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Should We Let Them Play or Not?*

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Abstract

Video games have been around for more than four decades. The purpose of video games is to entertain. Over time, the ways in which video games entertain have changed. Recently, there has been an influx of video games with the intent to educate. These games were created to educate the player while keeping them entertained. The impact of video games on education has yet to be examined. The purpose of this study is to gauge the effect of video games and its correlation with college entrance-exam scores. We assert that one major variable affecting the outcome of education and college entrance-exam score is the sudden prominence of video games in the American culture. Thus, our research will be on the effects that video games have on education, whether positive or negative.

Keywords: *video games, test score, academic achievement, time management*

Introduction

A considerable aspect of education that has yet to be analyzed is the impact of the video game market on education. Since the advent of *Pong* in the late 1970s video games have grown exponentially in the American's lives. There are now six major platforms on which a consumer can play games. Atari, one of the first video game systems, had close to 700 different games and sold close to nearly 15 million Video Computer System (VCS) consoles between 1979 and 1982 (Evans et al.,

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2006). Currently, the Microsoft *Xbox 360* has roughly 1,170 video game titles. More stunning than *Xbox 360* is the popular Nintendo *Wii* console. The *Wii* has sold over 101 million consoles and over 1,650 game titles. Video games have become an integral part of the American culture and simply cannot be ignored. Furthermore, recent studies have looked at video games and their effectiveness in education such as Annetta (2008), and Beavis and O'Mara (2010).

While video games have been growing, so too has the amount of funding that is spent per child for education. Over \$11,009 per public school student was spent per pupil over the period 2014 – 2015, i.e., an increase of \$4,333 since the 1997/1998 school year (U.S. Department of Education, 2016). While significant test scores have been sporadic at best. Clearly, there are externalities affecting education other than money. However, more importantly, how can tax money be spent better and more efficiently?

The aim of this study is to gauge the impact of possible education variables as well as the effect of video games and their correlation with college entrance-exam scores. We assert that one major factor affecting the outcome of education and overall college entrance-exam scores is the sudden prominence of video games in American culture. Thus, our research will be on the effect that video games have on education, whether positive or negative. While the aim of this article is not to prove or disprove other education variables, it will offer some empirical evidence as to the validity of other arguments.

Literature review

The purpose of video games is to entertain. Over time, the ways in which video games entertain have changed. Initially, games such as *Pong* or *Pac-man* were played for a short period of time and the user went on to other activities. Video games have become increasingly more difficult and vastly more complicated, which keeps the video gamer playing. Games such as *Grand Theft Auto*, also known as *GTA*, have become increasingly popular with the youth in America. In *GTA*, players are tasked with creating a gang like following in cities such as Miami or Los Angeles.

Recently, there has been an influx of video games with the intent to educate. These games were created to educate the player while keeping them entertained. One such game developed by the Federation of American Scientists is called *Immune Attack*, where the player acts as a helper to a deficient immune system. As the game progresses, you learn about various cells in the human body and

how they act within the immune system. The game is specifically targeted at high school students with the intent of teaching the basic concepts of immunology. While most would categorize a game by its target market or intention, *Immune Attack* is educational and *GTA* is for entertainment. Video games inherently must entertain as well as require some form of learning to play. Without these attributes, the video game would simply be discarded for another form of entertainment.

Currently, there is a debate on how well video games can educate a player. Annetta (2008), a proponent of video games in the classroom, states that not enough is done to teach kids with video games. While games such as *Immune Attack*, *Food Force*, and *Discover Babylon* are used in classrooms, she advocates that the boundaries in educational learning must be pushed. Concepts such as haptics or the sense of touch are incorporated in the learning experience. She also points to the possibility of a textbook being included in a video game. Since most video games have a narrative, the video game could feasibly assume this role. From Annetta's (2008) writings on, many new e-books contain further learning capabilities through links incorporated in the text. This allows e-books to contain almost limitless information. Along with the growing capacity and popularity of tablet PCs, a virtual library of all student's textbooks, with accompanying media and games, can be around the corner.

While Annetta (2008) advocates for the further use of video games in the classroom, there is at least one critic. Monke (2009) states: "In a new wave of publicity, the video games industry, backed by many university professors, argues that games are highly educational. Actually, video games promote overly rational modes of thought and remove young people from the experiences they need in the real world (p. 1)." Monke (2009) asserts that video games do teach, but they simply teach the wrong things.

Video games are like any other modern-day vice. If used with moderation they can help heal and educate. In some cases, simply the idea of a video game can be used to educate students. However, Monke (2009) points out that simply placing a video game in front of a child may teach the wrong things, but nonetheless still educate. Furthermore, there is the slight chance that violent games could be responsible for bullying and other violent acts. While this is not a specific byproduct of educational video games, one could reason that if video games can make a child violent they can influence them in other ways as well. Lastly, television has had little impact on education and early childhood development but requires no reasoning while watching. Video games, on the other hand, require constant processing of information and a logical decision process.

Researchers argue for a more balanced approach to video games and consider the “potential that these games hold for interventions that promote well-being, including the prevention and treatment of mental health problems in youth” (Granic et al., 2014, p. 76) due to dramatically changed video games in recent decades: complex, diverse, realistic, and social in nature (Ferguson and Olson, 2013). Hence, the use of video games for educational purposes to enhance cognitive development. For example, studies show that cognitive development occurs through playing of video games (Bavelier et al., 2012; Green and Bavelier, 2012; Granic et al., 2014), developing problem-solving skills (Adachi and Willoughby, 2013; Prensky, 2012), developing creativity (Jackson et al., 2012), motivation and persistence (Blackwell et al., 2007; McGonigal, 2011; Ventura et al., 2013), emotional benefits (McGonigal, 2011; Nakamura and Csikszentmihalyi, 2002; Olson, 2010; Ryan et al., 2006; Russoniello et al., 2009), and social benefits of gaming (Eastin, 2007; Ewoldsen et al., 2012; Gentile and Gentile, 2008; Gentile et al., 2009; Gill, 2012; Schmierbach, 2010; Tear and Nielsen, 2013; Velez et al., 2012).

Model and Data

We have adopted a model that contains aspects of Oshio et al. (2010) model of income, pupils per teacher and school expenditure against admission to a Japanese college. Furthermore, this model differs from Oshio et al. (2010), as it has a video game variable that has been added to the independent variables. This should allow the model to test whether or not video games have an impact on education.

$$SAT_t = \beta_0 + \beta_1 Expenditure_t + \beta_2 (Pupil/Teacher)_t + \beta_3 Game_t + \beta_4 Poverty_t + \varepsilon_t \quad (1)$$

where:

- *SAT*: scholastic aptitude test score,
- *Expenditure*: expenditure per student,
- *Pupil/Teacher*: pupil-teacher ratio,
- *Game*: video games index (created by compiling sales data using annual reports from each company),
- *Poverty*: poverty rate, and
- ε : omitted influences on personal saving and is assumed to be well behaved.

We provide descriptive statistics of the variables in Appendix 1. The dependent variable is the *SAT*. We obtained the *SAT* data from the National Center for Edu-

cation Statistics website. The SAT is a college entrance exam test that is generally taken by prospective high school students in grades 9–12, although it is often taken during the junior year of high school. Not all students take the SAT but we decided that this accounts for a large majority of the population. College entrance exams are an obvious choice when looking at a child's education throughout their years in the national education system. Using the SAT limits the model to only testing children that plan to go to college. There are obvious holes in the dependent variables such as some children do not take the SAT. Furthermore, there is no way to ensure that all test takers are at the same age and have the same amount of schooling, thus possible exposure to video games cannot be derived leading to possible errors in the results.

The video games index was created by compiling sales data for the period of 1997–2014. The companies that were analyzed were Nintendo, Sony, Microsoft, Game Stop, Electronic Arts, Activision/ Blizzard and Ubisoft. Nintendo, Sony and Microsoft are all manufacturers of video game consoles, although Nintendo is the only one that derives all its sales from video game devices and software. Microsoft and Sony are heavily invested into within other industries but have been included because a large portion of sales comes from video games and related items. Game Stop is the leading video games retailer in the United States. Electronic Arts, Activision/Blizzard and Ubisoft are three prominent video games developers in the world with numerous bestsellers. Sales figures for the above-mentioned companies were retrieved from the companies' investor relation websites, if currency conversions were not offered through the financial statements, currency conversion was made using the Federal Reserve annual average conversion rates. The sales were then summed for the total sales per year. This gives the index a result with a standard deviation that is quite large signifying that video games have grown considerably as they have such a large spread over an 18-year period.

Expenditures per student and the pupil – teacher ratio were both compiled through the National Center for Educational Statistics (NCES). These two figures are quite important as they give an idea of how many children there are per teacher, as well as how much money is spent on education on a per student basis. It should be noted that Oshio et al. (2010) found no correlation between the pupil – teacher ratio and educational outcome. They attributed this to the fact that students that generally need more help get more one on one attention, while students that do not need help can be in much larger classes. The same could be said of expenditures, as money cannot simply buy education. Although these two have flaws, they are an important way to evaluate the classroom. For instance, more money could generally mean a better-paid teacher, more books in the classroom or

better buildings. Similarly, the closer the pupil – teacher ratio gets to 1, the better the education might be assumed as it is completely tailored to that one child's needs. For these reasons, both the expenditures and the pupil – teacher ratio have been included in the analysis.

Poverty rate data were obtained from the U.S. Bureau of the Census. Poverty rate was included as it is an easy way to track poverty levels across America. This also gives a good indication as to the amount of disposable income that can be spent on video games. Furthermore, we assumed that income does not specifically produce poorer education results, but does affect other variables that do. In addition, poverty rate may add a degree of destabilization to the family environment. The added stress that a child may feel when a parent loses their job could well affect test scores. We believe that this variable measures different aspects of income as unemployment has changed over the last 18 years.

Results

The baseline model, equation (1) is presented in Table 1. The first column shows the result of the baseline model of all students, and the second and third columns show the results of the baseline model of male and female students, respectively. Table 1 shows that the coefficient for expenditure exhibits a positive number that is statistically insignificant at the conventional level. Further, even if the sign is correct, as we expected, the pupil – teacher ratio does not have a significant effect on students' achievement on college entrance exam since the coefficient for the variable shows a negative number. However, the number that is statistically insignificant at the conventional level implies that SAT score is not dependent on the pupil – teacher ratio. The coefficient of the poverty rate is positive except for the female students (third column) but not statistically significant.

Table 1. Regression result

Variable	All Students	Male Students	Female Students
Expenditure	2.030 (1.206)	1.721 (1.431)	1.362 (1.071)
Pupil – Teacher	-4.321 (5.830)	-6.421 (6.916)	-4.558 (5.179)
Game Index	-1.79E-10** (7.05E-11)	-2.06E-10** (8.40E-11)	-1.23E-10* (6.30E-11)

Variable	All Students	Male Students	Female Students
Poverty Rate	0.483 (1.120)	0.518 (1.329)	-0.026 (0.995)
Constant	1,062.266*** (104.246)	1,125.670*** (123.668)	1,059.531*** (92.608)
Observation	18	18	18
R ²	0.653	0.653	0.617

Note: *, ** and *** denote the significance level of 10, 5 and 1%, respectively.

For the coefficient of interest, *Game*, it is negative and statistically significant at the conventional level. These results indicate that the achievement of the college entrance exam score is decreasing as the revenue of the game companies is increasing, i.e., a decrease in SAT scores may have resulted from a significant increase in game time. This finding is in line with our expectations.

In addition, the basic sensitivity analysis test results for the baseline model (Equation 1) are presented in Table 2. We conducted variance inflation factor (VIF, for severity of multicollinearity), Breusch-Pagan (heteroskedasticity), Breusch-Godfrey (cross-correlation), information matrix (IM), (for model specification) and Ramsey (for specification error) tests. Each test statistic is evaluated at the 5% significance level. The results indicate that our model does not have heteroskedasticity, serial correlation, misspecification or omitted variables problems.

Table 2. Estimation sensitivity analysis

Tests	Test Statistics	Probability
Mean VIF ¹	7.16	
Breusch-Pagan / Cook-Weisberg ²	2.81*	0.094
Breusch-Godfrey LM ³	1.31*	0.253
Information Matrix Test ⁴	23.49*	0.217
Ramsey RESET ⁵	1.56**	0.260

Note: * and ** denote *Chi Square* and *F* test statistics. 1: VIF measures how much multicollinearity exists in a regression. 2: Tests for heteroskedasticity. 3: Tests for the presence of serial correlation. 4: Tests for misspecification. 5: Ramsey Regression Specification-error Test for Omitted Variables. Do not reject the H_0 at 5% for all tests.

Conclusion

The ability to make quick decisions on video games may factor in to why video games help college entrance exam scores. An ACT tester has significantly more questions to do in a shorter amount of time, forcing them to think quickly rather than think hard. Regardless of the type of video game played, the player is constantly reviewing actions and trying to improve their abilities. This process of improvement may also play a role in the actual test itself. Since the ACT is regarded as an achievement test, it would mimic the curriculum that children are used to seeing. This could also mimic the process used in video games, or basing current decisions on past occurrences and experiences.

The science and reasoning sections may very well exploit this type of video game thinking. The video game requires constant analysis of events to create future decisions. This type of thinking teaches, in many ways, things that simply cannot be taught in school, but rather by experience. This ability to analyze and formulate opinions and answers is exactly what is required by the ACT science and reasoning section. The SAT has no critical thinking sections, thus has no way to take advantage of the possible analysis abilities of a video game player. McManus (1991) notes that there are certain people that benefit from each test as they simply test different things. As for the results of this regression, video game players should apparently stick to the ACT.

One startling result came from the analysis involving the pupil – teacher ratio. Oshio et al. (2010) found that there was no significant correlation between the pupil – teacher ratio and Japanese entrance exams as the majority of students that needed help received it. Thus, this made the ratio irrelevant as students were getting the maximum amount of help that they needed. The same principle may be applied to our results.

For some individuals, the role that video games play can help to further educate and strengthen reasoning skills. For others, though, this simply does not happen. Whether it is a personality trait or simply the way a person thinks, our study indicates that video games have a negative effect on these individuals and education. However, the use of video games in the classroom remains to be debated, as it is our conclusion that every classroom will have a diverse mix of children, hence a diverse mix of kids that learn from video games. Video games may hold a place in the future as Annetta (2008)'s vision may someday come true. Electronic readers may be used in the future containing links to educational video games and other information. As Monke (2009) claims, we should take great care with how far video games are used in the classroom. The possibilities of portraying

inaccurate information must not be ignored. Furthermore, video games are not a replacement for books or teachers. Nothing can replace the invaluable resources that an experienced teacher brings to the classroom. Video games cannot gauge whether or not a child is learning the material. Finally, we do not believe that video games are the solution to our educational blight. That said, video games are not responsible for it either.

Appendix 1. Descriptive statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
SAT	19	1,016.474	6.031108	1,006	1,028
SAT (Male)	19	1,037.526	7.267648	1,024	1,051
SAT (Female)	19	998.5263	5.16794	989	1,009
Expenditure	18	19.89732	1.730324	16.5	22.09959
Pupil – Teacher	19	15.60526	0.396476	15	16.6
Game Index	19	1.34E+11	4.42E+10	6.22E+10	1.88E+11
Poverty Rate	18	10.88889	1.950834	8.7	15

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