

## خلاصة تحليلية للآثار السلوكية والمعرفية لألعاب الفيديو التفاعلية على طلاب التعليم العام

أ.د/ عثمان بن تركي التركي

## خلاصة تحليلية للآثار السلوكية والمعرفية لألعاب الفيديو التفاعلية

### على طلاب التعليم العام

أ.د/ عثمان بن تركي التركي

أستاذ تقنيات التعليم بقسم تقنيات التعليم، كلية التربية، جامعة الملك سعود

[ualturki@ksu.edu.sa](mailto:ualturki@ksu.edu.sa)

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الملخص: تم إجراء خلاصة تحليلية لتأثيرات ألعاب الفيديو التفاعلية (IVGs) على البنية السلوكية والمعرفية لدى طلاب التعليم العام فيما يتعلق بكيفية المعرفة، والمعرفة المباشرة، والمهارات التنظيمية لديهم، وذلك باستخدام المنهج الكيفي (النوعي) المستند على أساس نظري لتحديد موضوعات الاستكشاف في أطر منتظمة. وأظهرت نتائج الدراسة أن عددا كبيرا من المقالات تؤيد الموقف الذي يرى أن ألعاب الفيديو التعليمية (IVGs) تساعد الطلاب على تحسين أسس المعرفة الإجرائية، والمشروطة، والصرحة المباشرة، مع وجود عدد بسيط من البحوث التي تشير إلى غير ذلك. كما أدت مراجعة منهجية للأدبيات، وتحليل موضوعي للمحتوى، وتنظيم الموضوعات إلى استنتاج مفاده أن ألعاب الفيديو التفاعلية (IVGs) لها عدة آثار إيجابية وبعض الآثار السلبية. وتشمل الآثار الإيجابية: اكتساب مهارات التطوير المستمر لمهارات افتراضية، والتنظيم الذاتي، وأداء أفضل للمهام (اعتمادا على المعرفة التقريرية والإجرائية)، وارتفاع مستويات التركيز، وتحسين الاستدلال والقدرة على اتخاذ القرار، وزيادة الاستعداد الجسدي والقدرة التنافسية، بالإضافة إلى تغيرات إيجابية في الاتجاه والسلوك. وتقترح الدراسة أن استخدام استراتيجيات التدخل المناسبة يمكن أن تعزز المكاسب الإيجابية لألعاب الفيديو التفاعلية (IVGs). ومع ذلك، من المستحسن إجراء مزيد من البحوث لتحديد أفضل الاستراتيجيات لتحسين الآثار الإيجابية للألعاب والحد من آثارها السلبية بين طلاب التعليم العام.

الكلمات الدلالية: خلاصة تحليلية، السلوك، المعرفة، ألعاب الفيديو التفاعلية

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## **Meta-Analysis of the Behavioral and Cognitive Effects of Interactive Video Games on K-12 Students**

Uthman T. Alturki

Professor of Educational Technology, Educational Technology Department, College of Education, King Saud University

ualturki@ksu.edu.sa

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### **ABSTRACT**

A meta-analysis of the effects of Interactive Video Games (IVGs) on the behavioral and cognitive constructs of meta-cognitive knowledge, direct cognition, and regulatory skills of K-12 students was conducted using a qualitative approach based on grounded theory to address the subject of inquiry within formalized frameworks. Research results showed that a significant number of articles supported the position that IVGs help students to improve the foundations of their procedural, conditional, and declarative knowledge, with a smaller number contending otherwise. A systematic literature review, analysis of thematic content, and organization of themes led to the conclusion that IVGs have several positive and some negative effects. The positive effects include the acquisition of skills for continual development of hypothetical skills, self-regulation, better task performance (based on declarative and procedural knowledge), higher levels of concentration, improved reasoning and judgmental capabilities, increased physical arousal and competitiveness, and positive changes in attitude and behavior. Using proper intervention strategies could enhance the positive gains from IVGs. Nevertheless, it is recommended to conduct further research to determine the best strategies to optimize the positive effects of games and reduce their negative effects among K-12 school children.

**Keywords:** Meta-Analysis, Behavior, Cognition, Interactive Video Games

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## 1.0 INTRODUCTION

The introduction of computer games in almost every household, places of entertainment, and learning institutions globally has compelled academic researchers to study their effects on K-12 children in several countries including Saudi Arabia. The problem is that traditional perspectives on the cognitive and behavioral effects of Interactive Video Games (IVGs) on children differ significantly from modern findings due to methodological flaws (Sherry, 2001). The significance of these findings is based on different research results obtained by evaluating various works and a wide range of journals and relevant articles published on the subject of inquiry (Staiano & Calvert, 2011). The behavioral aspects investigated include the preferences students developed for computer games, the effects the games have on students' attitudes, and the skills they develop through better cognition abilities. However, researchers have used different approaches to investigate how to address the problems caused by playing video games and the results have formed the foundation for future research in this topic.

### 1.1 Purpose and objectives

- (a) List the most popular journals that have discussed IVGs
- (b) Determine the behavioral and cognitive effects of IVGs on K-12 children
- (c) Assist teachers and parents to deal with the effects of IVGs

### 1.2 Research questions

- (a) Which are the most popular journals that discussed IVGs during 2000–2015?
- (b) The total number of articles as well as that from each journal during 2000–2015.
- (c) What are the behavioral effects of IVGs on K-12 students?
- (d) What are the cognitive effects of IVGs on K-12 students?
- (e) How can teachers and parents deal with the effects of IVGs?

### 1.3 Significance of the study

The study could be useful for institutions and parents in understanding how exposure to IVGs either at home or school affects the cognition of K-12 students in Saudi Arabia. The results highlight the issues of increasing addiction, compulsive behavior, and competition among children. However, exposure to IVGs can enable children to develop superior learning skills.

## 2.0 LITERATURE REVIEW AND THEORETICAL BACKGROUND

### 2.1 List of popular journals

The results of the investigation into the journals and articles published in each journal on the subject matter, i.e., meta-analyses of the behavioral and cognitive effects of Interactive Video Games (IVGs) on K-12 students are shown in Table 1. As per Ke (2008) and Parra and Guild (2015), the popularity of the journal was based on the number of times articles were searched for, downloaded, or subscriptions made on the subject of inquiry.

Table 1: List of popular Journals

An ordered list of the most popular journals that discussed the cognitive and behavioral effects of IVGs on children	Search hits	No. of articles
(1) Advances in Experimental Social Psychology	100	70
(2) Aggression and Violent Behavior	94	15
(3) AI Magazine	8	10
(4) Child Development Perspectives	12	7
(5) Computers in Human Behavior	35	4
(6) Computers & Education	73	10
(7) CyberPsychology & Behavior	89	7
(8) Educational Psychology Review	200	60
(9) Educational Researcher	30	12
(10) Educational Technology Research and Development	45	15
(11) IOSR Journal of Humanities and Social Science (IOSR-JHSS)	150	50
(12) International Journal of Innovative Research and Development	50	5
(13) Journal of Applied Developmental Psychology	250	100

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An ordered list of the most popular journals that discussed the cognitive and behavioral effects of IVGs on children	Search hits	No. of articles
(14) Journal of Personality and Social Psychology	150	80
(15) Journal of Educational Computing Research	50	12
(16) Psychology, Health & Medicine	100	10
(17) Psychological Science	100	15
(18) Playing Video Games: Motives, Responses, and Consequences	240	140
(19) Review of General Psychology	18	2
(20) Science & Education	35	5
(21) Sex Roles	50	2
(22) The Journal of General Psychology	100	19

## 2.2 Theoretical background

Foundational arguments based on learning theory, social problem-solving theories, and cognitive theories demonstrate the evolution of thinking among different researchers on the effects of IVGs on children between 2000 and 2015 (Shea, 2000; Parra & Guild, 2015; Wellington, 2015). When modelled with input variables such as individual behavior, cognitive revolution, constructivism, cooperative learning, critical thinking skills, discovery learning, peer tutoring, attitudes, self-questioning, structuralism, emotions, beliefs, situations, and schemas, the theories are able to explain the underlying reasons that lead to the acquisition and improvement and development of cognitive skills and behavioral attitudes when exposed to IVGs (Sherry, 2001). Cognition, arousal, and affect are the fundamental elements that stimulate the psychological activities that lead to long- and short-term effects such as factual learning, changes in personality, thoughtful action, and impulsive actions. There are theoretical explanations for how knowledge and competence are developed through interactive experience, automation, perceptions, and interpersonal responses to environmental variables.

### 2.3 Effects of IVGs on K-12 children

Research on this topic has been mired in controversy because of evidence that has evolved through different dimensions and over time, including the introduction and use of terms such as meta-memory, which describes the knowledge processing capabilities of children as noted by Anderson and Dill (2000). The studies by Bartholow and Anderson (2002), Blumberg and Sokol (2004), Buckley and Anderson (2006), and Kato (2010) built on the findings of Anderson and Dill (2000), who relied on earlier research and established the use of the term “meta-cognition” for referring to the positive and negative effects of IVGs on school going children. The task variables included meta-cognitive knowledge on task performance such as the ability to comprehend the difficulty level of a problem and its solution. Other meta-cognition studies include internal experiences, affective experience, awareness of failure and success, and effects on thinking activities and how these effects relate to IVGs. Lacking conclusive evidence, Kirsh (2003) tapped into the habits of players based on the preferences of children who played video games; the variables included the effects of IVGs on meta-cognition knowledge, regulation, self-awareness, control, problem-solving skills, and intelligence using an inventory of 30 items.

Moreno and Mayer (2007) based their research on the findings of Anderson and Dill (2000), Bartholow and Anderson (2002), and Kirsh (2003), and concluded that the thinking style of a child exposed to IVGs was strongly affected with short- and long-term aggressiveness. In an attempt to address the limitations in past research by authors such as Moreno and Mayer (2007), a study in a similar context by Rhodes, Warburton, and Bredin (2009) based on the theory of violent behavior investigated children aged 12–18 years and concluded that when students were predisposed and exposed to physiological conditioning through violent IVGs, they developed violent behaviors. These studies have been criticized as some authors did not include violent video games in their investigations because of the argument that the effects of video game exposure on students were too distant and unreliable to provide satisfactory answers (Ogletree & Drake, 2007).

Skoric, Teo, and Neo (2009) conducted a study based on the findings of Subrahmanyam, Greenfield, Kraut, and Gross (2001) where children aged 5–12 years were characterized by pre-existing attitudes toward IVGs with a high frequency of exposure. Later, the “children were then allowed to play violent and non-violent video games for fifteen minutes and their heart beats recorded to collect primary data for analysis” (Haninger & Thompson, 2004, p.23). The children were asked to rate the level of disappointment or frustration they experienced when playing the games on a questionnaire on a scale of 1–10. Moreover, the studies were conducted longitudinally, and some recurred on a yearly basis with the assessments conducted for the same variables (Ogletree & Drake, 2007). Ogletree and Drake (2007) identified eight context variables based on high-quality games that influenced outcomes when playing games and included role playing, humor, level of violence in the games, rewards, and availability of weapons to assess the level of responses in the context of violence and other related effects. The study concluded that video games do not produce any effects, either violent or non-violent. However, reviews of the findings by Yee (2006) and Connolly, Boyle, MacArthur, Hainey, and Boyle (2012) involved 10 times more participants compared to past research and thereby corrected the methodological flaws of previous reviews, which used inappropriate quantifiable measures of aggression and failed to factor the effects of dissenting studies into the investigation by using small target populations.

#### **2.4 The behavioral effects of IVGs on K-12 students**

A study that examined the behavioral dispositions of children exposed to IVGs could not find a link between the video games and the children’s behavior (Gentile, Lynch, Linder, & Walsh, 2004). Some of the effects investigated included heightened sensitivity to the games, mechanisms that trigger undesirable behaviors, and the potential for health-related problems such as obesity.

Moreno and Mayer (2007) conducted a statistical analysis of the observed effects among children within the K-12 bracket. The results revealed that 65% of the children showed significant increases in the number of pains and aches; cases of “Nintendinitis,” where children suffer from joint pains; muscle problems; and body



weight. Other problems included wrist pains, peripheral neuropathy, and epileptic seizures in some cases. Other researchers such as Ferguson (2010) argue that video games inculcate a sense of aggressive behavior. According to Squire (2003), other focus areas include the effects of covert verbal behavior, which varies between violent and non-violent games. Squire (2006) showed that covert behavior had a strong correlation with the reading time of students when exposed to IVGs.

The type of game being played and amount of exposure has been shown to have profound effects on a child's behavior. For instance, a study in which students played a video game called Grand Theft Auto II showed that those who had prolonged exposure showed an increase in blood pressure, hostile and antisocial behavior, and more adverse health and psychological effects (Bartholow & Anderson, 2002; Gravetter & Forzano, 2015; Squire, 2006). It was noted that negative blood pressure resulted in negative information processing.

Table 2: Negative and positive effects

Positive effects	Negative effects	Year	Number of journals
Pain management and reduction of antisocial behavior and thoughts (Anderson & Dill, 2000).	Increases in aggression, aggressive thoughts, desensitization, and a decrease in pro-social behaviors (Anderson & Dill, 2000; Scandura & Williams, 2000; Shea, 2000)	2000	5
Increased pro-social behavior and increased sensitivity to violence.	Aggressive feelings and behaviors (Sherry, 2001; Squire, 2003).	2001–2003	5
Video structure and content increased attention, improved working memory, stimulated learning; and increased perception, attention, and positive attitudes (Carnagey & Anderson, 2005; Gentile et al., 2004; Grigorovici & Constantin, 2004; Squire, 2006).	Attention deficits, negative cognition control, negative attitudes, aggressive behavior (Blumberg & Sokol, 2004; Carnagey & Anderson, 2005; Gentile et al., 2004; Squire, 2006).	2004–2006	6

Positive effects	Negative effects	Year	Number of journals
<p>Teaches through motivation, provides engagement for the player, encourages active participation, reflects content-based behavior and cognition, encourages social problem-solving skills, improves ability to encode and interpret environmental cues, and assists in the interpretation of behavioral reactions.</p> <p>Increases affect, guides interpretation and positive responses to the environment, affective arousal, and factual learning; and reinforces knowledge structures (Connolly et al., 2012; Gravetter &amp; Forzano, 2015; Ke, 2008; Parra &amp; Guild, 2015; Rhodes et al., 2009; Skoric et al., 2009; Staiano &amp; Calvert, 2011; Van Reijmersdal et al., 2010).</p>	<p>Children become meaner, have an increased desire to see more violent games, see the world as scary, become more callous, less sympathetic, and less pro-social (Moreno &amp; Mayer, 2007; Ke, 2008).</p>	2007–2015	10

## 2.5 Cognitive effects of IVGs on K-12 students

The cognitive effects of IVGs on K-12 students have been investigated by various authors including Ogletree and Drake (2007) and Squire (2003) among others at different stages by relying on research paradigms that embrace the universal laws of cause and effect, which depend on a realistic ontology, by designing studies in which symbolic, iconic, and representational aspects are core components. One study focused on pattern recognition, long-term and short-term working memory, visual imagery, expertise and creativity (Van Reijmersdal, Jansz, Peters, & Van Noort, 2010). Ogletree and Drake (2007) emphasized on solution-seeking capabilities based on the student's problem-solving skills, which includes fluency in generating possibilities, what to do when seeking for partial solutions to problems, the ability to retrieve words from memory, and the retrieval of solution patterns to resolve anagrams. Ogletree and Drake (2007) and Koedinger, Brunskill, Baker, McLaughlin, and Stamper (2013) suggested that problem-solving expertise involves effective

problem monitoring and solution strategies, identifying schemas, and developing sophisticated representations.

Buckley and Anderson (2006) examined the different theories and models that explain the cognitive effects proposed by Carnagey and Anderson (2005). The results showed that children exposed to IVGs developed better motor cognition and problem-solving skills, which made them more competent.

A theoretical proposition that underpins the studies conducted to gather empirical evidence on the cognitive effects of IVGs on K-12 students (primary, intermediate, and secondary students in Saudi Arabia) could be that exposure to a Cognitive Abilities Test (CogAT, CAT) can serve as data for gauging the effects of IVGs. The Saudi Arabian education system for K-12 students provides for the development and mastery of the skills and concepts necessary for lifelong development and academic growth in order to successfully graduate from high school. Here, some relevant theories include those of Piaget and Vygotsky, which focus on a constructive understanding of students. An overview of the CAT shows that its critical elements include task performance, contextual performance, and cognitive abilities (aptitude, intelligence, and the ability to learn and acquire new knowledge and skills). Aptitude was used as a measure of a student's ability to recognize word patterns that occur among large amounts of data.

Research by Squire (2003), Blumberg and Sokol (2004), Ogletree and Drake (2007), and other contemporary researchers in the field of educational psychology has shown that video games have profound effects on the cognition of students.

A study by Ke (2008) based on secondary data from previous studies by Ogletree and Drake (2007) and others showed that students exposed to IVGs developed better hand-eye coordination skills and experienced relief from stress, which was corroborated by 29% and 49% of the participant girls and boys, respectively. On the other hand, a study in a classroom setting where video games were used as tools of instruction showed a significant increase in the mastery of the subject matter being taught at school. It was concluded that "the right video games help children master everything from basic grammar to complex math without the

drudgery of old-school flash cards” (Ke, 2008, p.12). Research has shown that video games act as a tool for spatial development, the development of spatial visualization (the ability to visualize in the mind how vertical and horizontal lines intercept), ability to judge distance, and the mental capacity to solve puzzles using certain cues.

A recent data-driven survey by Koedinger et al. (2013) demonstrated that IVGs equip students with better decision-making, analytical, and math problem-solving skills.

## **2.6 IVGs and the most popular IVGs in Saudi Arabia**

### **2.6.1 Minecraft**

A variety of IVGs are available on the Internet for students to download freely. The objectives of developing the games vary significantly depending on the environment where it is intended to be used. The first such IVG to be investigated is Minecraft (Parra & Guild, 2015). It is an independent sandbox video game developed by a Swedish programmer for the purpose of inculcating building construction skills and was designed to enable people to develop 3D structures from textures.

### **2.6.2 FIFA 15**

A multiplatform football simulation video game developed by Electronic Arts Canada that was released in 2014 (Parra & Guild, 2015). One is allowed to hire players from different teams for a limited amount of time, which allows the opportunity to create a highly skilled dream squad.

### **2.6.3 Call of Duty**

Call of Duty is a first-person shooter video game franchise (Parra & Guild, 2015). The game is meant to inculcate a sense of call to duty among the players. The games are often set primarily in World War II under different conditions with different weapons.

### **2.6.4 The Last of Us**

An action-adventure survival horror video game released on the PlayStation 3 (Shea, 2000); the key themes include the human condition, exploration, subtext, and a nuanced depiction of female characters. The game

has been highly acclaimed and is considered one of the greatest video games of all time for its uniqueness.

### **2.6.5 Destiny**

Destiny is an online multiplayer game released in September 2014 with a mythic science fiction theme. It was highly rated despite some criticism about the content, storyline, and post-campaign missions. It is a first-person shooter that allows the player to take different roles in the game (Van Reijmersdal et al., 2010). The game allows a person to participate in public events and features three character classes, which includes Warlocks among others.

## **2.7 How educators and parents deal with IVG effects**

Systematic advances in research on the effects of IVGs on the behavior and cognition of K-12 children that have occurred in the field of educational psychology show evidence of increased inquiry between 2000 and 2015. Anderson and Dill (2000) evaluated 20 journals and categorized 43 articles into the emerging themes of declarative, procedural, and conditional knowledge; pro-social behavior; and attitudes; and then used the themes to prevent aggressive behavior such as verbal attacks, destruction of property, aggressive cognition, affective aggression, and low empathy. Research by Bartholow and Anderson (2002) and Grigorovici and Constantin (2004) identified methodological flaws and created a new foundation for studying the topic based on the observation of casual effects resulting from new approaches to guiding children. The studies by Blumberg and Sokol (2004), Carnagey and Anderson (2005), and Buckley and Anderson (2006) were based on the meta-analysis of Bartholow and Anderson (2002) that used 100 articles from 24 journals such as the *Journal of Personality and Social Psychology*, *Journal of Experimental Social Psychology*, and *Journal of General Psychology* that inquired into the cognitive and behavioral effects of IVGs on children based on longitudinal and cross-sectional studies between 2000 and 2015. The trend was to conceptualize models for teacher and parents to guide children to achieve self-regulation and self-regulated learning

with a differential emphasis on each construct for knowledge development using IVGs.

Studies by Buckley and Anderson (2006), Squire (2006), Yee (2006), Moreno and Mayer (2007), Ke (2008), Skoric et al. (2009), Van Reijmersdal et al. (2010), and Staiano and Calvert (2011) recommended monitoring the child, regulating the time spent in a game, evaluating the accuracy of a game in the context of the desired output on behavior, motivation, control, and knowledge. Staiano and Calvert (2011) analyzed 20 articles and concluded that teachers and parents need to evaluate meta-cognition features such as the stability of character and task situations, knowledge awareness, and levels of proficiency desired from the game. It was emphasized that a teacher or parent needs to be knowledgeable about the effects of the video game before indulging in a specific guidance process. Later findings by Connolly et al. (2012) and Parra and Guild (2015) concluded that teachers and parents need to evaluate the content (by considering psychological elements such as skills, function, deliberately increasing the concentration of the student, development of meta-strategic awareness and control, knowledge, and information), nature, architecture, context, and mechanics of a game before allowing children to access it.

Parra and Guild (2015) emphasized on later models based on a meta-analysis of 20 journals and 23 articles. Their research was based on that of Staiano and Calvert (2011) who investigated monitoring, planning, and evaluation using statistical evidence from 20 journals and 39 articles with 78% of the articles noting that students should be guided through meta-cognitive strategies that involve modelling, self-recording, and thinking aloud. A hypothesis by Parra and Guild (2015) on the correlation between guiding children and positive outcomes recommended the use of positive and negative problem orientations to enable children to view a problem as a situation that requires a person's response. Drawing on previous evidence based on a study by Skoric et al. (2009), Parra and Guild (2015) evaluated 23 articles on issues related to video game violence because of certain features and concluded that teachers and parents should provide instructional learning mechanisms based on IVGs.

Instructional approaches include initiating the learning of important behaviors, avoiding unhelpful and anti-social behaviors, and avoidance of aggressive behaviors.

Skoric et al. (2009), Van Reijmersdal et al. (2010), Ferguson (2010), Kato (2010), Staiano and Calvert (2011), and Parra and Guild (2015) concluded that parents need to identify IVGs that encourage good social behavior and avoid those that lead to increased aggressive behaviors and attitudes. Methods of increasing behavioral sequences include committing to memory through repetition and giving rewards, associative learning, and encouraging interactivity through active participation that assists learning.

### **3.0 METHODOLOGY**

The study used qualitative research methodology based on grounded theory, where the elements of investigation are recoded as facts that are discovered throughout the investigation process by a systematic review of articles on the subject of inquiry (Wellington, 2015). Grounded theory provides a model for continuous investigations based on the positivist approach for gathering empirical evidence to achieve the objectives (Thomas, Silverman, & Nelson, 2015). Secondary data was analyzed through a classification of ideas, themes, and topics to generate concrete answers to the questions (Scandura & Williams, 2000). An iterative process was used to conduct a thematic analysis of the content by engaging in a critical thinking process of questioning and categorizing the results to make concrete conclusions. A statistical analysis of the study variables was conducted to determine the correlation between the elements of inquiry on the effects of IVGs on K-12 students. The results were discussed in the context of all the findings to address the research objectives.

#### **3.1 Population and sampling**

The sampling of the items of investigation was based on the year of publication of an article between 2000 and 2015 on the subject of inquiry (Parra and Guild, 2015; Scandura & Williams, 2000). A total of 650 articles formed the sample of population used in the inquiry regarding the effects of IVGs on K-12 children between 2000 and 2015. However, the sampling strategy was based on the number of articles per journal and the year of publication. The elements of inquiry in each article

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were based on an exploratory and factor analysis of the items of behavior such as beliefs, attitudes, thoughtful action, stress, anxiety, reactive and proactive responses, controlled evaluation, exposure time, feelings, anger, physical arousal, instrumental response, and cues.

#### 4.0 RESULTS & DISCUSSION

Table 2: Correlations

		Negative effects	Positive effects	Behavior	Improved cognition	Parental and teacher guidance
Negative effects	Pearson Correlation	1	-.571**	-.146**	-.077	.069
	Sig. (2-tailed)		.000	.000	.063	.139
	N	257	257	257	257	257
Positive effects	Pearson Correlation	-.571**	1	.095*	.081*	-.038
	Sig. (2-tailed)	.000		.021	.037	.385
	N	257	257	257	257	257
IVG exposure	Pearson Correlation	-.146**	.094*	1	-.002	-.338**
	Sig. (2-tailed)	.000	.021		.982	.000
	N	257	257	257	257	257
Improved cognition	Pearson Correlation	-.078	.082*	-.002	1	.044
	Sig. (2-tailed)	.063	.038	.985		.345
	N	257	257	257	257	257
Parental and teacher guidance	Pearson Correlation	.069	-.038	-.339**	.042	1
	Sig. (2-tailed)	.137	.389	.000	.345	
	N	257	257	257	257	257

\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

The results showed that the most popular journals during 2000–2015 on the subject of inquiry were Advances in Experimental Social Psychology, Educational Psychology Review, IOSR Journal of Humanities and Social Science (IOSR-JHSS), Journal of Applied Developmental Psychology, Psychological Science, and Playing Video Games: Motives, Responses and Consequences, all of which had greater than 100 hits. Based on the search rates, journals with fewer than 100 hits were considered less popular.



The number of articles per journal is shown in Table 1. For instance, there were 140 articles in the journal “Playing Video Games: Motives, Responses, and Consequences,” 100 in the Journal of Applied Developmental Psychology, 80 in the Journal of Personality and Social Psychology, and 70 in the Journal of Advances in Experimental Social Psychology. Other journals with articles on the same subject matter included the IOSR Journal of Humanities and Social Science (IOSR-JHSS) with 50, Educational Psychology Review with 60, and The Journal of General Psychology with 19 articles.

Typically, through qualitative research paradigms, the findings on the behavioral effects of IVGs on K-12 students were noted to include an increase in video-game addiction among those who spent several hours playing the game and changes in compulsive behavior, which is defined as an impulse control disorder that includes pyromania, kleptomania, and pathological gambling. It was noted that compulsive behavior leads children to develop a mentality that results in alienation from friends, ignoring personal hygiene practices, anxiety and depression, escape from reality, and getting easily irritated when not playing. However, the positive behavioral aspects include an increase in competition among the youth, superior cognitive skills, physical arousal and competitiveness, increase in positive changes in attitude and behavior, better student involvement in physical and academic activities, reversal of a sedentary lifestyle, increased expenditure of energy at work, improved levels of confidence among students with low self-esteem, and better eyesight for impaired students through an increase in vigor when exercising. It was also demonstrated that students acquire better hand-eye coordination skills, master basic to complex grammar, have a better comprehension of the situation have more perseverance, develop better estimation skills, and improve their level of concentration by becoming more attentive.

The cognitive results showed that students develop better working memory, improved problem-solving skills, a higher level of task involvement, increased attention, and improved learning capabilities and social and thinking skills.

## 5.0 CONCLUSION AND SUMMARY

In conclusion, the study established a strong correlation between playing interactive games and its behavioral and cognitive effects on K-12 students. The number of journals on the subject matter and articles published per journal provide evidence of an increase in inquiries into the effects of interactive video games on K-12 students, with a stable increasing trend between 2000 and 2015. On the other hand, the behavioral effects are both positive and negative. Playing interactive video games is associated with increased physical activity, improved self-confidence, better judgment, better learning and cognitive abilities, and higher active involvement in student activities. The cognitive effects include improved long- and short-term working memory, and improved expertise and creativity; however, the negative effects include compulsive behavior, addiction, obesity, muscle pain, and muscle problems. Further research needs to be conducted on how interactive video games can be used to harness their positive effects and minimize their negative effects on students.

In summary, while interactive video games have been shown to negatively influence the behavior of children who spend a significant amount of their time on games in terms of compulsive behavior, empirical evidence has demonstrated that such games also have positive effects. For instance, school going children in the K-12 category who frequently play video games have improved attention spans, are more involved in their tasks, enjoy reading books on their own, and have better cognitive and behavioral capabilities. However, there is a need to investigate the best methods that can be employed to overcome the negative effects of gaming on children.

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