



## Research Paper: The Relationship between Video Games and Cognitive Skills of Students



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### Abstract

This research examined the relationship between video games and cognitive skills including critical thinking and creative thinking. This was an analytical and cross-sectional study. The population of the present research consisted of high school students of Ardebil in the academic year 2013-2014. A sample consisting of 105 students, (54 female and 51 male), was selected using multi-stage cluster sampling. They filled out two questionnaires, namely the California Critical Thinking Skill Test (CCTST) and Critical Thinking Test (CT). The data collected from the questionnaires were analyzed by SPSS through one-way analysis of variance (ANOVA) as well as the Scheffe test. To conduct the analysis, the participants were divided into four groups based on the number of hours spent playing video games every day, namely no gaming, less than 1 hour, between 1-2 hours, and more than 2 hours of gaming; they were also divided into four groups based on the number of years they had been playing video games, namely no gaming, less than a year, 1-2 years, and more than 2 years. The results of the one-way ANOVA revealed significant differences in creativity between the four groups based on the hours spent playing and the number of years the subjects had been playing video games ( $P < 0.05$ ). The differences between the four groups in terms of critical thinking were also significant ( $P < 0.05$ ). The findings indicated that the individuals spending up to two hours playing video games on a daily basis had higher levels of creativity and critical thinking compared to non-gamers.

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## 1. Introduction

Now a days life has undergone a fundamental transformation compared to life in the past centuries and millennia. Due to social, educational, economic and cultural complexities, the modern lifestyle requires special skills, one of which is higher-order thinking. Higher-order thinking can be described as a type of non-algorithmic, complex thinking, which often produces a variety of solutions. Different types of higher-order thinking have been identified so far, two of which are critical thinking and creative thinking (Miri et al., 2007).

Examining the current literature on critical thinking, Aloqaili (2012) concludes that there is lack of consensus over its definition. As argued by Romeo (2010, as cited in Aloqaili, 2012), a universal framework does not exist for critical thinking, and there is a dearth of knowledge and theoretical definition of the construct. However, some researchers have provided a number of definitions for the variable. For example, Andolina (2001, as cited in Hariri & Bagherinejad, 2012) defines critical thinking as a process in which the opinions, information and resources providing that information are assessed, regulated in a logical as well as coherent manner, and then associated with other pieces of information and opinions. During this process, other resources are considered and their implications are assessed. Ennis (1985, as cited in Aloqaili, 2012) defines critical thinking as logical, insightful thinking that focuses on what to believe and what to do. Mertes (1991, as cited in Topoğlu, 2014) defines critical thinking as a conscious, purposeful process used to interpret and assess information and experiences.

Some researchers have also proposed components for critical thinking. Branch (2000, as cited in Emir, 2009) believes that critical thinking has seven components: Curiosity, open-mindedness, orderliness, analyticity, rationality, confidence and truth-seeking. Popil (2010, as cited in Amirpour, 2012) describes individuals with critical thinking as being endowed with characteristics such as openness to new ideas, flexibility, desire to be changed, innovation, creativity, analyticity, audacity, tirelessness, enthusiasm, exuberance, risk-taking, knowledgeability, skillfulness, attentiveness, and mediation.

Another aspect of higher-order thinking is creativity. Creativity is a concept associated with differences among individuals. This concept has been coined to explain why some people have greater ability to work out solutions to problems (Jauk et al., 2013). Psychologists believe that creativity is not just innate or inherent, rather it can be acquired. Through training, children can be taught to work towards unorthodox solutions and resort to divergent thinking to address their problems and come up with proper solutions (Parsamansh & Sobhgharamaleki, 2013). Creativity has been so far defined in many ways. Sternberg (2001, as cited in Agahi Esfahani et al., 2004) defines creativity as a combination of innovation, flexibility and sensitivity towards ideas that make a person capable of seeking productive solutions; as a result, the person feels satisfied and others become gratified. Many researchers now provide a single definition of creativity. It is the ability to come up with fresh, useful ideas or solutions (Motyl & Filippi, 2014; Amabile, 1988; as cited in Chen et al., 2013; Zimmerer & Scarborough, 2008; as

cited in Antonio et al., 2014). As for the constituents and components of creativity, a body of research is available, too. For example, Amabile (1988, as cited in Chen et al., 2013) divides creativity into three components: Technical know-how, creative thinking skills and motivation. Torrance and Goff (1989, as cited in Abedi, 1993) define creativity as having four main components: 1) fluency that involves generating a great deal of ideas; 2) originality that involves the capacity to generate novel, unorthodox ideas; 3) flexibility that involves the capacity to generate many distinct ideas; and (4) elaboration that involves the capacity to pay attention to details.

At the turn of the 20<sup>th</sup> century, technological advances accelerated affecting the quality and nature of recreational activities. Video games first appeared in 1972, when *Pong* (an electronic game simulating table tennis) was released; then the industry began to grow in the domains of software and hardware. With an increase in the quality and variety of video games, they have gained increasing popularity among young people (Morrison & Krogman, 2001, as cited in Abdolkhaleghi et al., 2005). Although the introduction of video games took place with little delay in Iran, they are now popular especially among teenagers. For example, a study conducted by Amini et al. (2007) find that 53% of high school students play video games.

Although video games have been associated with negative outcomes such as aggressiveness (Sultanbayeva et al., 2013; Abdolkhaleghi et al., 2005), adverse behaviors (for example, Cheshmi & Zamani, 2011), depression (Lemola et al.,

2011), and poor academic performance (Eow et al., 2009; Sharifi et al., 2011), other studies have stressed the useful aspects of video games. While considering the positive effects of video games, we should pay attention has mainly focused on the cognitive effects of them. Delbari et al. (2009) find that video games have a significant effect on intelligence quotient, simple reaction time, movement time, diagnostic reaction time and diagnostic movement time. Khalifeh and Ebrahimi Nobandegani (2012) find a relationship between gaming and creativity. However, another research in Iran indicates that video games reduce some dimensions of creativity in students (Gholami Toran Poshti & Karimzadeh, 2011). With regard to issues mentioned above and the existing literature, the purpose of this research is to investigate the relationship between video games and high school students' critical thinking and creativity.

## 2. Method

### 2.1. Sample and research process

The present study was an analytical and cross-sectional research. The population of the research consisted of high school students of Ardebil in the academic year 2013-2014. A sample consisting of 105 students, 54 female and 51 male, was selected from four schools using multi-stage cluster sampling.

### 2.2. Research tools

**Creativity Test (CT):** The creativity test has been devised by Abedi (1984) building on the Torrance Theory of creativity. This questionnaire was revised several times, and finally, a version consisting of 60 questions was developed by Abedi at the University of California. Each question has

three choices, and the test is divided into four sub-tests, namely fluidity, elaboration, originality and flexibility. Each choice receives a score ranging from 1 to 3 representing low, moderate and high creativity, respectively. The total score of each sub-test represents the score obtained by the subjects in that section. The total score of each subject in four sub-scales represents his/her creativity. The total score of creativity for each subject ranges from 60 to 180. The questions 1-22 are related to fluidity, 23-33 to elaboration, 34-49 to originality, and 50-60 to flexibility. The reliability coefficient of fluidity was 0.85, originality 0.82, flexibility 0.84, and elaboration 0.80 (Abedi, 1993). In a study carried out on 2270 Spanish students to determine the validity and reliability of the creativity test, Cronbach's alpha coefficient was 0.75 for fluidity, 0.66 for flexibility, 0.61 for originality and 0.61 for elaboration (Auzmendi, Villa & Abedi, 1996).

**The California Critical Thinking Skills Test, Form B:** This questionnaire that was developed and assessed by Facione in 1990 (as cited in Hariri & Bagherinejad, 2012) has 34 items; some of them have four and some have five choices. In each item, there is only one correct answer, with the maximum score of a person as 34. Five components of critical thinking assessed in this questionnaire include analysis, evaluation, inference, inductive reasoning and deductive reasoning. Analysis includes 9 items, evaluation includes 14 items, inference includes 11 items, inductive

reasoning includes 15 items and deductive reasoning includes 15 items. The specified mean of this test is 15.89

### 2.3. Data analysis

The collected data were analyzed by SPSS 22.0. In the descriptive statistics, mean, standard deviation, frequency and percentage were calculated. In the inferential statistics, one-way ANOVA and Scheffe post-hoc analysis were used to compare the scores of critical thinking and creative thinking among different groups.

### 3. Results

A total of 51 male students (48.6%) and 54 female students (51.4%) participated in this research. The mean age of the students was 16.77 with the standard deviation of 2.50. Among the participants, 69 (65.7%) played video games, 35 participants (33.3%) played less than an hour, 18 (17.1%) played between 1-2 hours, and 16 (15.23%) played more than 3 hours on a daily basis. Out of the 69 participants, 28 (26.7%) had been playing video games less than a year, 17 (16.2%) between 1-2 years and 24 (22.9%) more than 2 years.

After running the one-way ANOVA, the results illustrated a significant difference in creativity between the four groups of no use, less than an hour, between 1-2 hours, and more than 2 hours ( $F=5.61$ ,  $P < 0.001$ ). To find out which groups are responsible for differences, the Scheffe post-hoc test was conducted (Table 1).

Table 1

*Scheffe test to compare creativity in four groups based on daily hours spent playing video games*

Variables	Hours	hours	Mean difference	Standard deviation	Significance
Creativity	No use	Less than 1 hour	-7.54	2.63	0.048
		1-2 hours	-11.47	3.20	0.007
		2 hours and more	-9.15	3.33	0.063
	Less than 1 hour	1-2 hours	-3.93	3.21	0.685
		2 hours and more	-1.61	3.35	0.972
		2 hours and more	2.31	3.81	0.946

According to [table 1](#) and based on the Scheffe test, there was a significant difference between non-gamers and individuals playing video games less than 1 hour, between 1 and 2 hours regarding creativity ( $P < 0.10$ ).

There was also an observed significant difference between individuals playing video games less than 1 hour and

individuals playing video games 2 hours and more ( $P < 0.10$ ).

The results of the one-way ANOVA showed a significant difference in creativity between the four groups of no use, less than a year, between 1-2 years, and more than 2 years ( $F=16.55$ ,  $P < 0.001$ ). [Table 2](#) represents the results of the post-hoc Scheffe test.

Table 2

*Scheffe test to compare creativity in four groups based on the number of years of playing video games*

Variables	Year	Year	Mean difference	Standard deviation	Significance
Creativity	No use	Less than 1 Year	-6.13	2.47	0.111
		1-2 years	-14.94	2.88	0.001
		Up to 2 years and more	-16.09	2.58	0.001
	Less than 1 Year	1-2 years	-8.80	3.01	0.042
		Up to 2 years and more	-9.95	2.73	0.006
		Up to 2 years and more	-1.14	3.11	0.987

The results of the Scheffe test ([table 2](#)) illustrated that there was significant difference between non-gamers and individuals playing video games between 1-2 years with regard to creativity ( $P < 0.10$ ). In the case of individuals playing video games less than 1 Year compared to

individuals playing video games up to 2 years and more as well as between 1 and 2 years, the significant difference was seen ( $P < 0.10$ ).

Moreover, taking creativity into consideration, the significant difference was observed between individuals playing

video games with the duration of 1-2 years and individuals playing video games up to 2 years and more ( $P < 0.10$ ).

The results of the one-way ANOVA showed a significant difference in critical

thinking between the four groups of no use, less than an hour, between 1-2 hours, and more than 2 hours ( $F=4.91$ ,  $P = 0.003$ ). To find out which groups are responsible for differences, the scheffe post-hoc test was also conducted (Table 3).

Table 3

*Scheffe test to compare critical thinking in four groups based on the hours of playing video games*

Variables	Hours	Hours	Mean difference	Standard deviation	Significance
critical thinking	No use	Less than 1 hour	-3.26	1.09	0.035
		1-2 hours	-4.38	1.32	0.015
		2 hours and more	-3.11	1.38	0.173
	Less than 1 hour	1-2 hours	-1.11	1.33	0.872
		2 hours and more	0.15	1.38	0.999
		2 hours and more	1.27	1.58	0.886

The results of the Scheffe test (table 3) indicated that there was a significant difference between non-gamers and individuals playing video games less than 1 hour with regard to critical thinking ( $P < 0.10$ ). Based on table 3, there was a significant difference between non-gamers and individuals playing video games

Table 4

*Scheffe test to compare critical thinking in four groups based on the number of years of playing video games*

Variables	Year	Year	Mean difference	Standard deviation	Significance
critical thinking	No use	Less than 1 Year	-2.69	1.16	0.159
		1-2 years	-2.56	1.36	0.321
		Up to 2 years and more	-4.20	1.22	0.010
	Less than 1 year	1-2 hours	0.12	1.42	0.999
		Up to 2 years and more	-1.51	1.29	0.710
		Up to 2 years and more	-1.63	1.47	0.743

Table 4 indicated that there was a significant difference only between individuals playing video games less than 1 year and individuals playing video games up to 2 years and more taking critical thinking into consideration ( $P < 0.10$ ).

#### 4. Discussion

Since the popularity of video games have been on the rise in recent years, their positive and negative effects should necessarily be identified. The purpose of this research was to examine the relationship between playing video games, creativity and critical thinking.

The results presented a significant difference in creativity between the students who did not play games and the ones who played up to two hours on a daily basis. The students who played longer were proved to be more creative. The findings were consistent with some relevant research. Gackenbach and Dopko (2012) stressed that having a record of playing video games is related to some aspects of creativity. The findings are similar to those of other studies carried out by Khalifeh and Ebrahimi Nobandegani (2012) and Jauk et al. (2013). Higher-order thinking can be described as a type of non-algorithmic, complex thinking, often producing a variety of solutions. Creativity is a kind of higher-order thinking which can be improved by engaging in some activity (Miri et al., 2007). Salinous-Pesternak (2005, as cited in the Khalifeh and Ebrahimi Nobandegany, 2012) argued that video games would enrich and diversify the games played by kids and teenagers and that they can provide various problem-solving methods, helping to improve students' cognitive skills.

The findings also demonstrated a significant difference in critical thinking between the students who did not play games and the ones who played up to two hours on a daily basis; meanwhile, the students using video games for a longer period of time were better at critical thinking. Although there has been a wealth of research on the relationship between creativity and video games, the link between critical thinking and video games is yet to be sufficiently investigated into. Nowadays, there is a consensus on this issue that critical thinking is a skill that can be improved (Miri et al., 2007).

#### 5. Conclusion

Totally it can be concluded that video games have both positive and negative aspects. Two of the positive aspects are critical thinking and creativity. It is noteworthy to emphasize that students gaming up to two hours a day experience an increase in creativity and critical thinking, but longer periods of gaming do not affect these variables. However, creativity and critical thinking increase as the number of years of gaming increases.

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**Conflict of interests:**

The Authors declare that there is no conflict of interest with any organization. Also, this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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