Concise paper

Mindless entertainment: A literature review on the use of computer games in education

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ABSTRACT

Computer games have no place on campus; I have heard this a hundred times. The students should be working not playing games; yet retention rate is down worldwide, especially amongst computing students and we continue to predominately teach the same way we have always taught. This paper documents the wealth of literature and research into the computer game phenomenon and offers some insights into why many students appear bored, uninterested, and often fail to complete their studies.

Keywords

Education, computer games, cognitive abilities, learning styles.

1. INTRODUCTION

Skinner (1997) quotes an unnamed IBM executive as stating that education is the only sector undecided on the uptake of computer technology. He outlines studies by various groups, both for and against computers. The pro-computer advocates promote qualitative reports citing over 500 individual studies of computer based instruction having a positive effect, but their critics tend to be emotive in their response, suggesting that what may be appropriate for students with learning disabilities or the military, will not replace traditional teaching methods. Admittedly this was back in 1997, however Skinner notes that US schools report one computer for every nine students, up from one to sixteen students five years earlier; but over 50% of computer use in these schools was to teach computer skills, and not for any other learning. According to the United States Census Bureau (2004), by the year 2002, the ratio in the US had risen to one computer for every four students. In New Zealand, the Ministry of Education (2003) reported that secondary schools have one computer for every four students and one for every seven students in primary schools. Skinner concludes that schools are all too often used as laboratories and incubators of as yet unproven ideas. He suggests that although computers may provide the opportunity to collaborate, communicate, and share ideas and knowledge, many teachers in American public schools are sceptical, and therefore slow to embrace technology. He finishes with a 1993 study by the US department of Education stating the reading and arithmetic are no longer sufficient in today's environment. The ability to reason, to analyse, and to conclude, is now essential for students to obtain.

Smith, Curtin, & Newman (1997) agree with this and promote a change to education to include technology-rich programs in the teaching curriculum; but they suggest that many teachers are feeling technically inadequate when teaching digitally literate students. They go further to suggest that some academics believe that traditional education practices have withstood the test of time, negating the need for technological improvements. Smith et al. state that this contradicts significant research that focuses on meta-cognition skills enhanced by computer based learning. Mayer (1998) defines meta-cognition or meta-skills as knowing when to use, when to co-ordinate, and how to monitor the various cognitive skills we use for problem solving. Smith et al. interviewed fifty-four primary school children, and their findings suggested that these

students preferred learning by themselves and practising the tasks by doing them. They also found that these children looked upon school as an interruption in their computer usage time; time they used for playing computer games. In summary, they suggest that teaching institutions must use electronic media to re-package their course content to reach these students. Educators need to understand the pedagogy delivered by commercial computer games and utilise them in class, and they must re-define the term "literacy". Smith et al. suggest that the new literacy is multimedia, computer gaming, the Internet, and anything that encompasses technology. They state that instead of "the three R's", students need skills of analysis, evaluation, and prediction at an early age. All this pointed to student centred learning using technology with educators facilitating a technology rich environment in the future; but the future needed to be now or these students would surpass their teachers.

In more recent times, Brown (2002) states that learning comes as the result of a framework or environment that fosters learning rather than as a result of teaching. He maintains that today's students look upon technology as an integral part of life and a tool that they take for granted; for many of them computing has been part of their learning since early childhood. Brown suggests that there is a shift in the way that these students learn, and this has only been embraced by a handful of tertiary institutions, creating a problem in student retention. The shifts include literacy, from text to multimedia; lectures, from teacher to student centred; reasoning, from deduction to transforming; and reading, from solitary to social exploration. Prensky (2001) agrees and suggests that this decline in education is attributed to the change in the students themselves. Using the term "Digital Natives", he states that today's graduates have spent an average of less than 5,000 hours reading books, yet over 10,000 hours playing computer games. Because of this, Prensky concludes that these students think differently, process information differently, and get bored with traditional schooling techniques. "Digital natives" multi-task, prefer multimedia over text, and thrive on computer games. Unfortunately, even today, educators still assume that students learn in traditional ways, and Prensky maintains that this must change.

2. DIGITALLY LITERATE STUDENTS

Accepting that traditional skills such as reading, writing, and arithmetic, still need to be taught, Prensky (2001) suggests that subjects such as robotics, nanotechnology, and genomics also need to be explored. Ethics, politics, and sociology are also important but are not core subjects. However, it is in the delivery of this content where educators fall short. Prensky promotes computer games to teach and reinforce these subjects. Prensky uses a First-Person Shooter computer game called *Monkey Wrench*, developed for engineering students, and claims over one million copies successfully used world-wide, some in several languages. Prensky concludes by suggesting a change to traditional schooling to include topics like "binary thinking is essential." However, he re-iterates that educators must change the delivery of existing and future content if they are to reach the "digital natives." He questions why a student can memorise 100 *Pokemon* characters, from a game, and all their attributes, yet struggle with the names of the 101 nations around the world.

Squire (2003) contends that educators have largely ignored computer games, opting for the more traditional form of teaching aids. He suggests that although the military use commercial games and simulators to test the player's abilities, schools have not yet embraced this technology – even with the enhancements in game technology in recent years, the realism now included, and the research into the pedagogy of computer games. Squire outlines game attributes that may be of use to educators including drill and practice, and simulation and strategy. He states that much of the research into computer games for use in education is often pre-occupied with comparing game playing to teaching, and not game instructional design as compared to traditional teaching aids. Squire also details those aspects of commercial computer games that have now become part of many students' culture. He suggests that much of the social interaction is of greater importance than the game itself - specifically online multiplayer games. Brown (2002)

promotes the idea of multiplayer role-playing games to facilitate collaboration and create an environment for the interaction of technology and student. He discusses a twenty-four hour digital classroom rather than the current formal lecture and textbook scenario. However, he does conclude that most academics are not equipped for this and therefore return to focusing on the content of their course, and not the delivery.

Oblinger (2004) also suggests that our current students have grown up with computer games and have spent more time playing than reading. Similar to Prensky's "Digital Natives" (2001a), Oblinger names them "Millennials" and lists their traits to include a tendency towards group activities and a fascination with technology. Their strengths also include collaboration, goal orientated, and multitasking. Oblinger claims that computer games provide an environment that students can excel in. She notes that although many publications claim that games have already been introduced into education, a survey of college students found that 69% listed no experience of games in the classroom. Oblinger goes further and compares game players with student learning styles; she suggests that game players can be categorised into *committed gamers*, *wannabe's*, *fun seekers*, and *time killers*. She highlights the importance of considering this when including computer games as part of a teaching curriculum. While the committed gamers may invest time and effort into the projects, the other types may not. Oblinger then lists the learning attributes of games, including feedback, assessment, experimenting, and creating a social community. She concludes that using computer games in higher education provides greater potential than traditional methods by creating an immersive and performance-based environment. She suggests that an interactive and engaging platform, such as a computer game, leads to deeper learning.

3. THE IMPACT OF COMPUTER GAMES

With a slow uptake of computers and computer games in education, do students learn from games, or do games have a detrimental effect? Gee (2004) suggests that many of the so-called educational games have very few learning attributes and don't deliver what is expected. But the recreational computer game, that digitally literate students spend much of their time at home immersed in, does possess all the learning principles. Gee lists games like Rise of Nations, Prince of Persia, Metal Gear Solid, and even Halo, the latest first person shooter for Microsoft's Xbox, as having many of the learning qualities built in. He categorises learning into three major areas; empowered learners, problem solving, and understanding. Gee details the facets of each category that can be found in each of the various games. Facets like the ability to customise the game, the facility to manipulate features within the virtual worlds, and well-ordered problems that challenge the player are all achievable. Gee suggests that game designers must be encouraged to continue to include such learning principles into commercial games. However, Clark (2004) maintains that game designers focus on engaging the player and making the game fun to play. He states that it is the design of the interactivity that engages the player. This can be achieved at an emotional level or an intellectual level, but for the player to learn from the game, Clark states that the game design must include action and consequence; learning will then be achieved through cognitive conflict.

Antonietti and Mellone (2003) conducted a study with forty undergraduate students: twenty males, twenty females, with a mean age of twenty three years old. They selected the game *Pegopolis,* as it includes a board version of the game as well as a virtual version on a computer. They selected participants that had no previous experience with the game. Antonietti and Mellone used mixed methods to gather their data with participants being asked to describe the experience and the strategies they employed. Their moves were recorded and later analyzed using progressive matrices; in order to measure the participant's perceptual relations and reasoning ability. The researchers found that there was no significant difference in performance between the sexes within the results, nor was there any difference as to whether the game was played on a board or on a computer. They noted that participants found the game easier to play in the virtual environment but did not perform any better than they would have in the real world.

Antonietti and Mellone concluded that literature suggesting that the act of using technology on its own, increases the cognitive learning abilities of the user, is not justified. According to Kasvi (2000), it is the game itself that promotes the learning. Kasvi lists many of the attributes that promote learning including; motivation, challenge, feedback, goals, and communication. And while not all games have all of these qualities, Kasvi suggests that multiplayer games have the best results. Kasvi notes that while attempts have been made to market computer games that have co-operative themes and no conflict, violent or otherwise, they have not been commercially successful. Kasvi concludes by suggesting that more research is required into multiplayer games to ascertain if learning takes place while collaboration is facilitated.

4. RESEARCH INTO LEARNING

Ko (2002) explores a framework for studying the patterns children follow to solve puzzles in a computer game. Using a memory puzzle game called *Find the Flamingo,* Ko enlisted thirty-two children age seven, and fifty-five children age ten. Ko measured the children's technique for problem solving by counting moves and assessing the pattern of these moves. Ko did this using a board version of the game as well as a computer version. Among the findings, Ko notes that the children appeared more motivated to use technology and play the computer version rather than the board version. Ko also noted that the more times that the children played the game, the greater their understanding of the construction of the game and the inferences within the game-play. The group of ten-year-olds fared better overall than the seven-year-olds in the results; with the ten-year-olds requiring fewer moves to complete the game. Ko concluded that this study shows that children can problem solve by gaining inferences from the game itself, and, by using these hints, apply reasoned decision making to increase their performance. But, does the design of the game influence the child's playing behaviour? – Ko says yes, and suggests that educators must consider this when choosing games as part of a learning curriculum. Pillay (2003) conducted a similar study with thirty-six students between the age of fourteen and sixteen. He maintained that although their knowledge was significant, an analysis of the strategy process and how it affects performance was needed. The participants were divided into groups and each group was given either educational puzzle games or recreational strategy games. He used a mixed method design adopting both a quasi-experimental design and an adaptation of the PARI analysis (Precursor, Action, Result, and Interpretations). Pillay found that the recreational games facilitated learning more than the educational ones. He suggested that the game players reasoned more effectively and employed anticipatory thinking. He reinforced Ko's (2002) findings, suggesting that the students were able to learn by gaining inferences from the games design. However, although Pillay recommends cognitive skill labels for commercial games, he concedes that some games may also have negative effects such as short term aggression, but this was outside of his study.

Today's students are captivated by action games, in particular First-person shooter games like Counter Strike and Half-Life. In a survey of 25 computer game players, it was suggested that these games "not only enhanced hand-eye co-ordination, but also increased their ability to multi-task. A typical game involves controlling the player movement, aiming and firing the chosen weapon, evading being a target for other players, monitoring health status and ammunition supplies, and devising a seek and destroy strategy in order to complete the level. All this is done in unison, in a pressure situation." (Kearney, 2003, p.6). In a subsequent study to test these claims (Kearney, 2005), neuro-physiological assessment software was used to test participants for their ability to function in a synthetic work environment, before and after playing commercial computer games. In summary, the study indicated that certain types of computer games improve cognitive functions such as multi-tasking, and suggested further research to ascertain what other skills can be enhanced by similar games. The games used in this study were in fact First-person shooter games and not the typical education game used in most education institutions. Squire (2003) contends that educators have compared computer games to the act of teaching and not embraced the cognitive learning that this platform offers. Even

though Squire suggests that computer games form part of today's student's culture (Prensky's "Digital Natives"), it is unlikely that many educational institutions would accept *Counter-Strike* as part of their curriculum.

5. CONCLUSION

Much of the literature suggests that the current decline in student retention is due to student dissatisfaction with traditional teaching methods, and educators must rethink their strategies and revise their current delivery methods. Other studies indicate that younger people do in fact have increased cognitive skills, probably accelerated through the playing of computer games. Their ability to multitask will require a rethink of traditional learning styles. Outside the lecture theatre many of these students are immersed in the virtual worlds of commercial computer games. If our educational institutions are serious about retention and catering to the needs of this generation, they will need to provide the products and the delivery methods that captivate today's digitally literate students.

REFERENCES

Antonietti, A., & Mellone, R. (2003). The difference between playing games with and without the computer: A preliminary view. *Journal of Psychology, 137*(2), 133-144.

Brown, J. (2002). *Learning in the digital age.* Paper presented at the The Internet & the University: Forum 2001.

Clark, C. (2004). *The principles of game based learning.* Paper presented at the NETC/LSC Conference, Crystal City, VA.

Curtis, D., & Lawson, M. (2002). Computer adventure games as problem-solving environments. *International Education Journal, 3*(4), 43-56.

Gee, J. (2004). *Learning by design: Games as learning machines.* Paper presented at the Game Developers Conference, San Jose, CA.

Joyner, L., & TerKeurst, J. (2003). *Accounting for user needs and motivations in game design.* Paper presented at the 1st Global Conference in Interactive Convergence: Research in Multimedia, Prague, Czech Republic.

Kasvi, J. (2000). Not just fun and games - Internet games as a training medium. In P. Kymäläinen & L. Seppänen (Eds.), *Cosiga - Learning With Computerised Simulation Games.* (pp. 23-34): HUT: Espoo.

Kearney, P (2003). The impact of Computer Games on Children's aggressive behaviour and learning abilities. *Bulletin of Information Technology Research. 1*(1), 1-8.

Kearney, P (2005). *Cognitive callisthenics: Does playing computer games enhance the player's cognitive abilities.* Paper presented at the Digital Games Research Conference, Vancouver, Canada.

Ko, S. (2002). An empirical analysis of children's thinking and learning in a computer game context. *Educational Psychology, 22*(2), 219-233.

Mayer, R. (1998). Cognitive, metacognitive, and motivational aspects of problem solving. *Instructional Science, 26*, 49–63.

NZ Ministry of Education. (2003). *ICT in schools 2003*. Retrieved 22nd December, 2004, from http://www.minedu.govt.nz/index.cfm?layout=document&documentid=9486&indexid=6920&indexparentid=1024

Oblinger, D. (2004). The next generation of educational engagement. *Journal of Interactive Media in Education - Special Issue on the Educational Semantic Web, 2004*(8), 1-18.

Pillay, H. (2003). An investigation of cognitive processes engaged in by recreational computer game players: Implications for skills of the future. *Journal of Research on Technology in Education, 34*(3), 336-350.

Prensky, M. (2001). Digital natives, digital immigrants. *On the horizon, 9*(5), 1-6.

Skinner, D. (1997). Computers: Good for education? *Public Interest, Summer 97*(128), 98.

Smith, R., Curtin, P., & Newman, L. (1997). *Kids in the kitchen: The educational implications of computer and computer games use by young children.* Paper presented at the Australian Association for Research in Education Annual Conference, Brisbane, Australia.

Squire, K. (2003). Video games in education. *International Journal of Intelligent Simulations and Gaming, 2*(1), 49-62.

United States Census Bureau. (2004). *Facts for features*. Retrieved 22nd December, 2004, from http://www.census.gov/Press-Release/www/releases/archives/facts_for_features_special_editions/002263.html