

Effectiveness of Computer Games on the Creativity and Educational Performance of Students

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ABSTRACT— Today computers and their appurtenances have extended applications and include a wide range of applications. As a result of this extension in usage, many audiences from different ages, educational levels and experiences are accounted as users of this technology, among them children and adolescents' dealing with this technology is significant. According to different statistical data most of children and adolescent's using computers includes different types of computer games. Due to this fact that there is not a single opinion about the positive and negative effects of playing computer games, the necessity of further researches on different aspects of this issue is released.

Aim: In this research it's attempted to investigate the effects of computer games on educational performance and creativity of girl students in middle schools of 6th district of Tehran, Iran.

Method: The present research is a quasi-experimental type with two pretest-posttest groups and a control group. All girl students in middle grade of Tehran's 6th district were selected as the statistical population of this research. Using stratified cluster sampling, a school and an educational (first) grade including two classes were selected. The members were assimilated due to intelligence, demographic conditions, the time allocated to computer games and the type of enthusiasm (the number of each group members is 25 and overall is 50).

KEYWORDS: computer games, creativity, educational performance, students

Introduction

We have stepped in the era that is paralleled with the revolution of data and technology. The era that in Toffler's view is called "The third wave" and living in that leads to dealing with new changes. The increasing speed of expansion and influence of technology and its evolutions within all society's structures such as industry, economics, politics, and... is undeniable. These evolutions also go beyond and have influenced on different aspects of individual and social life such as education, lifestyle, and... . Meanwhile most of developed countries that definitely have more important role in producing and improving the technology, accepting this reality began to use this given opportunity desirably. For example a country such as Germany for achieving better education and training have invested largely in the field of technology and communications to have stronger and richer education and training (Afkhami Aqda et al, 2012).

In contrast, some countries still refuse to accept this important issue and by denying this, try to prevent it from entering the life of various sectors of people. This approach can be further seen in the developing societies who generally have the role of technology users. While despite their propensity, technology continues its own way .

The advent of computer is one of the best examples of technology. Today computers and their accessories have a widespread application, and include extensive range of analysis from complex information and advanced designs to a variety of educational software programs and different games. Due to this extent of applications, many audiences with different ages, levels of education and different experiences are considered as users of this technology, in which the interaction of children and adolescents with this technology is significant. According to various statistics most of computer uses by children include a variety of computer games (Shariat, 1388). Due to the report of Boot, Kramer, Simons, Fabiano and Graton (2008) 85 to 95 percent of American adolescents, and 75 to 90 percent of Japanese adolescents, have mentioned computer games as one of the most important tools for entertainment and leisure time. Asadollah Pour et al and Javadi, Emami Pour, Rezaei Kashi (2009) have also shown in their research that in Iran also access to and using computer games among children and adolescents in small cities and provincial capitals is between 65 and 80 percent. These reports show that , despite using computer games in different ages even by adults , most of these games' use is among children and adolescents (Chisholm, 2010).

Computer games date back to over 30 years ago. The emergence of this phenomenon have had a wave of promises and concerns. While some have accompanied good news for opening a new and creative world for children and adolescents and considered these games as an introduction to learn more about computer, language learning, improving eye-hand coordination skills and regulating leisure time, others have seen games' contents anxiously since by increasing the attractiveness and maximizing the use of technology, try to influence their audience in the virtual world sometimes violently, and transmit the culture of producing countries to the next generation of other countries (Saremi, 1375).

In 1980 researchers began to evaluate the effects of computer games in different fields including body and mental health, educational performance, social and cultural applications, etc (Fank & Boochman, 1999). In 2006, Anderson emphasized on the negative effect of computer games on educational performance and decreasing the students' self-esteem, while at the same time Martins considered using computer games moderately, useful for educational weak points. Among disadvantages of computer games is the emergence of anxiety derived from the excitement of some games' contents (Valadez & Ferguson, 2012) which put the mental health of children and adolescents in danger (Poor et al, 2009). According to the research of Möller et al (2009), this sort of games because of attraction and being much time consuming (addictiveness) are accounted as one of the causes of educational fall in students. Some research also mentioned body hurts and aggression derived from computer games in children (Delbari, Mohamadzade, Delbari, 2009). Efficient entertainments center, the Institute of the Intellectual Development of Children and Adolescents in a reporting the result of researches on effects of computer games has mentioned social isolation, health problems, aggression, poor educational performance, etc and on the other hand have pointed to enhancing problem-solving skill, improving the educational performance and skills in children with disabilities, and etc (1380). In contrast, other studies have shown the benefits of these games. These researches showed that computer games are very effective on speed, eye-hand coordination, and brain motivation for thinking (Lee & Atkinson, 2004). Matthews et al (2010), in their research cited the efficacy of these games on mental activities such as problem solving, planning and spacial visualization. Other researches also find these games useful to develop creativity, emotional drain, promoting learning, increasing the power of decision and mental challenge (Schubert, 2012; Reza'ian et al, 2012). Other studies such as the research of Pour Abedi (1379) and Yen Chuang (2009) showed that students using computer games at home, have better educational performance.

Since there isn't a consensus about the effects of computer games' uses, it is necessary to study the different aspects of this case. One of the main concerns of parents and education authorities is disturbing factors in children and adolescents' attention to educational issues, among them different types of computer games are in a special position. These games due to the extent of their applications and creating a more attractive space compared with doing homework, lead to interfere in scientific and educational performance. Traditional and non-innovative education system which is inconsistent with the spirit of curious and inquiring spirit of students, is one of the main concerns of teachers and researchers and reaching to the right solution requires more studies. Indeed, what should be done? On the one hand, the technology and desire to it is uncontrollable and undeniable, on the other hand mismanagement of using this case has caused increasing problems among families and schools. Reports indicate that these conflicts resulted in the reduction of students' interest to studying and going to school (Ferguson et al., 2012). Is it possible to make a correct link between these two, and use computer games for educational purposes? In this study, it is attempted to study the impact of computer games on school performance and creativity of the girl students in middle schools of Tehran's 6th district.

Research questions:

1. Do computer games affect on students' creativity?
2. Do computer games affect on students' educational performance?
3. Do computer games affect on different aspects of students' creativity?
4. Do computer games affect on different aspects of students' educational performance?

Hypotheses:

1. Computer games affect on students' creativity.
2. Computer games affect on students' educational performance.
3. Computer games affect on different aspects of students' creativity.
4. Computer games affect on different aspects of students' educational performance.

Method

This study is a Quasi-experimental study with two groups of pretest - posttest and a control group. In this study, there are an independent variable (computer games) and two dependent variables (educational performance and creativity). All middle school girl students (public, private, gifted) of Tehran's 6th district were selected as statistical population. Through stratified cluster sampling from 26 schools , one private school and by random method a grade (first) including two classes were selected . Classes in terms of intelligence and demographic conditions became homogenous previously and at the registration time (Number of members in each class was 25). Study tools were:

1. 10 computer games were selected from the products of Institute of Intellectual Development of Children and adolescents and National Foundation of Computer Games, which were designed and produced consistent with the need assessments and local culture and under the supervision of local experts. The games were from different diversity such as action, educational , intellectual , strategic and racing .These games are:

1. Black Gold: Black Gold is a strategic and management game in which actor plays the role of an individual who is the director of the oil industry in Iran.
2. Detective Alavi: an adventurous game from the third person perspective in which the actor solves different problems.

3. Out of the Land: The game has a fictional structure. The actor is the first person of the game and tries to take back the lands and occupied houses from the aliens.
 4. Mitra Planet: An action, adventurous and serial game.
 5. The story of the island: is reconstruction and management of a deserted island by actor.
 6. City of horror: is an action and strategic game and actor faces with horrible creatures.
 7. Driving in Tehran: A racing game with excitement and learning driving culture and getting familiar with Tehran.
 8. Mystery of Systems: Is an educational and intellectual game. Solving attractive riddles, using the laws of physics and several tools and facilities in virtual world, based on a physical simulating engine, and ability to design new steps by the user.
 9. Entertainment and Software of making puzzles: an educational and exciting game about making and solving different puzzles.
 10. [Institute's] Chess: is the intellectual game of chess. Along with training and the ability to run alone or by two-players.
2. The criterion for educational performance was educational performance questionnaire EPT based on Pham and Taylor test (1999), which was standardized By Dortaj in Iran. It has 48 questions and measures 5 issues of self-efficacy, emotional impact, outcome control, planning and motivation. The validity of this test using internal consistency (Cronbach's alpha) obtained 74%. The validity of this test is assessed through content and structure. The validity of each of the areas is respectively 92% (self-efficacy), 93% (emotional impact), 73% (lack of outcome control), 64% (planning) and 72% (motivation). The scoring is done through the Likert scale.
- 3- Creativity measurement tool was in creativity test that is set in 32 questions. Aspects of Schaffer's creativity include: making opinions, sense of fantasy, freedom of opinion, theoretical and aesthetic orientation, and desire to innovation. The reliability obtained from Cronbach's alpha coefficient is 74%. The validity of this test for each aspect is obtained 71% (making opinion), 78% (the sense of fantasy), 70% (freedom of expressing ideas), 68% (theoretical and aesthetic orientation) and 79% (desire to innovation).
4. The researcher-made questionnaire to assess the interest and time spent in leisure time on computer games.

How to apply:

Before beginning the intervention, the interest and time spent on playing computer games during leisure time in both groups were measured in self-reported method by researcher-made questionnaire to examine the homogeneity of these groups in terms of these two problematic variables and if necessary, taking some measures for controlling them. Due to the results of this survey (the results) it was ensured that the two groups are homogeneous and after that the pre-tests were taken. At the beginning through a meeting with parents the research objectives were mentioned and they were asked to cooperate with investigator. According to the school counseling program it was insured that students were playing computer games just in allocated times (controlling the timing and content of the game). From the third week of September in common hours of sport lesson, playing computer program was considered for test group, and students of control group did their routine activities in this time. During the 14 weeks 10 games were played that students in the test group had the freedom to choose and play them. Researcher and educator monitored them carefully to insure that all members engaged in playing either one or two-player games. After the performance both groups were assessed by post-test and the results were analyzed and interpreted.

Results

For analyzing the research data Spss16 software program is used in descriptive and inference level. At first descriptive statistics related to research variables in two groups of control and test, is provided. For exploring the research hypothesis, ANCOVA and MANCOVA covariance analysis methods are used. In this study computer games are considered as independent variables and creativity and educational performance as dependent variables and creativity and educational performance pre-tests as covariate variables.

Interests' frequency

frequency percentage	frequency	interests	group
20%	5	Violent and action	control
28%	7	Intellectual	
36%	9	Educational	
16%	4	Entertainment	
100	25	Total	
12%	3	Violent and action	test
36%	9	Intellectual	
44%	11	Educational	
8%	2	Entertainment	
100	25	Total	

Frequency of playing computer games in leisure times.

Frequency Percentage	Frequency	Time (In Hours)	Group
20%	5	1<	Control
72%	18	1-2	
8%	2	2-3	
100	25	Total	
28%	7	1<	Test
64%	16	1-2	
8%	2	2-3	
100	25	Total	

Table1-The results of descriptive variables of time and interest in each group

Control Group		Test Group		Number	Group
Standard Deviation	Average	Standard Deviation	Average		
0.525	1.88	0.588	1.76	25	Time
0.828	2.48	0.822	2.52	25	Interest

As a result of the above table two groups were not significantly different in terms of time and the interest variables. That is the groups are almost well homogenous in terms of time of using computer games and interest to a variety of games (violent and action, intellectual, educational and entertainment).

Table2- The pretest - posttest educational performance and creativity in each group

Control Group		Test Group			Number	Group
Standard Deviation	Average	Standard Deviation	Average	Scale		
8.013	147.25	6.30	147.76	25	Pre-Test	Educational Performance
7.05	149.40	5.03	156.16	25	Post-Test	
2.64	15	2.52	14.88	25	Pre-Test	Creativity
2.87	16.08	2.51	17.52	25	Post-Test	

According to the results of table above, in both creativity and educational performance the average of test group is more than control group, also the standard deviation of former is less than the latter.

Studying the research questions:

1) Do computer games affect on students' creativity?

Studying assumptions of covariance analysis (creativity independent variable)

1. The first assumption: normality of distribution of scores

Table 3 - Kolmogorov- Smirnov test for checking the normality of distribution of scores

sig	Kolmogorov- Smirnov test	
0.361	Pre-test	creativity
0.355	Post-test	

Results of Table above show that the p-value obtained is greater than 0.05, so the null hypothesis based on a normal distribution of scores is confirmed.

2 - Second assumption, homogeneity of groups.

Table 4- Levene test for homogeneity of groups' variance

sig	F	Levene test	
0.68	0.16	Pre-test	creativity
0.69	0.1	Post-test	

The results of the above table indicate that obtained p-value is greater than 0.05. So The null hypothesis based on homogeneity of variance of the scores distribution is approved .

3- Third assumption, the homogeneity of the regression slope .

Table 5 - Covariance analysis of post-test scores of creativity in control and test groups

Statistical Power	ETA	P	F	Ms	Df	Ss	Resource
1	0.54	0.001	56.51	191.136	1	191.136	Pre-Test Creativity
0.82	0.156	0.005	8.67	29.34	1	29.34	Group Membership

The result of interaction between group and pre-test indicates that the amount obtained $0.385 = P$ is greater than 0.05. So the null hypothesis based on homogeneity of regression slope is approved. As the results of table 5 show, there is a correlation between covariate variable and the independent variable. $P < 0$ so the assumption of correlation between covariate and independent variable is confirmed. The results of the above table also show that the impact of the independent variable is significant, that is after removing the effect of pre-test, there is a significant difference between the test and control groups in creativity. So the null hypothesis is rejected and it can be concluded that educational computer games have affected on increasing students' creativity.

2) Do computer games affect on students' educational performance?

Studying the assumptions of covariance analysis (educational performance independent variable)

1. The first assumption: normality of distribution of scores

Table 6 - Kolmogorov- Smirnov test for checking the normality of distribution of scores

sig	Levene test	
0.94	Pre-test	Educational performance
0.97	Post-test	

Results of table above show that both p-values obtained in pre-test and post-test are greater than 0.05 , so the null hypothesis based on a normal distribution of scores is confirmed.

2 - Second assumption, homogeneity of groups.

Table 7- Levene test for homogeneity of groups' variance

sig	F	Levene test	
0.96	0.16	Pre-test	Educational performance
0.3	0.2	Post-test	

The results of the above table indicate that the obtained p-value is greater than 0.05. So the null hypothesis based on homogeneity of variance of the scores' distribution is approved .

3- Third assumption, the homogeneity of the regression slope .

Table 8 - Covariance analysis of post-test scores of educational performance in control and test groups

Statistical Power	ETA	P	F	Ms	Df	Ss	RESOURCE
1	0.81	0.0001	204.91	1466.91	1	1466.91	PRE-TEST EDUCATIONAL PERFORMANCE
1	0.61	0.0001	75.78	542.52	1	542.52	GROUP MEMBERSHIP

The result of interaction between group and pre-test indicates that the obtained p value is greater than 0.05. So the null hypothesis based on homogeneity of regression slope is approved.

As the results of table 2 show, there is a correlation between covariate variable and the independent variable. $P < 0$ so the assumption of correlation between covariate and independent variables is observed.

The results of the above table also show that the impact of the independent variable is significant, that is after modifying the pre-test scores, there is a significant effect between subjects of the group ($f=75$, $p<0.000$, $ETA= 0.61$). And there is a difference between average of test and control groups. So the null hypothesis is rejected and it can be concluded that computer games have affected on increasing students' educational performance.

3) Do computer games affect on aspects of creativity?

To study this hypothesis, statistical test (MANCOVA) was used. Assumptions of this test were tested. The assumption of homogeneity of variance and the homogeneity of the covariance matrix were tested and in each case $0.05 < p$. So the null assumptions based on homogeneity of variance and homogeneity of the covariance matrix of the scores distribution are approved. The correlation between the aspects of the creations also were tested, all of them were less than 0.9.

Table 9- Descriptive indicators of creative component scores in two groups

Innovation		Theoretical and Aesthetic Orientation		Beliefs and Opinions		Freedom of Expressing Ideas		Fantasy		Variable
Standard Deviation	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation	Average	Index
0.73	2.04	1.31	2.64	1.66	5.76	0.89	1.8	1.25	4.4	Test
0.96	1.48	1.08	2.56	1.77	4.92	0.84	2/0	1.48	3.8	Control

In the table above, average and standard deviation of creative components (making opinions, sense of fantasy, freedom of expressing ideas, theoretical and aesthetic orientation and desire to innovation) have been reported in test and control groups. As you can understand from the table, the average of test group for all creative components is more than the average of the control group. And this approves that the test group has obtained higher score in creativity subscales. The average innovation in both groups is less than other components average and this approves that both groups in subscales are at a lower level. To determine statistical significant difference between two groups in creativity components, multivariate covariance analysis was used.

Table10 - multivariate covariance analysis test to compare the components of creativity in two groups

sig	F	value	test
0.037	2.64	0.253	Pillay- Bartlett Wilks's
0.037	2.64	0.747	Lambda
0.037	2.64	0.339	HT Lyng- Lay
0.037	2.64	0.339	Roy

According to the results of Pillay- Bartlett, Wilks's Lambda, HT Lyng- Lay, and Roy, in each case smaller significant level of $p < 0.05$ was reported, therefore one can conclude that there is a significant difference between the components of creativity in test and control groups.

Table 11- Effect between subjects

STATISTICAL POWER	P	ETA	F	DF	COMPONENT
0.69	0.01	0.12	6.67	1	FANTASY
0.25	0.19	0.03	1.08	1	FREEDOM OF EXPRESSING IDEAS
0.05	0.91	0.00	0.024	1	BELIEFS AND OPINIONS
0.17	0.30	0.02	1.44	1	THEORETICAL AND AESTHETIC ORIENTATION
0.70	0.01	0.13	6.44	1	INNOVATION

After testing and doing analysis of variance between groups and doing the Bonferroni correction for reducing the error of the first kind the result was $p < 0.05$. The results show that in test and control groups the difference between the two components of fantasy and innovation is significant.

4) Do computer games affect on aspects of educational performance?

To study this hypothesis, statistical test (MANCOVA) was used. Assumptions of this test were tested . The assumption of homogeneity of variance and the homogeneity of the covariance matrix were tested and in each case $0.05 < p$. So the null assumptions based on homogeneity of variance and homogeneity of the covariance matrix of the scores distribution are approved. The correlation between the aspects of the creations also were tested, all of them were less than 0.9 .

Table 12- Descriptive indicators of creative component scores in two groups

Motivation		Control		Self-Efficacy		Emotional Reaction		Planning		Variable
Standard deviation	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation	Average	Index
1.61	23.24	1.49	20.92	2.27	28.20	2.69	48.78	3	35.04	Test
1.95	22.08	1.35	20.56	2.24	26.72	3.31	46.48	3.52	33.04	Control

In the table above, average and standard deviation of educational performance components (motivation, control, self-efficacy, emotional reaction and planning) have been reported in test and control groups. As you can understand from the table, the average of test group for all educational performance components is more than that of the control group. Also the average of control component in both groups is less than other components of educational performance. And this approves that both groups in subscales are at lower level. Also the average of emotional reaction component in both groups is more than other components' average of educational performance. In fact both groups in this subscale are at a higher level. To determine statistical significant difference between these two groups in educational performance components, multivariate covariance analysis was used.

Table 13 - multivariate covariance analysis test to compare the components of educational performance

sig	F	value	test
0.0001	17.57	0.69	Pillay- Bartlett Wilks's Lambda
0.0001	17.57	0.307	
0.0001	17.57	2.25	HT Lyng- Lay
0.0001	17.57	2.25	Roy

According to the results of Pillay- Bartlett , Wilks's Lambda , HT Lyng- Lay, and Roy, in each case significant level more than $p < 0.05$ is reported, therefore one can conclude that there is a significant difference between the components of educational performance in both groups.

Table 14- effect between subjects

STATISTICAL POWER	P	ETA	F	DF	COMPONENT
0.907	0.002	0.208	29.28	1	PLANNING
0.989	0.000	0.305	56.96	1	EMOTIONAL REACTION
0.762	0.009	0.148	6.70	1	SELF-EFFICACY
0.963	0.000	0.254	5.69	1	CONTROL
0.923	0.001	0.218	11.	1	MOTIVATION

After testing and doing variance analysis between groups and doing the Bonferroni correction for reducing the error of the first kind the result was $p < 0.01$. The results show that in all components of educational performance, the difference of test and control groups is significant.

Discussion and conclusion:

As appears in the previous results, using computer games affects on students' educational performance , creativity and their different aspects. In other words, all research hypotheses were confirmed .The first and third hypothesis of findings of this study revealed that using computer game with controlled content and right time indicated positive impact on creativity and its different aspects, including the making opinions, sense of fantasy, freedom of expressing ideas, theoretical and aesthetic orientation and the desire to innovation, in the students of control group in contrast with comparison group. And a significant difference was seen between two groups. These findings are consistent with the results of work of Farhoodi (1387) and Zare' and Kadivar (1385), Chisholm (2012) and Barlett (2010). For explaining these results it can be stated that computer games can boost the students' curious and creative spirit through advanced graphical environment, a variety of colors , challenging positions , power of control and repeatability , the process of problem solving and testing different solutions without fear of failure , quick feedbacks, reinforcements and motivational tools , ability to create new environment , imagination , gradual difficulty and etc. These factors

are exactly the same gaps in traditional and closed education system. Creativity, is considered as a key factor in the progress and development of societies and since creativity is something that can be taught and learned, so by creating necessary conditions, facilities and equipments it is possible to foster creative people, in this respect school is considered as a good place for teaching students' creativity (Cheragh chashm, 1386). And among them technology position, especially computer games, of course with principles and accuracy in the content and time management is important. In relation with second and fourth hypotheses, findings demonstrate effectiveness of computer games on educational performance and its different aspects, including self-efficacy, outcome control, emotional reaction, planning and motivation. The results of this study are consistent with findings of researches studying the improver effects of computer games on the students' training and education quality, including: Studies of Yen Chuang et al., 2009, Barlett et al., 2008, Ventura et al., 2011 and Qatrfiy, Rashid and Delawar (2006) according to the type of selected games (local, educational, intellectual, strategic). In explaining these results we can point to important factors in educational performance that many researches has studied them. Factors such as thinking styles, learning styles, information processing, individual differences, problem solving skill, planning and commitment in accomplishment, attributing success and failure to various factors, responsibility, external and internal motivation, cognitive and meta-cognitive skills, enjoying from doing assignments and etc, that there are a lot of attributions for each. Due to the features mentioned above, in computer games, there are many factors reinforcing the educational function. Although some researches have mentioned the role of games in educational failure, the common thing in most of these studies in considering these games harmful, is addictiveness and lack of control in using them. So it is recommended that parents and schools' officials help children and adolescents in choosing computer games and teach them how to choose right game and the right methods of playing. For making and producing software programs it is recommended to the producers of cultural packages to use guidance of training counselors, and experts students, to design programs that increase students' educational performance. Success and improving educational performance reflects effective and efficient educational system that sustainable development of such a system would be one of its inevitable results.

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