

# Investigating the Effect of Two FPS video games on academic Anxiety and Exam Stress in High School Student

## 1-Abstract

The education system is one of the first encounters of children with their peers and the community outside the family center. However, attending school can be associated with many psychological pressures. Thus, it is crucial to find a solution to control the level of stress induced by students through schools. Computer games, as one of the most popular types of entertainment, have many capacities in creating a sense of pleasure and happiness and even reducing anxiety and stress in the audience. The statistical population of the present study included 66 second-grade high school students in three high schools in Isfahan. The statistical population was divided into three groups. At the beginning of the study, Gadzella academic anxiety questionnaire and the Abolghasemi exam anxiety questionnaire were provided to the statistical population. Then, the first group (N=22) and the second group (N=22) played computer games for thirty minutes for five weeks in their school. At this time, the first group played BioShock, and the second group played Call of Duty games. The third group, the control group (N=22), also continued their schooling without a change in their routine program. After five weeks, the mentioned questionnaires were again provided to three groups of students. The data showed the significant effect of playing computer games on reducing students' academic anxiety compared to the control group. These results were also true for exam stress. However, BioShock was found to be more influential than Call of Duty: Modern Warfare.

**Keywords:** *Computer games, Academic anxiety, Exam anxiety, Industrial games, Serious games.*

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## 2-Introduction

**2-1- Education system and anxiety:** The education system is one of the first encounters of children and adolescents with their peers and the community outside the family center [1]. Contact with the educational system is crucial both in terms of psychological and personality development and in terms of learning scientific and educational issues for children and adolescents and integration into society [2-4]. The major part of the scientific education of children and adolescents in every society occurs in schools. Thus, school plays a significant role in the growth and improvement of society. However, attending school can be associated with many psychological pressures [5, 6]. These mental pressures, in many cases, cause symptoms of depression and anxiety [7-9]. Depression and anxiety in adolescents may be associated with many complications. Sleep disorders [10-12], abnormal weight changes [13], decreased self-confidence, suicidal thoughts, and even attempted suicide are among these complications [14, 15]. Hence, it is essential to find a solution to control the level of stress induced by students through schools.

**2-2- Stress reduction activities in work and educational environments:** Much evidence suggests that the implementation of stress reduction activities can reduce the pressures caused by the difficult conditions of stressful environments (such as hospitals, the military, the work environment, and the education environment) [16-20]. Stress reduction activities tested in these environments include a range of professional interventions, relaxation, yoga, group activities, and the use of serious computer games. The studies

conducted in this field show the great effect of these activities on reducing the anxiety and stress of people in such environments [19, 21, 22].

**2-3- Computer games to reduce stress:** Computer games, as one of the most popular types of entertainment [23, 24], have many capacities to create a feeling of pleasure and happiness and even reduce anxiety and stress in the audience [25-27]. The capability of computer games to reduce anxiety has received much attention in the past years since computer games are cost-effective, accessible, and very entertaining [28]. The popularity of these games has increased over the past decades, and they have also been used in educational institutions [29]. Computer games not only have a unique capacity to create a sense of pleasure, but their implementation is associated with many cognitive and educational benefits, such as hand-eye coordination, improved environmental memory, increased decision-making speed, and increased reaction speed [29-31]. Investigating these special capacities can provide new information about the limitations and possibilities of using computer games to improve society's physical and mental health in scientific communities.

**2-4- Serious games: Industrial games:** Based on the review of the study, it was found that a significant number of articles and studies conducted in the field of computer games in the service of reducing anxiety have investigated the effect of serious and research games on these issues. Computer games are generally considered one of the largest markets in the entertainment industry and have had a steady growth of 9.3% annually since 2019 [32]. The industry of computer games has also grown significantly annually, and the number of computer games produced with million-dollar budgets is increasing day by day.

Experts 2020 predict that the market value of computer games will increase to 196 billion dollars by 2022 [33]. Among the different genres of computer games, the shooting style has the largest audience in all age groups, except for the 54-65-year age groups [34]. This issue makes it necessary to investigate the cognitive capacities of industrial games, especially this style of games, and its psychological effects on the audience. The present study was an attempt to investigate the effect of this activity and this genre of games on the level of educational stress and pre-school stress by allocating a part of the time of adolescents at school to play two computer games, including BioShock Infinite and Call of Duty: Modern Warfare to investigate the effect of this activity and genre of games on the educational stress and pre-exam stress of students.

### 3- Research background and literature:

**3-1-Stress reduction activities in stressful environments:** The use of anxiety reduction activities in stressful environments to reduce and control people's mental stresses has been investigated in several articles, for example, the article written by Shankarapillai et al. (2012) [35]. In the present study, dental students who were about to perform their first surgery implemented a 60-minute session of yoga exercises. The results of this study report the very positive effect of yoga exercises on reducing the anxiety level of students about to perform their first surgery, which is a stressful activity. In a similar study, Stoller et al. (2012) measured the effects of 73 hours of yoga exercise on US soldiers dispatched to Iraq [36]. These exercises were implemented over three weeks and in 6 to 7 sessions per week. This study also reports the great effect of these exercises on reducing anxiety. It should be noted that reducing anxiety in stressful environments does not end with yoga exercises. An extensive article by Van der Klink et al. (2001) and LaMontagne (2007) investigated the effect of intervention techniques to reduce stress in the workplace [37]. The intervention methods introduced in these two studies are very diverse. Some methods include activities performed in the work environment, such as relaxation and mindfulness exercises, cognitive behavioral interventions, and stress control methods training. Some other methods included positive changes in the work environment and regulation of responsibilities and job relationships. All the methods mentioned in these two studies have shown positive results, and they have reported more positive results in cognitive behavioral interventions. Other studies in the area of anxiety reduction in educational environments also show the diversity of stress reduction interventions in these environments. Buizza et al. (2020) reviewed the articles written in the area of anxiety reduction methods in the educational environment of health and treatment. Buizza concluded that most of the articles written in this area use techniques based on mindfulness. Other

intervention methods include relaxation exercises, voice and body coordination, and individual training. The results of these studies also show the positive effect of these methods on the level of anxiety of the experimental groups. However, the results of these studies have been reported on the level of depression of different experimental groups [38].

**3-2-Serious games to reduce anxiety:** Using computer games to reduce anxiety also has a long history [39]. Studies on the use of serious computer games in mental health services are very diverse and present a wide range of results and data. However, in general, the evidence is in favor of intervention with serious games compared to groups without intervention [40-43]. Most of the studies conducted in the area of using serious games to reduce anxiety use games that are specifically designed to reduce anxiety and stress and are not industrial [44-46]. Numerous researches examine the effect of serious games on reducing anxiety. Among these exercises, we can refer to two biofeedback games called Towards Infinite Wild and Freeze Framer. Both of these games help their audience in performing relaxation exercises through biological feedback. The study conducted by Knox et al. (2011) examined the effect of these two games on the audience and reported the positive results of these games on reducing anxiety and depression in the experimental group compared to the control group [47].

As another example, we can refer to the Dojo game, which has been examined in two articles to reduce anxiety. In the first article by Schoten et al., the Dojo game was provided to a group of adolescents with severe mental disorders. The exercise with this game was in the form of 30-minute sessions that were done twice a week and for four consecutive weeks. The results of the mentioned study also indicated the positive effect of this game on the anxiety level of the audience [48]. The results of the stress level of the audience of both games used in this study confirm the positive effect of these games. However, the arc of the graph obtained from the Dojo game indicates the stronger effect of this game compared to Rayman [49].

More recent research conducted by David et al. examines the effectiveness of a mobile app based on REBE techniques (Rational, Emotive, Behavioral Education) and proves the effectiveness of their application named REthink in emotional regulation as well as reduction of depressive moods [50-52].

**3-Commercial games to reduce anxiety:** In addition to the use of serious games that are specifically designed to reduce anxiety, another group of studies is designed to investigate the effect of commercial games available in the market on people's anxiety levels. The study conducted by Patel et al. (2006) is one of these studies. In this study, a Nintendo game console containing ten industrial computer games was given to patients aged 4 to 12 years to investigate the effect of playing this game on their stress levels. The results of this study indicate the

positive effect of computer games on keeping patients calm compared to the control group and the group where parents are present at the patient's bedside. The results emphasize the importance of computer games as a cost-effective and accessible tool for patients [53]. The study by Pallavicini et al. reviewed the articles written in the area of using industrial games to reduce anxiety and stress [30].

Among the reviewed articles in this study, fourteen investigated the effect of industrial games on stress levels, and twelve investigated the effect of these games on anxiety. Based on Pallavicini et al.'s report, eight of the studies that examined the stress reduction methods show greater effectiveness of playing computer games compared to other anxiety reduction methods. These methods included basic training in stress management, guided relaxation or sitting in silence, exercise programs with moderate intensity, surfing the web, using computer games for passive distraction, using systematic distraction methods, and not playing computer games. In contrast to these studies, one of the articles reported that middle-aged men with obesity or overweight experienced higher levels of anxiety by playing computer games. This report was compared to watching non-violent TV shows.

Another study revealed a significant reduction in stress in Pokemon Go players, and another study showed that people's lives improved by playing multi-player online games in the non-stress group, and the living conditions of the stressed group worsened with these games. As stated before, 12 games were used to reduce anxiety, according to Pallavicini's report. Based on the report of this review study, all these articles have pointed to the reduction of anxiety in the studied groups with industrial games in such a way that industrial games have shown to be more effective than the control and comparative methods used in these studies. It should be noted that during the searches conducted to write the background of the present study, no study was found that specifically investigates the effect of industrial computer games on academic anxiety in schools.

## 4- Tools and Methods:

4-1- Materials and Tools: Gadzella's self-reported academic anxiety questionnaire was used to measure students' academic anxiety, and Abolghasemi et al. self-reported questionnaire was used to measure their exam anxiety. To measure the effect of computer games on students' academic stress, BioShock and Call of Duty games in the first-person shooter genre were selected. BioShock game has been highly praised by computer game critics and has high richness in terms of story and art aspects. According to Schneider et al. [54], the existence of a narrative has a positive effect on the players' experience of first-person shooting games and shows a direct relationship with the level of immersion and self-identification of the

audience. Lu et al. [55] also reported that computer games can have psychological therapeutic aspects due to having a narrative.

They also stated that computer games can affect and improve the audience's behavior and cognition through self-identification and the phenomenon of story immersion. According to these issues, the BioShock game seems to be a suitable intersection between the very popular genre of first-person shooter games and the richness of the story and art. The Call of Duty game has a large number of game titles in its subcategory. According to the official report of the Call of Duty website in April 2021, the Call of Duty series of games has sold 400000000 copies since the release of its first one in 2003 until the last version of Black Ops in 2019 [56, 57]. It seems necessary to investigate the possibility of using this game positively. Thus, these two games with different strengths (story and artistic value versus focusing on gameplay and popularity in the market) were selected for this study to compare their effect on the audience.

A systematic review of the effect of casual commercial games on stress, anxiety, and depression also shows the great effectiveness of casual games in the reduction of said indices [42].

A larger number of researches on the same subject have been conducted due to the stress and pressure during the COVID-19 pandemic. The paper published in 2021 by Kowal et al. reviews this research and concludes that commercial video games show great promise as inexpensive, readily accessible, internationally available, effective, and stigma-free resources for the mitigation of some mental health issues in the absence of, or in addition to, traditional therapeutic treatments [58].

**4-2-Methods:** The statistical population of the present study included 66 second-grade high school students in three high schools in Isfahan City, who were selected randomly. Twenty-two students belonged to the first school, twenty students belonged to the second school, and twenty-four students belonged to the third school. The selected students from each school were divided into three groups, including two experimental groups and one control group. To conduct this study, the statistical population was divided into three groups of 22 people.

At the beginning of the study, Gadzella academic anxiety questionnaire and the Abolghasemi exam anxiety questionnaire were provided to the statistical population. Then, during five weeks, the first and second groups played computer games for thirty minutes at school.

During this time, the first group was playing BioShock, and the second group was playing Call of Duty. The third group, as a control group, continued their school routine without changing. After five weeks, the mentioned questionnaires were

again provided to three groups of students. The results are mentioned in the data section.

## 5-Results

During this study, there was no dropout in the participants of the three groups. The information of the participants is as follows: The number of participants for the three groups, Bioshock, Call of Duty, and the control group, is 22, and the demographic information of these three groups is as follows: The average age of Bioshock group is 17.55 years, and the standard deviation of this group is 0.671. In the Call of Duty group, the people who participated had an average age of 17.45 years, and the standard deviation of this group was 0.596. The control group participated in this experiment with an average age of 17.64 years and a standard deviation of 0.658. The participants in this experiment were male and female with different percentages; in the Bioshock group, out of 22 participants (32%), 7 were female, and (68%) 15 were male. There were 8 women and 14 men in the Call of Duty group, and finally, in the control group, out of 22 participants in this group, there were 5 women and 17 men; in total, three groups out of 99 participants, 20 women and 79 men.

Table 1. Levene's test for exam stress questionnaire

Group	Sig	F	Df
First experimental group (BioShock)	0.478	0.512	42
Second experimental group (Call of Duty)	0.634	0.229	42
Control	0.918	0.011	42

Before performing the research tests, the assumption of homogeneity of variances was examined using Levene's test. According to Table 1, the level of significance is higher than 0.05, so the presumption of homogeneity of variances in the investigated variable of both groups is not rejected. The standard deviation and average of all three groups were measured before the experiment and after the experiment and the obtained data were as follows: The standard deviation and mean of the bioshock group before the experiment were 12.722 and 51.08, respectively, which decreased by 10.91 and 46.15 after the experiment. It was 14.932 and 49.47; after performing the test, these values were calculated again, and the standard deviation and the average of this group also changed, and the standard deviation reached 13.2 with a decrease of more than 1.5 units, and the average also decreased by almost 4 units. Reaching the value of 44.99, the standard deviation and mean level in the first and second groups decreased significantly;

nevertheless, in the case of the control group, which did not receive any intervention, the mean and standard deviation changes were insignificant. Thus, it can be stated that playing computer games has been effective in reducing exam stress. Also, the level of changes in the standard deviation of the first group is higher than the second group, which indicates that the BioShock game is more effective than the Call of Duty game.

Table 2 T-test of exam stress questionnaire

group	sig	SD.
First experimental group (BioShock)	0.175	4.931
Second experimental group (Call of Duty)	0.298	4.25
Control	0.816	4.243

Table 3. Normal distribution of exam stress questionnaire data

Group	sig	Statistic
First experimental group-pretest	0.991	.0045
second experimental group-pretest	0.993	0.047
control group-pretest	1.00	0.040
First experimental group-posttest	0.967	0.106
second experimental group-posttest	0.998	0.064
control group-posttest	0.999	0.063

According to Table 3, it can be concluded that the data are normally distributed, so the t-test was used to examine the significance level of the data of the groups in the pretest and posttest stages. As a result, according to the significance level mentioned before, it has values higher than 0.05. We conclude that there is a significant relationship between the research variables.

Table 4 Levene's test of exam stress questionnaire and academic stress questionnaire

Group	sig	F	Df
First experimental group (BioShock)	0.291	1.145	42
Second experimental group (Call of Duty)	0.439	0.61	42
Control	0.915	0.012	42

Table 5. Mean and standard deviation of academic stress of three participant groups

	Pretest	Before performing various tests for the research variables, the assumption of homogeneity of variances was checked with

			Levene's test. According to Table 4, the value of the significance level is higher than 0.05. As a result, the assumption of homogeneity of variances in the studied variable of both groups is not rejected. Posttest
Group	Number of samples	SD ± MEAN	SD ± MEAN
First experimental group (BioShock)	22	130.12±17.13	121.04±13.634
Second experimental group (Call of Duty)	22	126.95±18.254	118.42±15.056
Control	22	127.98±13.462	129.19±13.253

According to Table 7, the standard deviation and mean in the first and second groups have decreased significantly, but in the case of the control group that did not receive any intervention, the changes in the mean and standard deviation were insignificant. Thus, it can be stated that computer games have effectively reduced exam stress. Also, the rate of changes in the standard deviation of the first group is higher than the second group, which indicates that the BioShock game is more effective than the Call of Duty game.

Table 6 T-test of academic stress questionnaire

Group	sig	SD.
First experimental group (BioShock)	0.064	4.77
Second experimental group (Call of Duty)	0.097	4.25
Control	0.764	4.027

Table 7- Normal distribution of academic stress questionnaire data

Group	sig	statistic
First experimental group-pretest	0.883	0.065
second experimental group-pretest	0.999	0.061
control group-pretest	0.385	0.114
First experimental group-posttest	0.998	0.052
second experimental group-posttest	0.927	0.083
control group-posttest	0.969	0.060

According to Table 7, it can be concluded that the data is normally distributed, so a t-test was used to examine the significance level of the data of the groups in the pretest and posttest stages. Thus, according to the significance level in

Table 6, which has values higher than 0.05. We conclude that there is a significant relationship between the research variables.

## 6- Discussion and Conclusion

As stated in the previous sections, the educational environments of schools can be stressful for students and harm their mental health. The use of computer games to reduce anxiety and stress has a long history, and promising evidence has been obtained regarding their positive impact on the level of anxiety and stress of the studied groups. However, most of these studies conducted in this regard focus on serious and non-industrial games explicitly produced for the conducted studies and do not study industrially-produced games. First-person shooter games are among the most popular genres of computer games, and it is crucial to investigate the effects of these games on their large audiences in various age groups. The present study examined the effect of two games, including BioShock Infinite and Call of Duty: Modern Warfare, on the level of academic stress and exam stress of high school students. Based on the obtained results, both experimental groups (the first group played the BioShock game, and the second group played the Call of Duty game) showed a significant reduction in academic stress compared to the control group. Also, the data of a study conducted by Cheney suggest that the BioShock Infinite game had a stronger impact on the experimental group than the Call of Duty game. This result is in line with the results of Schneider et al. and Lu et al. regarding the impact of stories on the emotional connection of players with computer games (46, 47) and can be justified according to their opinions.

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## Conflict of interest:

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Ethics statement

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki.

## 8- Limitations and future research

Due to the lack of resources, it was impossible to implement different anxiety-reducing methods and compare them with the implementation of computer games in the present study. It is recommended for future studies to investigate and compare the effect of playing computer games with other anxiety reduction methods such as group activities, yoga, or art therapy. Additionally, it is recommended that future studies investigate other popular genres, such as adventure games, in terms of their impact on student's mental health. Investigating the impact of games on other aspects of mental health was another point that was not investigated due to the limitations of this study. Investigating the effect of playing these games on issues such as the level of concentration, depression, or self-confidence can also help to find new solutions to improve the mental health of students in scientific environments.

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