus on more kindergartens in order to generalize the findings.

Suggestion and Future Investigation

The present study is suggested to set up a supervisory committee in the Ministry of education in Jordan to study of using iPad at kindergartens to increase the levels of creative thinking among preschool children due the positive outcomes as shown at the current study. As well as the possibility to use iPad as an educational tool to teach literacy among preschool children.

Hence, the current study is recommended to conduct the iPad apps as an educational program to increase in the levels of creative thinking among preschool children. Further, the current study addressed only preschool children, while other studies could focus on other education stages in order to generalize the findings.

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