

# Video Game Education

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## **Abstract**

Although video games have had a negative connotation in the eyes of some educators, others have taken advantage of the attention grabbing powers of games and highly personalized feedback and instructions the computers are able to give students. This paper takes a close look at video games and how they are used in education. It finds out how, even in the college level, games can improve students' learning ability. The games can directly teach specific subjects or they can more generally influence students' critical thinking and decision making skills. It also looks at what properties video games promote learning and what designers can do to improve them. Finally, it discusses the negative side-effects that many people associate with video game playing. The video game industry is very popular among young students. Many students are already familiar with video games, but they may not even know how playing them can positively affect their thinking skills.

## **1. Introduction**

Technology has always had a way of making its way into the classrooms. Teachers use videos to supplement lectures, slide shows to display notes, and the internet for book keeping and research. These technological advancements make learning a more dynamic experience for students and make the teachers' jobs easier. It is important that these advancements be used in the best way possible to maximize their effectiveness. Many schools have a large number of computers available to the students and a good way to use those computers is for educational video games. Just like educational board games or puzzles, video games can get students excited about learning. However, with video games, students get individual instructions and help so they can dive into the learning experience without having to worry about the speed of the class or about understanding the rules.

Not just any video game can be placed in a school and help students learn. Many video games contain inappropriate content for school and do not award positive behavior. That is why it is important to look at what make a good educational video game. It is difficult to quantify the educational power of a video game but there has been some experiments done to test how student respond and learn from video games. This research has been used to aid video game designers to try to increase the educational value of their games without ruining the fun and excitement that players expect. Of course, video games have a negative connotation to some people. The integration of video games into schools has met some resistance from those who feel that video games have a negative effect on students school work.

## **2. Use of Video Games in Education**

Video games can aide in education in two major ways. One way is improving general thinking skills such as critical thinking and decision making. The Wisconsin Department of Public Instruction recognize that U.S. employers look for traits that can be developed by video games like quick learning, prioritizing, multitasking, and many more. These skills make U.S. employees more desirable in a market that cannot compete with low-wage workers provided by other countries. The Toronto Catholic District School Board, though critical of video games found a number of positive effects to students physical, social, and cognitive development. Video games can help with children's self esteem by giving them something to participate in and something in which to excel. Games can also de-stress children and provide much needed down time to their busy life. Some argue that simply by playing video games student will be able to improve their learning ability. However, playing just any video game may not give the maximum results. In order to really immerse a student in a learning environment, students need their own personal classrooms that will challenge them and give them the personalized instruction that will help them succeed.

As opposed to traditional student-teacher interaction, learning with video games makes for a better and more efficient learning experience. Video games have an engaging effect

on the players. The games provide clear goals, customized (and progressing) difficulty levels, and a dynamic learning environment. Video games cause students to actively pursue the goals of the game without questioning why or expecting any external award. Students can work at their own pace because instruction is personalized based on what they have achieved so far. The feedback they receive is meaningful and immediate. By being engaged in a game, students lose their sense of time and their self-consciousness disappears. This allows their attention to be completely focused on the subject material. A student being taught by a teacher has no control over what they learn and may not understand why they need to learn the material. They are forced to maintain the speed of the group where they may fall behind or become bored. Their feedback usually comes in the form of grades which can be shallow and meaningless (Squire).

One example of using a video game to teach a specific skill is the game called *SeaGame*. *SeaGame* is a video game that is used to teach students (mostly high school students) safety and best practices of water sports. Bellotti et al analyzed the game for its educational value. In the game, players interacted freely with the virtual world. Most experienced players would recognize this type of game as it is highly popular in the industry. Games like *Grand Theft Auto* use this type of game style to allow players to experience the virtual world and learn from it. However, instead of being rewarded for violence and aggression, *SeaGame* awards players for demonstrating skill and technique in nautical activities. Like *Grand Theft Auto* progressing through the game increases skill levels and unlocks new challenges. When players find themselves unable to advance in the game, the game will teach them the skills they need to continue. However, unlike in a teacher-student setting, the game will make them seek out the knowledge. A teacher would most likely tell the student exactly what they need to know to complete the task, but the game simply makes the knowledge available to them and lets them sort out what is important and what is extraneous.

Video games can also be used to teach computer science subjects. *EleMetal* is a game that was designed to teach computer science students how to recursively traverse a binary tree. The game was part of a *Game2Learn* project where older computer science students created video games to teach younger students important computer science concepts. In the game, the students are allowed to write code that is compiled and executed. The students' code controls an avatar whose goal it is to do a depth first search on a tree. Since the avatar follows the instructions in the code, the students can see how their algorithm works and perhaps where their bugs are coming from. The levels in the game start at a simple "Hello World" program and progressively works up to a recursive depth first search using a stack. Traditionally, when computer science students are experimenting with an algorithm, their code is executed in the blink of an eye and they have to spend tedious time debugging and blindly adjusting their code. By graphically visualizing their code, they can more easily determine what error they have and easily fix them (Chaffin).

*EleMetal* was played by a group of computer science students of various ages. Sixteen of the students were given a test on recursion before and after the game, and 42 of them were given a survey after playing the game. Even though the sample size was small there

was a statistically significant increase in test scores. Of the 42 students that took the post-game survey, they found that most of the students said they enjoyed writing code in the game and that the game helped them learn computer science concepts. Some students even admitted to miscoding on purpose just to see what happened. When asked if they preferred the gaming assignments or traditional computer science assignments, 78% agreed they would rather play the games. One student stated, “Game assignments are better because a lot of people enter computer science wanting to do things like gaming, and are disappointed because all they get to do in the first few assignments is write code to calculate tax on different stuff.” The students felt that the introductory level programs seemed useless and didn’t really do anything. Solving a graphical problem was much more rewarding for them (Chaffin).

Once out of school, video games can continue to help people learn. Some companies are beginning to use video games to train their new employees. Training is often the worst part of a new job. Most training today is taught via PowerPoint by going over rules and concepts. Employees benefit more by being given real life examples and situations. This enables them to practice making decisions and learning how their job is done. Training by video games is low-cost, effective, and flexible. It also transcends language, cultural, and geographic boundaries.

### **3. Making Video Games More Educational**

Video games (as well as all computerized technology) have been advancing at an almost unbelievable rate. Since the time of Pac-man, graphic and sound qualities have improved and games have become more intricate in their design and implementation. However, these advancements have been mainly used to increase the *entertainment* value of the games. Little has been done to increase their *educational* value and there is little research done to produce guidelines to maximize the educational value of game. Even so, there are a few points that educators (or developers) should keep in mind when trying to design or choose an educational game.

Perhaps the earliest use of video games in the classroom is a virtual “flash card” type game. By using a computer, students can rapidly answer questions and do math problems with little delay and immediate feedback. This type of drill may work for memorizing facts and multiplication tables but without a digital world to explore and learn from, students cannot come to understand concepts or procedures.

A better practice for creating educational videogames is to create a 3-dimensional virtual world for students to explore and learn from. Bellotti et al analyzed a video game *SeaGame* to find out it’s educational value and discover how to improve it. The game is what’s known as a “sandbox” game. The user is free to roam the 3D digital world and interact with other players controlled with AI. They have no clear goals in the game, they are just allowed to explore. Through their exploration, they will encounter “missions” that they have the option to complete. By completing missions, they increase their skill levels and open new missions. This type of game is popular in entertainment because it allows players freedom, and freedom is what engages the students.

The educational value of *SeaGame* was tested on a group of high school student to determine if the added educational element had a negative effect on the enjoyment and playability of the game. It was found that based on 23 dimensions that are typically used to rate video games; *SeaGame* was rated nearly as well as commercial state-of-the art video games. The only significant difference was in dynamism. This means that *SeaGame* lacked the surprises and twists that a commercial video game would have. The results of the *SeaGame* test manifested a couple ways that video games' educational value could be enhanced without losing the fun and playability the students expect.

One of the areas that *SeaGame* felt they lacked was in the depth and number of elements in the game. By increasing the number of events and object which the user interacted with, the playability and educational value of the game could be increased. Also, they experimented with the of *microGames* or short games that focus the player's attention on a particular item that he may find during exploration of the 3D, would better focus the direction of the game and allow a more direct focus on a task rather than worrying about the bigger picture. They found that these *microGames* made the users think more and get more information from the game.

#### **4. Dangers/Myths of Video Games**

With all this evidence that demonstrates the positive educational power of video games, you would think every school and in the country would try to start integrating games into their programs as much as they could. However, using video games in an educational setting is somewhat of a radical idea and has met some resistance from individuals who consider the negative effects video games may have on students. Video games have always been on trial for their addictive nature, violent content, and negative physical, social, and mental effects. There has been little conclusive evidence that show the extent of these side-effects, but some still feel that encouraging video game playing has a negative effect on students.

Various studies have shown that playing violent video games can increase aggression in children compared to children who play non-violent video games. Some people believe that aggressive behavior can be correlated to all video games, however, no relation has been found between aggressive behavior and video games in general. (Squire) The types of games that are utilized for education are not violent, therefore the exposure of students to them during class will likely not have a negative impact on their aggression levels.

Accessibility is another problem when using video games in education. Most studies (including the ones mentioned above) used test subjects that were already familiar with video games. For example boys are more likely to play video games than girls (63% vs. 40%) (Jenson) and the test samples usually reflected this gender ratio. This could suggest that using video games in school is catering to males' learning style over females'. The reason that boys are generally more likely to be familiar with video games than girls is largely due to the commercial market. Video games are generally made to cater to males'

interest like cars and guns. The content in an education video game should be gender neutral (or gender configurable) not to mention race-neutral and un-biased in any way that could make the game inaccessible.

## 5. Conclusion

It is likely that video game (and other technologies) will continue to make their way into classrooms. Their educational value and simplicity make them extremely valuable and practical tools. With computers becoming more and more commonplace in schools, video games spark interest in technology and provide a gateway for computer usage. It may take time to replace “flash card” memory games with more thought stimulating and fun games, but, eventually game developers will perfect the art of supplementing education through video games and education will become more easily accessible to more students.

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