Another take on game-based learning.

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We admire the fact that **e-Mentor** decided to raise the issue of game-based learning. In this article we present a preliminary sketch of the field. Our main thesis is that commercial computer games have an underestimated educational potential, which presents a large opportunity.

The Functions of Educational Games.

The fundamental framework of digital educational games provides several reasons why they can be superior, as learning tools, to simple exercises and lectures. A player in a game has the opportunity to participate more actively in the learning process than a passive learner. Because of this increased participation it may be easier for a student to understand a certain topic and to enhance various skills by experience gained in the virtual world. Worthy educational games, digital or not, enable the learning process by performing at least the following three functions. Games:

1. **motivate** the user by presenting an attractive psychological backdrop for learning. This is especially helpful for young learners who often have more emotional identification with gaming than education.
2. **simulate** real life situations. They can provide experience and skills present in a setting that would be hazardous or impractical to maintain in the real world.(eg. in strategic games and flight simulators).
3. **facilitate** operationalization of complex theoretical structures, such as mathematical algorithms, by more intuitive means of game strategy.

In all of those cases, but especially in the last one, the learning is often coincidental in the eyes of the player.

Digital games fulfill these three functions better then most of the traditional games and thereby constitute remarkable learning tools, provided that they do not fall into oversimplification, or purposeful ideologization, of the problem-solving methods or structures they inculcate in the learner.[1] The greatest challenge in designing and using game-based learning is to make the learning products as relevant to the to the field being studied as possible. This means that problem-solving strategies present in the game must increase one's chance of success in endeavors in the real world.

The Mechanisms of Educational Games.

[1] This point is vital since, by providing specific problem-solving structures, games may promote various ideologies. For instance, in the first digital version of ***Risk*** the computer could be set to play the 'conservative', 'imperialist' or 'mixed' strategies. (The first one defined as ***defending one's territory for any cost and attacking only when attacked + trying to destroy only the forces that destroyed another country***. The second one defined as ***gaining as many continents as possible).*** The room for ideologization comes from the fact that, depending on the mathematical values assigned to various strategies, the message sent by the game in regard to the respective viability of such strategies will be quite different. The same is true for more complex games (eg. in ***Civilization II*** there are two win-conditions, one through economic development and the other through conquest; yet, the latter one is much easier to play).

The first way in which an educational game educates is by demonstrating to the learner -- using a standard trail and error mechanism -- that a lack of certain skills can have negative consequences while the right skills increase the likelihood of success. This provides simple pragmatic reasons to seek the solutions that work in a given environment (and to avoid those that do not). Consequently, this learning experience results in the gamer's realization what specific skills need improvement..

According to the second learning mechanism, by repeating the reward and punishment process until the optimal reward is reached, the player works on perfecting the skills that lead to success at the first stage. Thereby, one becomes one's own teacher and learns through experience how to adapt to new situations.

The third mechanism, involved only in the best instances of game-based learning, lets players go beyond satisfying the learning needs discovered at the first level. Beginning with the simplest, easily understandable form of the challenge, players can gradually progress to more complex levels of the game; they discover and subsequently acquire completely new skills.

A sophisticated game, digital or not, gives skilled players a good practical grasp of very complex mathematical models.[2] Mastering those strategies counts as transferable skills that apply to various areas.[3] It provides a particularly helpful method for those learners who do not exceed in traditional academic learning.

An ideal educational game framework would incorporate all the three of those mechanisms in order to fulfill its functions of motivating, simulating and facilitating learning. In the next section we show how digital games have the potential to come close to satisfying this ideal.

Digital Educational Games.

Educational digital gaming can take many forms: from simple online group decision exercises to fully marketable computer games. Digital games can be divided into the following very general (and not totally exclusive) categories: combat games, simulators and sports games, strategic games, role-playing games, and traditional educational games.

Direct combat games have become a significant form of entertainment for younger males around the globe. Even these often-crude games have their prospective benefits. Gamers who play these kinds of games regularly increase their eye-hand coordination, perceptibility to detail, tactical thinking and fast reaction abilities in certain environments[4]. Gamers can transform a lot of information at the same time and acquire other cognitive skills. Therefore games can be seen as an essential part of student centered, constructivist,

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[2] Games facilitate operacionalization of various strategies that, in order to be grasped through theory, would require advanced training in mathematical decision theory. See. *The Math Behind Tom Carpenter's Assumptions* Michael A. Rutter http://www.starcitygames.com/php/news/expandnews.php?Article=5263.

[3] See *Back to Basics #3: Counting Card Advantageby Oscar Tan* . http://www.starcitygames.com/php/news/print.php?Article=4835 In this paper, one of the best players in the cards game *Magic* demonstrates that counting card advantage isn't so different from managerial accounting. You begin with resources or assets such as your hand, your library size and your life total, and you gauge swings in the game by the net changes in each resource. To compute card advantage, thus, you just have to take a couple of "before and after" snapshots of your hand size.

[4] Recent research conducted at the University of Bristol demonstrates that shows that children learn a range of strategic thinking and planning skills that teachers find beneficial to their pupils' learning. The report demonstrates that children learn important thinking, strategic and negotiated skills via games that are not necessarily encouraged as easily through other mediums http://www.bris.ac.uk/news/2002/mcfarlane.htm

University of Bristol New research shows benefits of playing computer games 2001 The University of Bristol, UK. See also http://money.cnn.com/2003/07/09/commentary/game_over/column_gaming/?cnn=yes.

modern education.[5] Those are transferable skills applicable to the situations in modern life that range from car driving to operating computerized military systems.

One category of commercial games, that can clearly be applicable to education, is the simulator. Because the virtual world has the capability to create unique, safe, environments, NASA, the U.S. military[6] use various simulators as training tools. Other simulators, such as *SimCity* and various sports games can assist the learning of management and sport strategies, respectively. Another aspect of sports games is that all of them allow students to learn about sports facts and the rules, which makes them alike to the traditional educational games.

Many computer games are in part role-playing games, in which a character is being formed by his/her experiences throughout the game. Role-playing games teach the players a whole gambit of interpersonal cooperation skills.[7] By shaping individual characters they demonstrate vividly how a few decisions in life lead to the acquisition and development of certain skills, and naturally to neglect of others, and how those choices shape someone into a given *persona* in their professional and even private life.[8]

Strategic computer games provide an effective way to test certain advanced strategies applicable to real-life situations, just like the best traditional strategic games, such as chess and various card games. The best example of such a learning strategy is provided by war games, which have been played by generations of military officers as a part of their tactical, operational and strategic training.

In order to understand how skills acquired in strategic games may be applicable not only to war, but also to many elements of everyday life, especially to business, one needs some background in decision and game theory and its uses for business strategy. Many **perfectly competitive** business games can be mastered through computer simulations.[9] However, the reliance on win-lose game scenarios makes some strategy games inept tools for learning realistic business strategy. The highest ranking[10], and presumably best, strategic computer games employ **a mixed strategy** of limited competition and cooperation similar to the oligopolistic strategies predominant in real-life business situations.[11] Oligopolistic

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[5] *Video Games - The Necessity of Incorporating Video Games as part of Constructivist Learning* By Obe Hostetter based on research by Richard Clemens from James Madison University, Department of Educational Technology, http://www.game-research.com/art_games_contructivist.asp

[6]. See. information in BBC News http://news.bbc.co.uk/2/hi/entertainment/2004345.stm

[7] For instance in the popular role playing games *Diablo* and *Baldur's Gate* conversations with various characters, and learning skills, are the main source of information required to complete assigned tasks.

[8] Just like the hero in *Heroes of Might and Magic* can start the game as, say, a knight and then acquire either lordship and become a warlord, or magic skills and become a sorcerer. Also in one's life one can build one's social self by being involved in various clubs, organizations, or taking part-time jobs, and then turn out to be qualified to have very different skills then one may thought of, depending on the kind of those involvements, which may have been selected with no purpose other then social relations, or providing extra income.

[9] Perfectly competitive games, otherwise called zero-sum games, are two party games in which one player's gain is the other players' loss. Hence, they leave no space for compromise. Perfectly competitive games must not be confused with perfectly competitive markets, as defined in classical economics. To the contrary, perfectly competitive markets are the markets on which it makes no sense for a business to aim at weakening competitive position of any of its competitors since there are so many, relatively small, competitors on the market that even eliminating a few of them would never affect the price, or market share, in any significant

[10] See for instance the computer game ranking site http://www.gamerankings.com/

[11] Oligopolistic strategies provide the best simple description of the existing business competition (Michael Porter: *Competitive Strategy* Harvard, 1984). They are far from *idealizations* provided by the true believers in Adam Smith's theory of *perfectly competitive markets* in which aiming to weaken the competitive position of one's competitors is futile since there are enough of similar competitors so that the price stays constant even if a few of them leave the market. The dominant strategy on oligopolistic markets also differs from purely cooperative win-win strategies.

strategies -- which rely on increasing one's competitive advantage, require a limited initial cooperation with some of the other players and the use of zero-sum strategies when cooperative methods outlive their utility -- are perceived by some people as morally suspect. This explains the tendency to see digital games that require such strategies as objectionable as well. However, it is important to understand that one can play win-win games only in the cases of rapidly growing markets or an inefficient initial distribution of resources, or market shares (so that the game occurs below the edge of optimal solutions); after those imperfections have been corrected (we reach the edge of optimal solutions) the only rational strategy can be defined as a perfectly competitive game. This point is important to meet the criticism that strategic computer games rely overly on win-lose models. They do so to a lesser degree then chess, checkers and other traditional games, since many of the best strategic games encourage some level of cooperation with the computer-created environment, and even with other participants, before the players reach the end-game stage.

In this regard many digital games closely approximate real-life successful strategies, although there is one caveat: game educated persons such as, chess players, tend to overestimate the role of endgames in the real life.

Educational Games, Old and New.

In our short overview of educational aspects of digital games we did not refer extensively to the category of traditional educational games. Some of them, such as the old *Mario Teaches Typing* come close to simulation games; they teach transferable skills, and in this way are the clearest instance of game-based learning. Yet, the majority of *strictly* educational games, especially those focused on young learners, are aimed at creating an entertaining environment in order to enhance learning of particular facts or simple abilities. Those games should be appreciated as one of the many helpful educational tools; yet, they tend to neglect the main functions and mechanism of educational games listed in this paper. I this sense they can be seen as less educational then many of the commercial *entertainment* games, and not very much of a game either. Yet, by being more advanced in terms of design and strategy involved, many commercial computer games are almost addictive, which needs to be factored into their proper use in the classroom.

In this paper we make a case for educational value of many elements of the entertainment games, since they satisfy the main functions and mechanisms of educational games specified in the first part of this paper. Actually, they seem to constitute highly efficient learning tools. In doing so we focus on a broad sense of learning, learning *how* (or *learning by acquaintance*) -- not so much on learning *that* (or learning by description), which is the traditional form of academic learning.[12] Many of the popular computer games, especially

[12] Peter's remark: My guarded approach to the traditional games comes in part from my view that, in the contemporary information society, collecting information should belong primarily to the learner's external memory (such as various databases) not to the learner's internal memory (brain). Education must focus on learning how to apply strategies for using those data by enhancing one's operational knowledge, ranging from one's library searching skills all the way to the skills needed by an MBA graduate to run a large company.

Nick' remark: Ideally, both information and applicable skills should be present in the learner's internal memory, since the learner can formulate valuable assumptions based on his understanding of the both. The learning of facts is, in my belief, the first step to understanding any strategy, as all strategies are formulated around a combination of facts and experience.

the strategic and role-playing ones, as well as simulators, provide the skills of learning *how* to a larger degree then the traditional educational games. They promote a kind of learning relying on behavior change (consistent with *Aristotelian* theory of education) and overshadow a less hands on method of learning based on theoretical reflection (which can be called, a *Socratic* learning method). It seems that the former method is a better fit with our practically oriented informational society, at least in most areas, such as business, medicine and engineering.

An important challenge faced by companies producing materials for technology enhanced learning and for online learning is to include the best practices from the world of commercial computer games as an integral part of the learning process. Many leaders in online teaching include such an advanced role playing game as *The Paradox of the Commons*, games into their classes.[13] However, due to the limitations that follow from copyright laws, and to the fact that a major market for game-based educational units for online and other advanced classes has not materialized yet, it may be quite some time until higher education will be able to use games to the highest potential of this brilliant educational tool.

The present situation is likely to undergo a radical change only when major corporate investors decide to become content providers on the market of higher education. There are some worries that this move may be detrimental to the integrity of higher education, which may be the case if the process was to occur as a low priority extension of corporate training institutions (this may lead to overly standardized, less creative learning products). It is also possible that the process would be dominated by publishing houses (which would result in the focus on e-books, interactive text and basic videos. Nevertheless, there seems to be a good chance of a different scenario involving the main-stream business partners, working with academic institutions, allowing for major investments in modern learning tools including educational digital games.

[13] We owe this and other information about game-based online learning to our discussions with late dr. Lee Frost-Kumpf from University of Illinois at Springfield who used this game in his highly successful classes on Public Policy. Today, many games of this character, such as ***oil-field exploration*** are used in various universtites.