

Making the case for computer games as a learning environment.

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Abstract

In this paper we initially consider some of the features that are common to successful computer games by contrasting the views of those authors who contend that the narrative of the game is pivotal to its success, with those who suggest that the actual game play is of greater significance.

We then go on to contrast the approaches taken by computer games to engage players with those of education to engage learners and ask whether there is any common ground. We further consider what sort of skills or knowledge could be acquired through the use of computer games with a particular emphasis on literacy.

Finally we question current trends in the development of the virtual student learning space and suggest that some rethinking may be required if virtual learning environments are to be embraced by students.

Keywords

computer games, education, virtual learning environments, literacy.

In this paper we will seek to establish the case for the use of current computer game platforms as an appropriate medium for students to acquire key skills such as literacy or numeracy. We will initially consider some of the aspects of digital game based learning which may make it a suitable educational development environment, including a consideration of some of the theoretical and pedagogical underpinnings. We will then go on to consider the nature of the student learning space and the implications that this may have for the development of successful educational computer gaming systems.

What makes a good game?

Which is more important the narrative or the game itself? Is it more important that a game tells a good story or that players have the autonomy to construct their own narrative through the decisions that they make? These are two views of games as either a new medium for the familiar process of story telling, or a dynamic space where players can make apparently endless (but in reality limited) choices that will influence the direction that a game takes.

These two views, on the one hand that the quality of the interpretation of the game as a narrative form determines the success of a game, and on the other, the view that the way the game plays (ludology) is paramount, represent two very different perspectives on gaming.

The game as a distinct narrative form (Murray 1997) does not necessarily represent an oppositional position to that of the ludologists (Aardseth in Jenkins 2002). Squire does refer to arenas of contested space (Squire 2001), however to a certain extent they are both considering different aspects of gaming. Along side these discourses there is clearly room for a middle ground as suggested by Jenkins who makes the case for games designers as narrative architects (Jenkins 2002). This is a view that blends elements of narrative and game play and suggests compellingly that narrative is influenced by the space within which the game is enacted.

With movies, books, music, and websites, directors, authors, producers and designers make conscious decisions relating to target audience, decisions that may change the way a story is told, or the way a particular product is packaged and marketed.

In game design issues such as complexity, re-playability, and the extent to which the game can become an immersive experience are all factors that may ultimately affect the success of a game. The one factor that is seldom if ever considered when designing games is the potential educational value that the game may have. After all, games are entertainment so why should there be any need to try and sell them as learning experiences as well? One of the more difficult concepts relating to the success of a game is this notion of the game as immersive experience.

Murray (1998) defines digital environments as having four essential qualities:

- Computers are Procedural

That is computers are machines that work by rules and by executing commands, if you click something, something else happens but only something which has been pre defined.

- Participatory

Digital environments are appealing to us not just because they exhibit rule generated behaviour but because we can induce the behaviour.

They are responsive to our input. (Therefore motivating and neutral - machines don't judge us easier to get things wrong)

- Spatial

The new digital environments are characterised by their power to represent navigable space. Linear media such as books and films can portray space, either by verbal description or image but only digital environments can present space that we can move through.

- Encyclopaedic

The movement to the global databases of the internet means access to a huge range of resources, textual, visual, audio and video

One of the main qualities that make game based interaction so compelling is the location of interaction within an immersive context or environment Gamers can play games for many hours at time, often displaying extreme concentration for long periods; they are "in the zone". This state of total concentration is similar to that categorised by Csikszentmihalyi as the psychology of optimal experience or flow theory (Csikszentmihalyi 1997). The extent to which this effect can be achieved appears to be critical to the success of the game itself. Many action games create this state by having an emphasis on refining motor skills through concentration and repetition, enhanced by music and the gaming context.

We can see therefore that there are several factors that contribute towards making a game successful. Caillois (2001) outlines six formal qualities of games:

- Freedom
- Separateness (from events outside the rules)
- Uncertainty of outcome
- Non productiveness
- Games are governed by rules
- Make believe (not real)

Whilst he was not writing specifically about computer games many of the qualities that he identified can be applied to modern games as well. To this list we would add in relation to computer games the following qualities:

- Immersiveness
- Indeterminate completion time
- Tendency towards complexity

Again, non of these features on the surface appear to offer any compelling support for the use of games as educational tools, or do they?

Games vs. Education?

It is perhaps pertinent at this point to consider both similarities and difference between the format of games and learning experiences before suggesting ways to combine the two. We need to establish just what can be learned more effectively within a games environment than within a more formal educational setting. In addition, we will seek to outline the reasons why educational games are not as effective as games that have pure entertainment at their core.

Caillois (op cit) defined playing as a free and voluntary activity that provides the participant with joy and pleasure. This then, is nothing like the educational experience but perhaps closer to it is Caillois' definition of gaming which states that 'actions and events in a game, even though seemingly free and open to variation, are always bound and framed by the rules of the game'.

"Responses in games are free within the limits set by the rules of the game."

The set of rules in an educational environment would be the lesson objectives and rules of interaction with the content to construct knowledge. This is traditionally set and controlled by the teacher-mediator at the point of delivery, and more widely, by the dictates of the curriculum and societal objectives for education as a whole.

Within a classroom environment the rules are transparent and articulated by the mediator, a game conversely gives the illusion of freedom to choose within the boundaries of the rules, whereas education does not. Most formal education has a proscribed route for achievement and is product driven. Whilst students undoubtedly do acquire important skills along the way these are not always measured effectively. This often means that process (how we acquire skills rather than content), which may be the most interesting part of an educational experience, becomes secondary to educational product or qualifications.

Games tend to focus more overtly on the mastery of skills before game obstacles can be overcome. Games allow repetition and practise of skills to gain automation before introducing more difficult tasks. However, these skills tend to fall mainly in the psychomotor domain (Bloom 1956) rather than in the higher cognitive domains. Additionally it can also be said that the obstacles themselves require cognitive skills in the solving of them, even within the most rudimentary of shoot-em ups, for example the game Half life requires that a submerged chamber be traversed by diving to turn a handle which drains the water to allow progress to the next level. This categorisation of how players acquire skill at a game would sound familiar to an educationalist and many of the qualities inherent in gaming would be desired features within a formal learning environment. The beauty of a game, however, is that it allows the individual to be placed at the centre of the learning experience. Skill at the game is the arbiter of success not other's judgement of how you played it. Too often in educational situations there are agenda other than pure learning that need to be mastered, motivation that needs to be engendered in the face of curricula that are perceived to be increasingly irrelevant, and moral suasion and control that needs to be exercised in the production of good citizens for the global economy.

The idea of the educational gaming experience being learner centred rather than teacher centred reinforces the currently popular idea that teacher centeredness and the notion of an expert culture do not sit comfortably in a post modern world (Edwards, Gilroy 2002). This does however present a false dichotomy as it ignores the third dimension of the learning experience which is the actual content itself. A content centred learning experience might at first seem to suggest a return to traditional notions of a clearly defined

curriculum, however, when we are seeking to engage students interest in a gaming environment it is the content contained within the environment that will determine the interest far more than any predetermined notions of teacher or learner centeredness.

It is probably true to say that students expect autonomy if they are playing single user games against computer generated adversaries or scenarios. The pedagogy should therefore be inherently geared towards the mediation between student and content to create knowledge rather than teacher – content – student, since the game effectively replaces the teacher, at least for the duration of play. It may even be true to say that the game also replaces the user/learner/player as they become immersed in the game play and become embodied within the game character or as an agent of the game.

Within the constraints of this model there is still enormous scope for a wide range of pedagogic interactions and it is worth considering how these may be implemented in a gaming environment.

Traditionally, there has tended to be a perceived split between behaviourist notions of learning as exemplified by early CAL systems and still found widely in business software training systems, and a constructivist model based on the ideas of meaning as a individually constructed position, mediated within the context of a larger normative social structure (Bruner 1956)

From the behaviourist position we see educational games that use techniques not unfamiliar in classrooms of 100 years ago, drill and practice, positive reinforcement of desired behaviours and penalisation of transgressive behaviour. All of these features can be built into logical rules-based software without having to develop overly complex systems. Some semblance of choice can also be created by building divergent routes to progression, with ultimately similar outcomes.

Taking a constructivist approach, by creating gaming environments with many different start or finish points and with very non-linear game play the opportunities for far greater differentiation of experience is possible, and, to extend the idea of knowledge as being the pivotal element of the gaming environment, the learning experience evolves from socially situated acts of cognition which may not be predicted by a rules based system, and which may not always manifest themselves during the game play.

This last point could of course be said to be true for behaviourist approaches since if it were not then the central purpose of the game, i.e. to inculcate transferable learning experiences would not be achieved.

The evidence in favour of complex, multitasking, graphic rich environments which utilises the parallel processing, graphics awareness, and random access capabilities of what Prensky describes as digital natives (Prensky 2001) is compelling, providing as it does a rationale for why traditional schooling and games derivative of that approach might be perceived as boring and ineffective by students.

To summarise, it can be shown that irrespective of the format, games need to be learnt by the players in order to achieve mastery of the game. This learning may encompass the acquisition a range of skills and knowledge in a variety ways, in much the same way that conventional education does.

So is there really a division between games and education? We would suggest that again this represents an attempt to categorise work and fun as being separate or even oppositional activities. This somewhat arbitrary classification system may account for some of the dissatisfaction expressed by older children (Key stage 3-4) with the school system. Education is often described as work (homework, work in class, extra work, finishing your work on time), which, when it is contrasted with the range of modern recreational pursuits, does not cast it in an attractive light.

There is a strong argument for suggesting that these two oppositional terms need re-evaluating and combining into what Papert refers to as hard fun (Papert 1998). We have already commented on the time and effort that is expended on computer games, so clearly in one sense they could be seen as requiring a great deal of work. However, one of the central arguments against computer games, and games in general, that needs to be addressed is what Callois (op cit) refers to as unproductiveness. It is certainly true that computer games require a lot of work, the challenge then is to make that work not only enjoyable but ultimately of some use to the player by allowing them to build knowledge and understanding and acquire skills.

Games for education or educational games?

At this point we will make an important distinction between educational games and the use of games for education.

A great many educational games already exist. Some of them are excellent, however a great many of them exhibit many of the least desirable features of conventional education translated into a different medium. Games for education however, utilise existing games in ways that the designers may not have originally considered. These two approaches have been summarised by Reiber (1999) as either exogenous in that an existing game format is re-appropriated for educational purposes e.g. Black and White Light (a development mooted by Lionhead studios for teaching citizenship through bespoke versions of their god game), or endogenous when the educational content is seamlessly integrated into the games structure e.g. Sim City.

Educational games and computer based educational material tend not to have the same effect in terms of motivation as real games. Traditional educational games tend to have sanitised subject matter, they have objectives which are explicit from the start and they have constant feedback on what the user/player/learner did wrong. These interventions and disruptions to the flow of the game are the disembodied voice of the hidden teacher. Just when you were starting to enjoy yourself, the game is interrupted by some thing telling you how you could have done it better. As Papert notes

Shavian reversals—offspring that keep the bad features of each parent and lose the good ones—are visible in most software products that claim to come from a mating of education and entertainment.

(Papert 1998 op cit)

The problem is that the structures of the formal learning environment are the structures which define and confine the screen based learning experience of educational content. The structures of game play are ignored at best and at worst only borrowed from.

Education in the broader sense of on line learning materials in the mould of the National Learning Network materials (www.nln.ac.uk) tends to replicate itself in it's own image.

The new learning architecture within formal education tends to be learning object based where learning is broken down into smaller and smaller one outcome objects with hopefully re-useable activities that are context free. This industrial approach to learning envisages a world where students utilise learning objects that are selected for them by learning advisors for just in time learning experiences that transmit and test subject knowledge. Learning content is information led and is corralled and controlled by managed learning environments. Within these learning environments sit learning objects. Chunks of bite-sized context free learning of around ten minutes length or slightly more that are selected and blended into students traditional learning programmes. The content is pre selected by a tutor and the activity is designed usually by an instructional designer. This type of learning is big business and is often disguised as being learner centred in that the knowledge is there on a just in time basis. In reality, it merely replicates the original linear curriculum and is sanitised for organised consumption by students.

Educational computer games should not however be seen as a failure, many of them are highly successful as an adjunct to conventional classroom practice. Where they have been less successful is in generating broader appeal outside of the school environment, and into mainstream popular culture. This may be due to the rather heavy handed approach of many educational games with educational objectives stated overtly and intermittent input from the game acting in the capacity of a teacher. Indeed, the approach that appears to have been taken with *real* games is one of making games fit into the context of formal learning. This strategy is not without its difficulties as research by BECTA notes. The main benefit of games in education was seen in their research to be motivation.

‘Motivation can be ascribed to some satisfaction or anticipation of satisfaction in the outcome of the game, to interest in the content of the game, or to pride in achievement of mastering the game’s rules and requirements. All of these responses are of value to teachers and learners in educational settings. ‘

Their findings, summarised below, tell us as much about the formal learning environment as they do of the effectiveness of games for learning purposes.

Benefits	Problems
Support for ICT skills	Time consuming
Increased motivation	Too complex for classroom context
Encourage collaborative working	So engaging that an educational focus is lost
Encourage discussion of citizenship issues	Girls may be disaffected
Positive side effects, e.g. increased library use	Inappropriate vocabulary or reading level
Increased self esteem	Technical problems
Engagement with the content	

Games (dependant on genre) certainly produce the benefits outlined in the table above and the problems tend to align themselves with Callois qualities. Freedom of action and experience might make them too time consuming. An educational environment is very much like a production line, there are so many minutes for the transfer of particular knowledge and skills. A game, with its user centredness might require different time periods for different users to gain mastery. The differentiation by skill level, often sought by educators within their own materials is built in to the structure of a game; it's just that it takes people a longer amount of time to practise and master skills.

Separateness from events outside the rules is another quality of games that does not really transfer to an educational environment. The teachers as supra mediators of learning have objectives that do not adhere to the rules of the game. Likewise, learning has a certainty of outcome, if you do x then y will be achieved. In one of the Becta examples a football management game was utilised to teach towards objectives concerning the use of databases, the outcome however was a little unsatisfactory for the teachers as students "became engrossed in the detail of the game".

Equally, non-productiveness is a game quality that is directly opposed to the notion of education in the UK. A product is essential to the educational process, it is how learning is assessed. The products of gaming have less worth in this regime, they produce process skills like collaboration and discussion which are notoriously non measurable. The question of whether or not skills transfer between contexts will be examined later in this paper but it seems fundamental to the discussion that if games are to be of worth in the area of learning then it is their product less skill development quality that needs to be harnessed. As soon as you define a product you define an outcome and the illusionary freedom of choice within the game is lost. The notion of mastery which leads to flow and skill automation is less easy to achieve because the outcome is known.

The challenge then is to produce games that have mainstream appeal, which acknowledge popular culture, and which have an educational value. This approach to gaming needs to be created in an environment which is independent of conventional approaches to education, and one which is built around the relationship between players, content and process

Just as low cost, high volume printing could be credited for improving national literacy in the last 150 years, we would contend that as recreational pastimes become more computer game oriented one way of developing the skills of young people may lie with the next generation of education games that combine the production values of the games

industry with the pedagogical knowledge of both educators and educational software design

Children who read well, often do so because they read outside of the school environment. One of the issues at the moment is that reading books is not always perceived as interesting to children, since books lack many of the more exciting features of computer gaming systems. Indeed, until mastery (of the reading process) is achieved their immersive qualities are lost. Games give an instant, graphical escape. For many children computer games fill the space previously occupied by reading. We would contend that computer games can still offer potential opportunities to develop literacy or numeracy skills than that can supplement and support conventional reading. Fluent and competent readers achieve that competency by automating and combining various skills. The more automated or natural those sub skills become the more time the reader can spend on interpreting meaning directly. What better place then, than a computer game where progress is dependent on skills development to introduce aspects of the skills needed to improve reading competency.

Poole notes that in game design the relationship between players' skills levels and task or obstacle difficulty are crucial in maintaining motivation. If the match of skills to task is too greatly in favour of the player then the challenge and hence motivation to succeed is diminished and if the reverse occurs the user/player is quickly disillusioned. What resonance this has with the world of education. The only difference is that the game format or structure has plenty of opportunities for practice and several different levels of skill that a player can select and a community of practice where being good at games is a desirable rather than a forced cultural notion

We can summarise some of the desirable pedagogical features of computer games as follows:

- Players can select an entry level of difficulty
- Players can achieve mastery through repetition
- Progression is rewarded
- Mastery conveys social status
- Failure is private

This represents the relationship that exists between players and their computer games. We would suggest that any game that fails to respect this framework will fail either as entertainment or educational experience.

To conclude this section we would suggest that it has been due to not working within the recognised frameworks of successful game play that has led to the failure of educational computer games to gain more mainstream popularity, and conversely it has been a general failure of the education sector to acknowledge widely the educational potential of computer games that has led their being underrated as a valuable educational tool.

What can be learnt from computer games?

Within some sections of the media computer games are portrayed as vehicles for the assimilation of a whole range of undesirable forms of learning. It has been variously suggested that computer games contribute to social isolation, that they brutalise and desensitise children to acts of violence, or even actually encourage violent behaviour and sociopathic tendencies. In fact computer games generally have been demonised by some of the more conservative elements of society and charged with responsibility for the general degeneration of youth culture. There is actually little evidence to support these arguments.

Of more relevance to us is the consideration of what sort of knowledge or skills can actually be acquired from playing computer games, rather than a detailed rebuttal of some occasionally fairly spurious allegations.

There is considerable evidence to support the use of computer games for the acquisition of psychomotor skills. The mere fact that the aerospace industry invests considerable sums of money in developing flight simulators, which are really only a much more sophisticated version of the games found on most consoles, would suggest that games and simulations of real world activities have a valid educational purpose.

It is within the cognitive domain that the benefits of computer games as learning tools becomes less clear. It is outside the scope of this paper to attempt to develop a taxonomy for computer games and attempt to ascribe different categories of learning experience to them, however at a general level we can state that computer games offer the following opportunities for development of cognitive skills and processes:

- Deductive reasoning
- Literacy Skills
- Numeracy Skills
- Communication skills

Of the above list deductive reasoning is perhaps the easiest to provide evidence for as it is often the central feature of many strategy, simulation or God games e.g. Black and White and the various Sim family of games.

Turning to consider literacy skills, here the evidence here is less clear cut since whilst games are undoubtedly targeted at audiences in terms of the level of player skill or age, or at specific sectors of society there is little to suggest that games are developed with any appreciation of the level of literacy required to engage with them.

We can however identify three distinct dimensions to gaming that may demonstrate different aspects of literacy and language use and which may provide different literacy development opportunities. These can be categorised as follows:

- The functional literacy level required to understand how to engage with the game by following the operating instructions
- The literacy involved in the engagement with the game itself and any dialogue between players and the game for the purposes of playing
- The literacy of the supporting social structure that may extend beyond the game itself in the form of virtual communities

The first two aspects of language use and development opportunities clearly lie within the domain of the game and could be used to extend the aforementioned taxonomic approach to computer gaming by offering more specific stratification within the cognitive domain. It is the third dimension to computer gaming, that of the emergent virtual communities that provide support and discussion space that offer the best opportunity to develop literacy skills, and it is this aspect of gaming that we will consider in our final section which addresses where learning actually takes place.

The role of computer gaming in supporting the acquisition of numeracy skills represents the most significant challenge, as the incidental use of mathematics during game play is at best limited to simple mental arithmetic to solve puzzles in rpgs or the use of estimation to predict velocity, distance or angles of trajectory in simulation games such as golf or snooker.

The extent to which numeracy skill acquisition can be developed within a gaming environment has already been considered in relation to complex levels of learning to support physics or optics (Squire op cit). The development of numeracy at a lower level is often presented as pre-school edutainment such as Sesame Street rather than for a more mature audience. It may well be that opportunities for game play to develop adult numeracy are limited, although a number of popular pastimes such as darts or betting offer opportunities to integrate numeracy into a computer gaming format

Our final category of communication skills may not at first seem obvious if a stereotypical view is taken of computer gamers as solitary, introverted individuals with poor social skills. The evidence however is clearly weighted against this view. Whilst there are undoubtedly people that play computer games who do exhibit poor communication skills, it would be simplistic, and indeed inaccurate to suggest that this is a consequence of their gaming activity.

Recent studies of games such as Counter-Strike (BBC News) have shown that a considerable degree of on-line communication develops between players and there is

evidence of sophisticated strategic thinking. Even games that are off-line are seldom played alone, and frequently form a central component of the social infrastructure of modern culture. Players will play against each other, compete to gain high scores, share tips and cheats with each other in a variety of locations from playground to pub to chat room.

This leads us on to consider in our final section the relationship that needs to be developed between gaming and its attendant social structures, and education as it may develop in response to changing social conditions and cultural practices.

The student learning space

As we have suggested previously the attendant social networks associated with computer games of all types offer the opportunity to develop learning opportunities which transcend the usually accepted conventions of what constitutes a suitable learning environment.

Rheingold amongst others has demonstrated clearly that online social networks can benefit organisations (Kimball and Rheingold 2000). The logical extension of this into educational settings has already been extensively developed with the emergence of a wide range of VLEs (Virtual Learning environments).

There are a growing number of VLEs which offer some form of online learning experience. Many of these attempt to replicate the range of pedagogical interactions available within a traditional classroom environment. The structures of VLEs are in the main very conventional in appearance as for them to work they must present an interface to teachers and course developers which allows for the easy translation of content and teaching into an online environment.

Within a VLE there is frequently a greater emphasis placed on socialisation and knowledge construction (Salmon 2000) and more of an acknowledgement of the value of social learning theory than would be found in a more traditional learning environment (Bandura 1977, Wertsch 1985, Wegerif 1998). This online socialisation is often more formalised than that which is found in game oriented on-line communities, and often tends to exhibit similar hierarchies to a conventional learning environment

The current generation of VLEs are functional, provide a useful depository for information and an effective means of communication, however without exception they are not entertaining, or inviting places, and there is often little sense of ownership by either students or teachers. A typical VLE is not somewhere where students or teachers are likely to want to spend hours immersed in the environment as tends to happen within the gaming world.

To draw a parallel, the current generation of VLEs have the appearance of well ordered classrooms. They are well organised, have nice pictures on the walls and have lots of useful resources all stored tidily away. Teachers can work within the VLE in a comfortable, regulated way, with lots of planned activities and a sense of overall control, in short an idealised virtual classroom.

In contrast online gaming environments, or console games, and specifically the online communities that have developed to support them, can give the impression of chaos, lack

of order, no overall control and often present the very antithesis of a suitable place to learn. We are so used to associating learning with rigid structures that the notion that this kind of environment could in fact be a far better learning space is rarely considered. To take this limited view of how online learning works is to fail to acknowledge the range of approaches to education that have been developed in the last 40 years; specifically the work of Neill at the Summerhill school (<http://www.s-hill.demon.co.uk/>) or the de-schooling approach of Ilich (1970) provide examples of how an alternative approach to education can still deliver positive results whilst appearing to fly in the face of the received wisdom of how the education of children is supposed to happen.

If these approaches are extended to the development of student learning spaces and online collaborative communities then the current range of available VLEs can be seen to offer, in the main, fairly limited opportunities for replication of some of the less mainstream approaches to education, facets of which can be seen emerging from within the computer gaming community.

Conclusion

In this paper we have considered some of the differences between the pedagogy of computer games and that of conventional and on-line learning. We have attempted to demonstrate how the appropriation of computer games for educational purposes is more likely to work if learning emerges as an adjunct to the game rather than forming the central core or main purpose. We have concentrated on games in terms of the opportunities that may exist to develop key skills rather than more sophisticated or specific forms of learning.

The challenges that our analysis presents are in developing a model of education that embraces computer gaming, without centralising it and making it less of a counter culture, in developing a pedagogy for on-line learning that intersects with conventional education to produce a true blended learning environment, and finally to de-school the virtual classroom before students and teachers re-create some of the failures and disillusionments of modern education.

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