Application of computer games in the field of education

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Abstract

The computer gaming industry has today become bigger than the world music and movie industries. The influence of computer games over the youth of today is akin to that of the cultural influence of music, political movements and even religion on youth culture of the past. Of late, computer games have been attracting people of all kinds into using computers. They have driven the spread of computers into the lives of individuals who had earlier had no incentive to use them. Computer games are gaining unprecedented access to the homes, minds and souls of people today. Hence it has become increasingly important for game developers and educators to study the application of computers for enhancing the education offered to the next generation of students. Computer games can be used to give a better form of education and can even make computers become the unique tools of learning. The paper will present the current scenarios of computer games being used for the purposes of education and training. It will also dwell on areas in which the tremendous capabilities of computer games as an education medium can be utilized in educating a new generation of students weaned on computer games. New possibilities for computer games as tools of knowledge will also be projected.

Introduction

Computer games are today the most popular pieces of software on the planet. They have an incredible fan following comprising people of all ages. They have become so popular that blockbuster films are being made out of the plots of popular computer games. The computer gaming segment leads the industry in terms of technological embrace and leadership. Today's teenagers live and swear by the cult of computer games and people whose lives had remained untouched by computers have been drawn into the computer arena through the lure of games. Online gaming remains an entire subculture with its own meeting places, characters and environments. The promise of the computer as an entertainment medium is realized today only through computer games. They are even gaining recognition as forms of art like sculpture or poetry. At this juncture it becomes increasingly essential to overview how games are being used in the field of education. Games as a whole are one of the most interesting ways for pupils to learn new things. The use of the computer in education is generally thought of as a panacea by itself. It must be understood that without proper methodologies, the computer cannot realize its potential as a tool for education. To fully utilize the power of digital technology in the classroom, we need to emphasize the development of a framework as such for the deployment of computers in the field of education. In particular, the computer gaming industry and the game development community must realize the enormous opportunity which has opened up as a result of such initiatives being undertaken by educators.

Games in education

> Once you forget that their main purpose is to play games, you start getting into trouble (Tom Roginski on computers, 1994 cited in Lubar, 1995).

From the time the first game Space War was developed by Steve Russell at MIT, games have achieved a remarkable growth. The primitive ASCII art which featured the games of yesteryear looks light years away from the highly sophisticated computer graphics being rendered for today's computer games. There

was a time when text-based adventure games were considered to be state of the art. That really seems to be a faraway time when you realize that the best of computer hardware today is tested for efficiency by calculating the number of frames per second that are obtained on them while playing Quake. Computer games have taken over as the medium of choice for entertainment. But, increasingly, these mediums of entertainment have tremendous potential and levels of capability as mediums of education.

In general, it can be said that games offer many types of pleasures: agency, immersion, challenge, reward, immediacy, a dialect of repetition and variety, physical and mental engagement, and multi-sensory stimulation. Computer games raise the yardstick of immersion and interaction even higher as they "suck in" the player. As Friedman (1994) says in his essay on "Making Sense of Software: Computer Games and Interactive Textuality":

> What makes interaction with computers so powerfully absorbing – for better and worse – is the way computers can transform the exchange between reader and text into a feedback loop. Every response you make provokes a reaction from the computer, which leads to a new response, and so on, as the loop from the screen to your eyes to your fingers on the keyboard to the computer to the screen becomes a single cybernetic circuit.

If such a reaction is used effectively to propagate learning it can raise the level of interaction between the educative medium and the student to a new level.

Friedman goes on to say "If the feedback loop between user and computer is what is most distinctive about human-computer interaction, then computer games are in many ways the quintessential software products." Traditionally education – learning as it is imposed upon students in traditional atmospheres – is simply not a "fun" activity. Generally apart from the good reflexes developed from playing computer games, games have had very little or no educative features. This is slowly changing. Right from games for school-age kids ("Where in the world is Carmen Sandiego?") to games for would-be hijackers (Microsoft Flight Simulator), today's computer gaming arena has more educative content than at any time before. If these "quintessential software products" can make education a more

lucrative activity for today's students they must be given a chance.

Ventures

> I don't think it makes sense to distinguish too strictly between teaching programs and games. If a teaching program is good, it feels like a game; if a game is good, it teaches you things (Arthur Naiman, 1985 cited in Lubar, 1995).

Here we give an overview of some efforts undertaken to develop educative computer games. These are from a broad range of applications right from schooling to corporate level education.

Logo
The Logo programming language developed at MIT can be considered as one of the earliest applications of computer games as a form of education. It has been through several modifications and is still alive and doing well after many years of development with its own development community working on it with further improvements and advancements. Currently, although more than 30 years old, Logo is still coming out in newer implementations to suit learning in different fields of education. It has even evolved as a philosophy on its own as an approach towards computers in elementary education. There are innumerable versions around with their own approaches towards Computer-Aided Learning. Logo is being used in schools the world over as a tool to teach computer programming (and other things) to school children. Although a little out of date now, a still interesting case study of a bright student being taught Logo for a year in substitution for his regular mathematics class can be found in Adamson (1993).

E-GEMS
E-GEMS, the Electronic Games for Education in Math and Science project, is a collaborative project centered at the University of British Columbia (UBC). E-GEMS involves researchers in computer science and mathematics education as well as teachers, children and professional game developers. In addition to UBC, the E-GEMS participants include Queen's University, Electronic Arts, and several schools in British Columbia and Ontario. The E-GEMS project has produced several important guidelines to

be followed while designing educative computer games. These include aspects such as gender specific criteria, user interface improvements, the use of a gaming network to enable the participants to participate as a group etc. Some interesting conclusions include the fact that putting two children on the same system improves their participation, achievements and motivation. Another conclusion was that choice of interaction style, i.e. point-and-click movements versus drag-and-drop, can affect both achievement and motivation. Student researchers involved in the project have submitted their findings which can be found at their home page[1].

Simulation games in military training
A few years back *Wired Magazine* ran a feature length article about commercial computer games like Doom and Quake being used in combat training for US Marines. Simulations have long been used in the army as a tool for equipping soldiers with exposure to situations which cannot be enacted out in real life without enormous expense. These simulations have generally employed state-of-the art virtual reality equipment and other expensive investments. But in the *Wired* article, at the Quantico, Virginia Marine Corps Base, a commercially available version of Doom II was modified using freely available modifying tools and level editors and a customized game called Marine Doom was developed. This game featured a superior training environment for Marines which was very different from the standard simulation games in terms of interactivity and entertainment value.

The game was based on development work done by the Modeling and Simulation Office of the Marine Corps base which had no other costs to pay except for a CD-ROM of Doom II which cost around US$49.95. All other tools were downloaded for free over the Internet. This was highly cost-effective compared to other efforts in the development of simulation games. Though it can never possibly replace field training it is still a very good option for situations on say battleships and other remote locations where space and environments for practice may be unavailable for troops to train during deployment or in case of unique training requirements where the knowledge of a specific region needs to be learnt and the place may be out of bounds for training and field visits. A specific case when

US Embassies were threatened by takeover or hostage situations, the game developers planned to create new levels based on floor plans of actual US Embassies around the world in case training was required for handling hostile takeovers and other terrorist threats. Thus an off-the-shelf game was used to successfully implement simulation training for a highly mission critical application.

Adventure games in business and corporate environments
Adventure games have come a long way since their initial text avatars in the dawn of gaming. They have proceeded into various subgenres which have included puzzle games, role playing games, simulation games etc. They have the added attractions of being a form of interactive story telling. They have several unique advantages over conventional books or other sources of literary entertainment – they are non-linear in nature, they offer a high level of interactivity and they offer an overall more immersive experience than any other form of digital or non-digital entertainment.

The first computer role-playing game, Adventure, was written at Stanford in the 1960s: the game was text based and play involved controlling the adventures of a character trekking through a magical landscape while solving puzzles[2]. And in his column, Mathematical Games, in the October 1970 issue of *Scientific American*, Martin Gardner described the game of LIFE, a simulation of cellular growth patterns written by his friend, British mathematician John Conway. LIFE was an immediate hit and the first "software toy," an addictively open-ended model of systemic development designed to be endlessly tinkered with and enjoyed. Since then adventure games have become a mature form of entertainment with today all sorts of educational experiences being built around them. In the real world the most natural way to accumulate knowledge in a domain is to be immersed in situations related to the domain and to practice. This mode of acquisition (the learning by doing) while somewhat very efficient for the transmission of operational knowledge, is however difficult to implement in the case of a classroom. The problem involved in making students gain such experiences in real life, high pressure situations, for example stock trading, may be solved by making use of

computer simulation games. Specialized corporate learning games and other games for the business field have been developed featuring real life situations like marketing situations, planning situations etc. Strategy games have long been used in the corporate world to provide training for management trainees and others. Strategy games like SimCity have mutated into hundreds of different variants each with its own area of manipulations. Schools have their own versions to treat geography and history; business schools have their own versions to teach effective administrative skills; different versions serving a multitude of purposes exist.

Paradigms

For a computer game to be more than competent in educating the player in a selected domain, it should be more than just a rehash of the conventional educational technologies used in computer-aided learning, i.e. for it to proceed beyond the stage of "old wine in a new bottle" and to be truly effective, gaming should be thought of as an entirely new playing field and as a totally new canvas for educationists. To excel in this newly developed area with infinite potential for producing efficient educational experiences, the educationists must possess thinking that is both "out of the box" and "lateral". It will be necessary for the developer to have a sufficient level of competency in three key areas – interface design, domain expertise in the relevant area and pedagogical knowledge. Only if these key areas are concentrated upon will the game rise above the level of a ordinary computer game and be a truly innovative application of computer games.

Interface design
The interface design has to take into account several factors – usability, accessibility, interactivity etc. Usability engineering has a heightened emphasis in the case of educational gaming since the target audience for educational games may include people who are inherently new to the concept of computers, and children whose expectations form an interface which may seem unreasonable from the eyes of an adult spectator. Also in a game developed for people all around the world, special care has

to be taken to make the interface intuitive enough and friendly and sensitive enough for people from all backgrounds. With games being used as a form of therapeutics for disabled people it becomes essential for the designer to take note of their side of the problems too. An otherwise superior game can be ruined by the lack of a competent interface. Hence new paradigms need to be adopted for the interface design.

Pedagogical knowledge
The teachers of today have a wider variety of tools than ever before. But to use these tools effectively to coach "the MTV Generation", refined techniques need to be advocated. Pedagogical knowledge in a subject not only dwells on the contents of a subject but also how it is to be presented in a form that will reach the learner in a very effective and entertaining way without any "noise" creeping in the communication and without any vital information getting lost. This efficiency must be present in any educational game since after all the main idea is to teach something to the player. This is achieved by consulting a wide range of expert knowledge on the subject at hand about how it is taught conventionally, in what order are the pieces placed together and what improvements can be made in a digital environment to the learning process.

Domain expertise
Domain expertise is a facet of game development which must be thoroughly analyzed for developing a flow and a feel in the game and to make it an intellectually simulating experience for the player. The difference between a game that plumbs the depths of knowledge and merely surfs over the turf lies in how much time has been spent by the development team in gaining domain expertise. In games teaching subjects with advanced concepts, lack of domain expertise on part of the developers can create a "train wreck" whose ill effects can be hard to bear and which can damage reputations.

The future

Today the computer game development world has the cutting edge of computer technology at its feet. As a segment which is currently holding one of the most glamorous

positions in the computer industry and whose turnover has surpassed even that of Hollywood, computer gaming has gone big time. Gaming is propagating research in areas such as artificial intelligence, computer graphics, 3D animation and other technological fronts which have earlier been the domains of theoretical computer science and which were previously thought of as "uncool" areas or as impractical frontiers with little scope for future research and development. Writing in the January 1, 2000 issue of *Newsweek*, Seth Stevenson says, "In the century to come, the medium producing the most dynamic, vital and exciting new art will be video games". Stevenson says these games will be "more entertaining than movies, more profitable than movies and yes more moving than movies". For gaming to become a mature and value generating industry it becomes necessary for it to enter new dimensions and frontiers and explore the areas where it can raise itself beyond the plateau as an entertainment industry it finds itself on now. It is time for the industry to explore these new paradigms and rejuvenate

itself for the next stage of evolution that lies ahead of it.

Notes

1 E-GEMS Project Home Page. http://taz.cs.ubc.ca/egems/home.ht
2 Transcripts from `Computer and Video Games Come of Age, A National Conference to Explore the Current State of an Emerging Entertainment Medium´´, hosted by the Program in Comparative Media Studies at the Massachusetts Institute of Technology on 10-11 February 2000, available at: web.mit.edu/cms/games/education.html

References

Adamson, E. (1993), `The best learning is play´´, *Logo Update*, Vol. 1 No. 1, Spring, available at: www.media.mit.edu/logo-foundation/pubs/logoupdate/V1N1.html

Friedman, T. (1994), `Making sense of software: computer games and interactive textuality´´, in Jones, S. (Ed.), *Community in Cyberspace*, Sage, Thousand Oaks, CA, see also www.duke.edu/~tlove

Lubar, D. (1995), *It´s Not a Bug, It´s a Feature!: Computer Wit and Wisdom*, Addison-Wesley, Reading, MA.