

Unpredicted Educational Uses of Video Games

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Abstract: Many computer games have recently been examined for educational benefits. The work presented here looks at popular video games that are not characterized as educational and suggests possible knowledge and skills that may be supported or enhanced by playing these games. A scoring process is presented to calculate the educational potential of a video game. The summarized results of applying this scoring process are presented with the potential educational areas for over 200 games. It appears that role-playing games may have the best potential for educational uses and that the top benefits are improving reflexes and planning and strategy skills. However, the data suggests that each game should be considered on a case-by-case basis for any potential educational purposes and benefits.

Introduction

Educational games have been used for centuries to teach or enhance learning. Educational computer games have been around since some of the first personal computers. Recently, educational computer games have been of interest to companies for training purposes. There are over 1000 educational computer games as shown in a search at <http://www.wingz2fly.com/GameSurvey> (Gaither 2009). Much of the current research on educational gaming effectiveness has been recently published in the *Handbook of Research on Effective Electronic Gaming in Education* by Ferdig (2009). One effectiveness study on a commercially-available educational computer game showed a significant increase in understanding of algebraic concepts over a 5 week period of playing *Math Blaster Algebra* (Redfield, Gaither, and Redfield 2009). More importantly for the purposes of this paper, this study also showed no negative effects on grades or test scores for the students who played the game. These results give promise to educational computer games and may even have implications for computer video games that were produced without intended educational outcomes.

Other researchers have listed ways that games might be used for instruction (Hays and Singer 1989). Hays (2005) further surveys what studies have been performed on video games and categorizes potential benefits to include learning concepts and skills, modifying attitudes, and improving problem solving and critical thinking skills. Peterson, Verenikina and Herrington (2008) review the literature of research on the developmental and educational value of computer gaming and find computer games have been shown to help people acquire abilities in many areas including collaboration, communication, creativity, critical thinking, memory, organization, problem solving, self-esteem, and technology skills. They suggest that action-type games have less educational value than other genres. However, even the popular video game *Unreal Tournament* has been used to support learning physics concepts (Price 2008).

The work presented in this paper looks at popular video games that are not specifically characterized as educational and suggests possible knowledge and skills that may be supported or enhanced by playing the games. A scoring process for educational potential was developed, and the results of this scoring and the potential educational

areas for 238 games are summarized. The data suggests that each game should be considered on a case-by-case basis for educational purposes.

Data Acquisition

A scoring method was developed called the Video Game Educational Viability Index after reviewing and applying Rice's Video Game Cognitive Viability Index (Rice 2007). The following table shows the form used for this survey. If a game showed any evidence of the characteristics, a point is awarded. Each of the scored characteristics is explained after the table. In general, a point is given if the game appears to have the characteristic in any way and for any depth.

Video Game Educational Viability Index	Yes / No 1 / 0
Name of game: Genre: Platform(s):	_____
The game requires that you assume a role.	
The game has a storyline.	
The game includes puzzles.	
The game employs environment manipulation.	
The game allows for multiple perspectives.	
The game requires gathering information.	
The game requires the player to increase his/her knowledge-base.	
The game requires creating and combining information.	
The game offers multiple playing paths with different results.	
The game connects to real issues.	
Total score:	
Notes and potential educational uses:	

Table 1: Video game educational viability index questionnaire

The game requires that you assume a role. A game may be awarded this point if it either forces or allows the player to assume a role. In other words, rather than simply playing the game, the player is brought into the game by assuming a role within the game. For example, a game would earn this point if the player were allowed to choose to be a wizard, a hunter, or an archer. However, a game would not earn this point if the player were simply allowed to shoot at something, for example. Most arcade shooters and simple fighting games would not earn this point. This point was in the original rubric and was kept in the new scoring system because allowing the player to assume a role facilitates a deeper understanding of the environment in which the player is immersed.

The game has a storyline. A game may be awarded this point if a story is told during game play. The game must provide the player details as to why they must do what is asked of them. Role playing games would earn this point, whereas racing games and space shooters might not. This point was also in the original rubric and was kept in the new scoring system because offering a reason as to why a player must do what is asked of him or her allows for deeper connection to skills, knowledge and processes.

The game includes puzzles. A game may be awarded this point if it includes any brain teasers or puzzles. Puzzle games will earn this point, as well as certain role playing games that require you to solve puzzles either to continue with the story or as side-story tasks. Racing games usually would not earn this point. This point was kept in the new rubric because puzzles are important in problem-solving skills and critical thinking.

The game employs environment manipulation. A game may be awarded this point if it allows the player to change the environment. In other words, if the player can change his or her in-game surroundings, the game would earn this point. Role playing games and adventure games that require the player to change the in-game environment

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to succeed would earn this point. Environment manipulation is important because it allows players to directly see how their interaction affects their surroundings.

The game allows for multiple perspectives. A game may be awarded this point if it offers the player alternate or opposing viewpoints. Some role playing games would earn this point along with games that allow you to choose a side (thus changing the story to be seen from the opposing point of view). This change in view allows the player to learn to gain a better understanding of a situation by considering more than just one perspective.

The game requires gathering information. A game may be awarded this point if it requires the user to acquire information from within the game. Role playing games would usually earn this point along with some more advanced first-person shooters. For example, if a game requires you to find a password in an object in the game to unlock a door to continue, it would earn this point. This characteristic forces the player to pay attention to his or her in-game surroundings.

The game requires the player to increase his or her knowledge-base. A game may be awarded this point if it requires the player to increase his or her knowledge, whether it is in-game knowledge or real-world knowledge. Sports games with various rules and regulations would earn this point along with games that require you to learn a method of dealing with game objects or variables. This requirement is different from just gathering information because in order to increase the player's knowledge-base, he or she must not only gather information but must also apply it to what he or she is doing.

The game requires creating and combining information. A game may be awarded this point if the player must combine information to form new information or if the player must create new information. For example, if players were given hints and must combine them to figure out how to proceed or if a player were allowed to create a new type of item based on choosing various properties, the game would be awarded this point. This characteristic forces the player to practice problem-solving skills and creativity.

The game offers multiple playing paths with different results. A game may be awarded this point if there are either multiple ways to complete the game or the player is presented with multiple paths that ultimately change aspects of the game. For example, if a game presented the player with the choice to either save a party member or leave them behind and the player's decision impacted how the game ended, it would be awarded this point. This capability allows players to understand that their choices may ultimately affect future outcomes.

The game connects to real issues. A game may be awarded this point if it connects to real-world issues. For example, sports games would earn this point because they are representative of real-world sports. Also, a game would earn this point if it included politics, sociological concepts, or resource management situations.

The total scores for each game range from 0, where none of the characteristics listed above appear to be in the game, to 10 where all of the features listed above do appear to be contained in the game. The following table is a recommended scale of overall score evaluations for potential benefits. If someone is looking for a particular benefit of a game, the total score may not be as important as having that one benefit in the list of potential benefits for the game.

Total Score	Details
10	<i>Perfect score.</i> Game has excellent and varied potential for educational use.
7-9	<i>High score.</i> Game is a good candidate for educational use.
4-6	<i>Medium score.</i> Game has some potential for educational use.
1-3	<i>Low score.</i> Game is a poor candidate for educational use.
0	<i>Zero score.</i> Game has very little or no educational value.

Table 2: Game score evaluations

Analysis and Results

There are over 10,000 currently available video games that can be purchased (IGN.com 2008). Many of the top games from various gaming websites such as IGN.com, GameSpot.com and CNET.com as of July 2008 were included in the survey. Mostly students from St. Mary's University either had played the games already or took on playing some games for this study to evaluate them with the new survey. Many of the games were evaluated by work-study and graduate assistant students of the Computer Science Department. With over 200 games surveyed so

far (just over 2% of the currently available video games), the following table shows the summary of the findings. The top percentages and average scores are italicized in the table below.

Genre	# of games	% of total	Average Score / 10	Top Benefits
Action	66	28%	4.26	Reflexes
Adventure	31	13%	4.97	Reflexes
Education	3	1%	3.33	Critical Thinking
Fighting	7	3%	3.86	Reflexes
<i>First Person Shooter</i>	12	5%	6.42	Reflexes
MMORPG	6	3%	6.67	Resource Management
Music	1	0%	2.00	Reflexes
Party	1	0%	5.00	Reflexes
Puzzle	17	7%	2.29	Critical Thinking
Racing	18	8%	1.72	Reflexes
Real-Time Strategy	6	3%	4.00	Planning & Strategy
Rhythm	1	0%	8.00	Critical Thinking
<i>RPG</i>	23	10%	8.26	<i>Planning & Strategy</i>
Shooter	10	4%	2.80	Reflexes
Simulation	12	5%	5.25	Planning & Strategy
Sports	16	7%	2.69	Reflexes
Strategy	8	3%	5.25	Planning & Strategy
<i>Total</i>	238	100%	4.52	

Table 3: Average scores and top benefits by genre

Role playing and rhythm games received the highest marks while puzzle, racing and sports games got the lowest. Role playing games probably scored higher because they involve many different types of interactions. For example, in the role playing game series *Legend of Zelda*, a player must manipulate the environment to solve complex puzzles as well as use reflexes during combat. It is interesting to note that each game evaluated using the Video Game Educational Viability Index seemed to have at least one potential benefit. The most prominent benefits along with the count and percentage of each are shown below.

Benefit	# of games	% of total
Critical thinking	15	6%
Hand-eye coordination	1	0%
<i>Planning & Strategy</i>	56	24%
Problem solving	13	5%
<i>Reflexes</i>	135	57%
Resource Management	17	7%
Math	1	0%
<i>Total:</i>	238	100%

Table 4: Potential benefits across video games

The benefits of hand-eye coordination and reflexes are represented as different categories because hand-eye coordination consists of controlling game objects in a representative manner while reflexes involve reacting to game stimuli. Other benefits presented in some of the evaluated games include *reading*, *communication*, *dexterity*, and *logic exercise*.

It appears that role playing games have the most potential for educational use. Role playing games may be the best candidates for educational modification as well. The most common benefits of the games assessed in this

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study were reflexes, and planning & strategy. Although role playing games scored the highest in this study, there are counterexample games in many categories that could show higher potential educational uses than the average score. For example, the puzzle genre was one of the lowest scoring of the study, but most any type of puzzle can be considered exercise for your brain and works logic and critical thinking skills. A racing game could potentially enhance hand-eye coordination and other driver-related skills.

From this survey, it seems that there are many characteristics of video games that are difficult to quantify into a definitive scoring system to determine educational value. While the scoring system employed here may be a good indication of educational viability, it does not appear to determine whether a game has educational value or not. Therefore, video games and their potential for educational use should be considered on a case-by-case basis. This survey work is continuing at St. Mary's University in San Antonio, Texas.

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