Game-based Learning or Game-based Teaching?

Paul Pivec

About the author

Paul Pivec has over 30 years in the computing industry and eight in academia. Having completed a Masters Degree in Game-Based Learning, and a Graduate Diploma in Higher Education, Paul is now completing a PhD at Deakin University, Melbourne, Australia, investigating the academic value of playing computer games.

Now based in Europe, he is also combining his knowledge in pedagogy with his development skills to complete his latest project in multi-user game-based learning via the internet.

He can be contacted at [paul.pivec@mac.com].

Contents

Introduction – *setting the scene*

As a game developer of many years, and an academic of late, I find the use of such terms as 'Serious Games' and 'Game-Based Learning' to be overused and often in the wrong context. These terms are often employed as a justification to introduce digital games into the classroom or to sell a product that has little entertainment value. Digital games do have a place in the classroom, but as a tool to be utilised by creative teachers and not to replace teachers as suggested by some (Bushnell, 2009; Prenksy, 2004).

Microsoft's Bill Gates has been credited as stating, "Technology is just a tool. In terms of getting the kids working together and motivating them, the teacher is the most important." This suggests that 'Game-Based Teaching' using a role-play or meta-game surrounding a game, would provide the desired learning outcomes. Yet we are told that Strategy games such as *Civilization* and *Great Battles of Rome* provide factual declarative knowledge to the player, but no authoritative studies have verified the content within such games. We are also told that playing 'brain-training' games can prevent Alzheimer's and increase your IQ, but there is no substantial proof that this is true.

All this comes under the umbrella of Game-Based Learning and appears to be blindly accepted as such, but more than often it is simply clever marketing. Digital computer games have now been around for over three decades and the term Game-Based Learning has been attributed to the use of computer games that are thought to have educational content, but there is much debate surrounding this theory. Having recently completed an extensive literature review on the use of games in the classroom for the EU-based project 'Games in Schools' (Pivec and Pivec, 2009), many researchers have questioned if Game-Based Learning really works or whether it is simply the environment in which computer games are used to teach that imparts the knowledge. This article seeks to explore the theory of Game-Based Teaching in contrast to Game-Based Learning, and discusses the context in which computer games are used in academia. Being an advocate of using computer games in education, I propose that the meta-game surrounding the game is of more value than the game itself and suggest how games can be used effectively at all levels of education.

Tutorial Level – the digital native myth

Academics have long been promoting a change in education to include technology-rich programmes in the teaching curriculum (Papert, 1996; Rushkoff, 1996; Smith, Curtin and Newman, 1997), but they suggest that many teachers are feeling technically inadequate when teaching what they suggest are digitally literate students. These students have been called 'the computer generation' and referred to as 'screenagers'. Many academics use the term 'Nintendo Generation' and suggest that teachers, along with parents, are dealing with a new breed of learner. Others believe that these children look upon school as an interruption in their computer usage time (Prensky, 2001; Squire, 2003), and that teaching institutions must use electronic media to re-package their course content to reach today’s 'digitally literate' students.

Much of this belief has been spawned from the notion that today’s children are 'digital natives', having grown up in a digital world. They apparently think differently because they have adapted to their digital environment (Prensky, 2001; Gee, 2003; Squire, 2003; Oblinger, 2004; Shaffer, 2006 and many others). However, many of us that support the application of technology as a learning tool and also Game-Based Learning (GBL), refute the belief that learners are different because they have grown up in today’s digital world. The term 'digital natives' was originally promoted back in 2001 when referring to university graduates. Prensky stated that the average graduate would have spent less than 5,000 hours of their lives reading books, but over 10,000 hours playing video games. Interestingly, these university graduates will now be in their early to mid 30s, and this correlates with the Entertainment Software Association figures (ESA, 2008) of 35 being the average age of computer game players. However, it also correlates with the suggested average age of teachers in England surveyed by Futurelab (2009), where 42 per cent of these teachers had never played a computer game.

Many publications have supported or opposed the premise of a Nintendo Generation, yet neither side offers substantial evidence for their view. Salen (2008) suggested that these debates are 'overly polemic and surprisingly shallow'. However, Prensky’s theories get quoted often when references are needed to support the introduction of a game into the classroom, even when Prensky himself has offered no empirical evidence. Yet, there are many other publications and researched theories that support technology and its place in the academic curriculum.

Take for example the 'Hole in the Wall] project (Mitra and Rana, 2001).[1] Computers were set up across India in locations that had never seen any type of technology before. No training or tuition was provided, yet these children were surfing the internet within hours, downloading movies, using drawing software, playing video

[1] See http://www. hole-in-the-wall.com/Beginnings.html

games, and even taught themselves how to cut, paste, and save their files. They collaborated with each other and worked in groups, they formed social groupings, and became highly motivated to continue to use this new available technology, all without supervision. They displayed all of the attributes that Prensky, Oblinger (and others) suggest are only present in children that they refer to as 'digital natives'.

Another example is the poverty alleviation project in Peru, set up by Dr Logan Muller (Muller, 2004).[2] The task of this project was to install computers in remote locations high in the Andes to provide access to market information. These locations had no electricity and had never seen technology of any kind. Yet the local children were quick to utilise the computers and often assisted the older generation in how to use them. They collaborated, preferred multimedia applications, appeared to be goal orientated, and as with the 'Hole in the Wall' project, they displayed all the traits of children who have grown up in a digital world and spent countless hours playing computer games.

So are today’s students any different from previous generations and do they utilise technology in different ways than those of the teachers who are teaching them? Perhaps it is the technology itself and the way it is used that simply appeals to creative learners, and the digital native theory is simply a marketing ploy created and disseminated without any empirical evidence to support it.

[2] See http://www.unitec.ac.nz/

Cognitive Learning – *practising the test*

It is said that cognitive abilities such as memory retention and analytical skills are improved by repeated playing of digital games, even to the extent of assisting with the offset of learning disabilities (Klingberg, Forssberg and Westerberg, 2002) and diseases such as Alzheimer's (Korczyn, Peretz, Aharonson and Giladi, 2007). However, like the digital native debate, there are just as many academic publications that refute these claims (Wainess, 2007), as there are to support them.

Published research suggesting that academic achievement can be predicted through the use of cognitive assessments includes the tests of working memory, pattern matching, and cognitive skills known as 'chunking'. This has led to the popularity of games and products such as the *Brain Training* series from Nintendo and *Mind Fit* programs from Cognifit. Sadly, all these games appear to do is to teach the player how to pass the cognitive test. They use methods such as the standard digit-span test and the *Stroop* task, available from any first-year psychology textbook. Yet many institutions have introduced cognitive training games into their classroom in the belief that it will improve the students' cognitive skills, at the same time motivate their students (Miller and Robertson, 2009), and subsequently increase the academic achievement of their learners. As we know, practice makes perfect and by practising a cognitive test or any task, the participant will always improve within the limits of their ability and achieve higher scores.

'The Digit Span test is defined by Wechsler Intelligence Scale for Children (Wechsler, 2003) and includes a Digit Span Forward (DSF) and Digit Span Backward (DSB). The DSF requires the participant to repeat numbers back to an examiner in the sequence that they were said. The DSB requires the numbers repeated back in the reverse order. The DSF test is designed to test the phonological loop capacity involving rote learning, attention span, encoding, and auditory processing. The DSB test requires mental manipulation, transformation of information, and visuo-spatial imaging.

The Stroop Task is a psychological test of our mental (attentional) vitality and flexibility. The task takes advantage of our ability to read words more quickly and automatically than we can name colors. If a word is printed or displayed in a color different from the color it actually names; for example, if the word *Green* is written in blue ink, we will say the word *Green* more readily than we can name the color in which it is displayed, which in this case is *Blue*. The cognitive mechanism involved in this task is called directed attention, and you must manage your attention, inhibit or stop one response in order to say or do something else.'

(Pivec, 2008)

In support of the cognitive training games, Doman (1986) argues that 'how well we learn is a direct reflection of how well we receive, process, store and utilize information', all cognitive functions of working memory. Jaquith (1996) shows a direct correlation between the results of digit span tests and academic test scores: the greater the working memory capacity, the high the academic test scores. Students who had participated in the Stanford Achievement Test (SAT) for Total Reading, Math, Listening, Thinking, Word Reading, Language, Letters/Sounds, and Spelling, had their scores compared with their digit span test scores (Auditory and Visual tests). Jaquith concluded that if 'one improves one's auditory and visual digit span, and thus auditory and visual processing, the individual's academic function relative to grade level will improve' (p1). Hence it would appear that the improvement of working memory is critical to academic achievement, and likewise, Gathercole, Lamont, and Alloway (2006) suggest that poor working memory is associated with learning deficits in daily classroom activities. The increase of working memory is what games like Nintendo's *Brain Training* focus on.

However, it is debatable if it is the cognitive games that lead to improved academic achievement, or if the environment provided by the game is simply motivating the student to practise these skills and pay attention in the classroom. Some would say it does not matter, as the end justifies the means. Yet many of the games that are deployed within the school system are justified under the Game-Based Learning theory. Games currently used in UK classrooms, such as *Inquizitor* from 3MRT, are digital study aids interleaved with mini arcade games. Installed in over 250 schools in the UK, *Inquizitor* provides a drill and practice platform in a game-like environment and rewards the student with recreational game time. This provides the motivation to the student to study. Trials of *Inquizitor* conducted in the United States on 7th Grade students (age between 11 and 13 years) concluded that the product does in fact motivate the students to continually re-engage. The study resulted in statistically significant improvements for test scores of the treatment group over that of the control group. The authors concluded that, 'the *Inquizitor* software promotes learner engagement in content practice in a fun and motivating way', (Armfield, Blocher and Sujo de Montes, 2007, p14). In other words, the game environment provided the motivation to learn and the learning outcomes, and not the game itself.

A study carried out with P6 students in Scotland (aged between 9 and 11 years) using Nintendo's *Brain Training* game on a handheld gaming device for basic arithmetic practice, argued that completion times for a written numeracy test covering basic arithmetic had significantly reduced for those using the game over a 10-week period (Miller and Robertson, 2009). One would think that this would be obvious as practice makes perfect, but the teachers concluded that the game device provided extra motivation for the students to practise. The control groups used *Brain Gym* techniques or had traditional classroom teaching over the same period. However, the researches did admit that the Nintendo group spent more than twice the amount of time than the other groups, which suggests a motivating drill and practice tool rather than Game-Based Learning. The students who used *Brain Gym* also improved over those experiencing traditional teaching techniques

– and with half the time than that of the Nintendo users. Would they have improved the same amount had they been motivated to complete the same amount of time of drill and practice?

Academic Achievement and Movement – *level up*

Brain Gym is a technique developed by Dr Paul Dennison that uses a suggested relationship between body movement and learning. Dennison suggests that 25 physical movements have significant positive effects for a significant number of students when learning. In the early 1980s he put these movements together into the system now known as *Brain Gym*. In a study of 246 children, Demuth (2007) found a significant improvement in academic achievement for students using this technique over those that did not. Beigel, Steinbauer and Zinke (2002) also tested children (aged 8 years) over a period of 8 weeks using *Brain Gym* methods. Their results showed a statistically significant improvement in reading comprehension for the participants.

While it is not known how movement affects academic achievement, there are many theories available. One of these is Gardner's (1993) theory of multiple intelligences that suggests there are eight core intelligences: linguistic, logical-mathematical, spatial, bodily-kinaesthetic, musical, interpersonal, intrapersonal, and naturalistic intelligence. He argues the students with bodily-kinaesthetic intelligence remember things through their body, rather than through words or images. He states that these people are adept at being athletes, craftsmen, and surgeons where skills and dexterity for fine motor movements are required. Linksman (2006) suggests that it is often difficult to differentiate between bodily-kinaesthetic learners and learners with attention deficit disorder. She suggests that 'Kinesthetic learners require body movement and action for optimal results: they need to move around, use their muscles' (p1).

Hands-on teaching techniques using movement gained recognition because they address the needs of kinaesthetic learners, while at the same time catering for the needs of auditory and visual learners. Differing from constructivism, where the learner explores the task at hand to assimilate the knowledge into their already existing world, kinaesthetic teaching allows the learner to perform physical activities while learning, activities not always directly connected to the knowledge or skill being taught. Jensen (2001) argues that learning while doing physical movement creates more neural networks in the brain and therefore has a longer lasting effect. Rutherford, Nicolson and Arnold (2006) tested 895 participants with attention deficit disorder and found that symptoms of inattention and hyperactivity were reduced by 60 per cent through a 10-minute, twice per day physical exercise programme. They suggest that exercise and movement stimulates the cerebellum associated with attention deficit leading to learning disabilities and therefore reduces the symptoms of inattention, thereby improving concentration, and hence the ability to learn. Much of this research has been criticised as having flawed methodology. However, it must be conceded that at the very least, physical movement improves the blood circulation and thus the oxygen supply, and therefore maintains the metabolism in the brain, improving attentiveness and concentration, both which are required for academic achievement.

Movement-based games such as *Dance Dance Revolution* (DDR) have been used extensively for physical therapy to treat obesity in children and for general exercise of young and old alike. However, there has been no research linking any of these movement games with an improvement in cognitive abilities. Research conducted by the author has shown that players of DDR use visual searching, pattern matching and memory chunking, similar to what is needed in cognitive training games, as they progress through the levels. These games place a high cognitive load on working memory. A four-minute DDR song can require over 1600 dance pad moves, and each move is observed, recognised, converted, memorised, and then actioned up to 7 times per second.

To substantiate this research, a Tobii ET-1750 eye-tracking monitor was employed to record the eye movements while playing a DDR Simulation. A simulation was used because the recording software from Tobii utilises DirectX technology, and this can cause a conflict with some commercial games that require exclusive control of the installed graphics card. Eye gaze, blink rate and scanning patterns can be measured while playing computer games, and these are indicators of mental processing (Kahneman and Beatty, 1966; Rayner, 1998). In an earlier study by Pivec and Pivec (2009a), it was also concluded that eye-tracking technology could also be utilised to identify player immersion. The analysis of eye-tracking recordings of an expert DDR player highlighted visual searching and pattern matching by the player. Scanning ahead for patterns was evident, with keystroke combinations chunked to working memory for subsequent action. The blink rate was minimal, indicating a high cognitive load and as was seen in early studies while playing two-dimensional games (Pivec and Pivec, 2009a), the move was completed using peripheral vision.

Movement games such as DDR provide both cognitive exercise and physical movement. If exercising cognitive skills increases academic achievement and physical exercise accelerates the results, then perhaps movement-based games such as DDR should also be included into the mainstream curriculum to provide exercise, motivation, and cognitive learning. But can this really be considered as Game-Based Learning (GBL) and would players of such games naturally be high achievers regardless of computer games in the classroom? None of the above abilities was observed when recording a novice player of DDR, hence it could be concluded that cognitive abilities such as increased working memory are learnt or enhanced only after the repeated engagement with computer games. To investigate this theory, the author conducted a study with 238 participants in late 2008. The results, described in the following section, suggested that experienced game-players of recreational type games, not cognitive training games, do have an above-average level of cognitive ability in tests of working memory.

Player Perceptions and Abilities – *gamer's talk*

An accepted digit-span forward test of working memory ability (Lichtenberger, Kaufman and Lai, 2002) was completed by 238 of the participants, 165 male and 73 female, with an average age of 32 years. Those who played games scored an average of 40 per cent higher than those who did not. Participants who considered themselves as *Novice* players, averaged game time of less than one hour per week and their scores were similar to those who did not play games. Those who considered themselves as expert players averaged 16 hours game time per week and scored higher than intermediate players (see Table 1), showing a correlation between cognitive ability and hours of play.

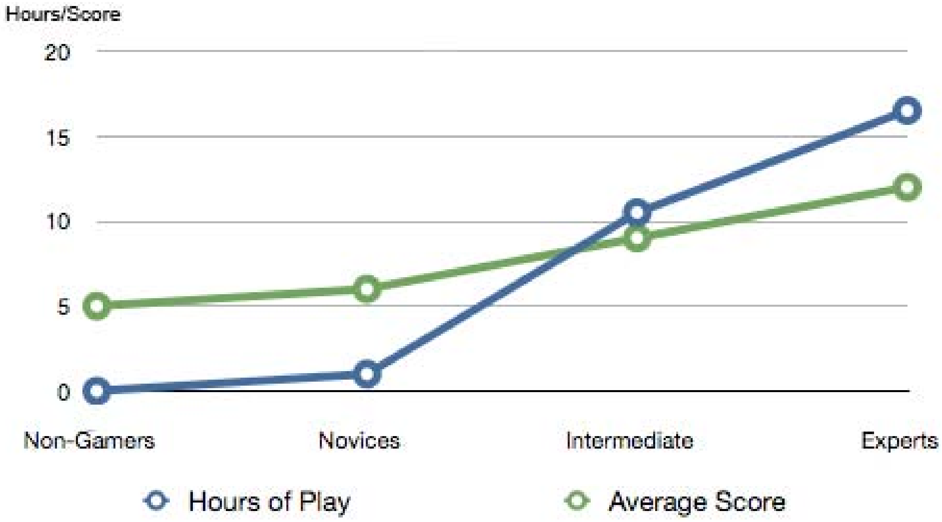

Table 1: Correlation of Game Time and Test Score

However, based on these results it cannot be concluded whether the game playing had increased their cognitive skills or if people with high cognitive ability immerse themselves in computer games. Interestingly, those who scored the highest in the working memory test (10 and above, when the average is 7), considered themselves to be expert game players, and those who scored 12 and above were all role-play game players.

In a subsequent study by the author of 510 participants, less that 25 per cent had ever played an educational game, and only 5 of the 510 participants had ever played *Brain Training* games. In addition to that, more than 70 per cent of the game players in this survey believed that little or nothing was learnt from playing computer games. Table 2 makes a correlation between the results from teachers surveyed (Futurelab, 2009) and game players, when asked what they thought were the learning outcomes to be achieved from computer games. The teachers believed that motor skills such as hand/eye coordination and reaction times were increased (85%), high-order thinking skills such as problem solving and strategic thinking were improved (65%), and declarative knowledge in specific areas was gained (47%). The players perceived that computer games provided little, if anything, for the above learning outcomes. Contrary to the teachers, in the social skill category, players believed that collaboration and communications skills were gained from games (75%) whereas the teachers did not (23%). Both teachers and players agreed that ICT skills, the use of technology, were improved, but as many of the players stated, this would be obvious.

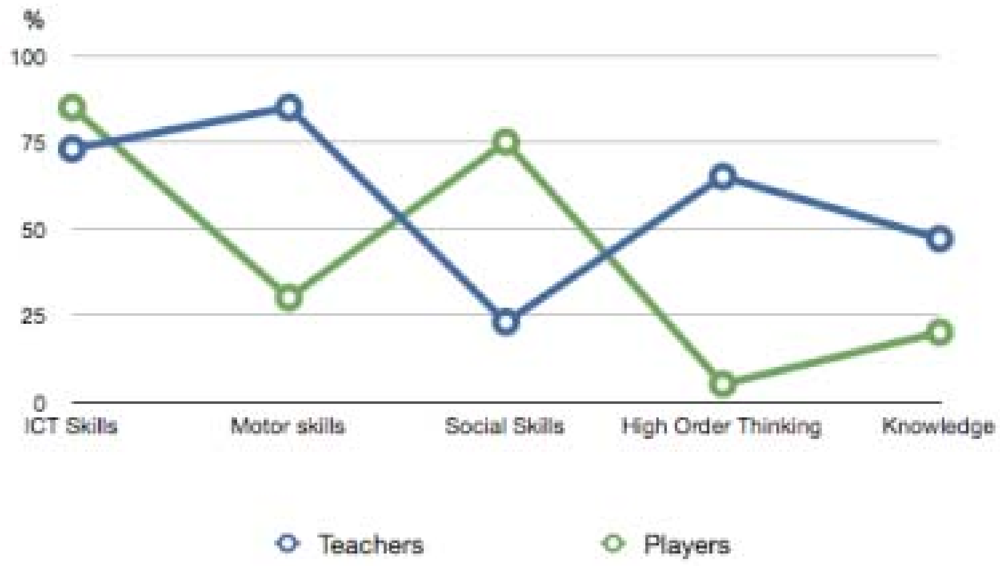

Table 2: Correlation of Learning Outcome Perceptions

Although the teachers who support the of use game-based learning suggest that both declarative knowledge and cognitive skills are strong learning outcomes from computer games, and the players lean toward social skills being the main by-product, whereas the teachers perceive that skills come from the game itself, the players suggest that it is the environment, or meta-game, that provides any improvement in abilities. They state that it is the collaboration with other players, either in a multi-player game or the social environment outside the game, which provides the motivation to persistently re-engage, giving the 'practice makes perfect' scenario. Yet most of the players surveyed had never played cognitive training or any other educational computer game. When asked if they would consider playing games for learning and what would motivate them to do so, over 50 per cent suggested better game-play, with multi-player learning being a desired feature. This ties in with the player perception that communication and collaboration are strong learning outcomes from playing games. A common belief is that students require rich 3D graphics to play an educational game, whereas less than 10 per cent of participants suggested better graphics are a motivational factor.

There is no current empirical evidence that students playing any form of cognitive training games will achieve better results in the long term, nor is it certain if it is the game itself or the meta-game surrounding the lesson-plan that motivates the learner to be more involved. While products such as *Inquizitor* provide motivation for the early teenagers and teaching techniques utilised in Scotland appear to attain results, it is doubtful that either would work at higher levels of education to provide any more than a drill and practice of knowledge already learnt through traditional teaching. However, if learners believe that a game environment provides motivation to learn, collaborative role-play scenarios or real-life simulations would be more suited for higher education than providing a Nintendo DS to practise cognitive ability tests. The meta-game that surrounds many of the examples of games used in schools highlighted in Futurelab's report (2009), can be viewed as role-plays. Role-play scenarios can be structured to impart declarative as well as procedural and strategic knowledge, and provide the refection-on-action needed for effective learning. Linser (2008) suggests that for pedagogical purposes, a role-play is closer to a simulation than a game, and argues that with the acquisition of real-world knowledge, and the understanding and skills acquired by the player, a role-play is designed as an attempt to simulate processes, issues and conditions that exist in the real world. Linser (2008) concludes by stating that while he considers role-play as a simulation, given the right environment and delivery platform, a role-play can include all the engagement, immersion, and motivation that are inherent in the computer game environment. Fortugno and Zimmerman (2005) agree but argue that many games do not include sound pedagogical principles in their design. However, they do support the opinion of game players in that it is the teaching environment in which the game is used, the scenario created around the game, that stimulates learning to occur. This suggests that it is the use of games within a teaching environment that facilitates learning and not merely playing a game – hence the term *Game-Based Teaching*.

Game-Based Teaching – *the meta-game*

When introducing *Game-Based Teaching* into the curriculum, many barriers need to be overcome, the initial acceptance of a computer game in the classroom being one of many. The level of technology to support the required software, the pre-requisite knowledge required by the teacher or facilitator, and the financial and licensing issues, all need to be considered. A meta-game surrounding the computer game itself also needs to be conceived and activities to promote thought, communication, and collaboration must be created.

Although creating a scenario or list of tasks surrounding a computer game at primary school level may be easily achieved given the available resource, this is not always the case at secondary and tertiary educational institutions. With more than 50 per cent of Scottish employers stating that school leavers are not prepared enough for work in terms of the core skills of teamwork, communication and problem solving (Future Skills Scotland, 2004), the communication and collaborative learning that players perceive comes from computer games should be employed at these higher educational levels. Employers rated cognitive abilities such as numeral literacy and ICT skills as sufficient but emphasised soft skills as being severely lacking.

There are different beliefs as to *if, how, why* and *when* learning takes place while playing games. Wainess (2007) argues that it is purely the context in which they are used that stimulates any learning to take place, yet Garris, Ahlers and Driskell (2002) argue that learning occurs only after reflection and debriefing, and the game characteristics and instructional content are paramount in allowing this to happen. Shaffer (2006) partially agrees and states that the virtual worlds created by such games allow players to take action within the game and then reflect on this action, both during and after play. All of this suggests that a role-play scenario, a meta-game surrounding a game or a scripted situation, is the ideal platform for Game-Based Teaching.

However, when designing a game-based scenario or meta-game, various aspects should be considered to achieve the desired learning outcomes. Pivec and Pivec (2009b) list the following points when building a meta-game or role-play:

- Are there clearly articulated learning objectives within the scenario?
- Are there clearly definable goals that can be reached and solved?
- Are both the learning objectives and scenario goals achievable within the given timeframe?
- Is the storyline able to be described adequately for the players?
- Is there additional resource and research information available to the players?
- Are there sufficient roles for individuality and equal opportunity to participate?
- Can the workloads of players/students be adequately balanced?

- Does the scenario allow for collaboration between players and is this desirable?
- Does each player have sufficient power within the scenario to achieve the stated objectives?

As with all scenarios, the storylines may be fictitious, but the places, items, and/or concepts should be real, allowing the players to research the background and gain factual knowledge about the included topics. Teaching and Learning in Scotland build meta-games around *Guitar Hero* at a primary school level, creating marketing material and biographies about their favourite rock stars. Future plans to role-play a world tour and concerts in specific countries around the globe, will allow students to learn basic logistics of travel and organisation, and cultural issues in other parts of the world. For a secondary or tertiary level role-play, Pivec and Pivec (2009b) provide examples for project management, risk assessment, problem solving, and culture sensitivity training. Using a collaborative role-play platform called *The Training Room*, a game-based scenario was created that involved fantasy, rules, and competitiveness, yet encouraged collaboration, communication and teamwork. Buchanan (2004) suggests that computer games include all the underpinning characteristics for quality learning and Garris *et al*., (2002) list these characteristics as follows:

- Fantasy – imaginary or fantasy context, themes, or characters
- Rules/Goals – clear rules, goals, and feedback on progress towards the goals
- Sensory Stimuli – dramatic or novel visual and auditory stimuli
- Challenge – optimal level of activity and uncertain goal attainment
- Mystery – optimal level of informational complexity
- Control – active learner control.

Pivec and Pivec (2009b) created a real-life role-play to teach design students at a university level, and subsequently turned it into a digital game by using an e-learning role-play platform. The scenario was fantasy and the platform provided rules, control, multiple forms of communication and feedback for both players and moderators. Although not an immersive three-dimension virtual world, visual and auditory stimuli were provided via video and podcasts. Other scenarios tested involved cultural awareness training by role-playing alien races from competing planets, and project management competencies via business wars. Participant feedback suggested a high level of immersion and repeated engagement with the scenario, resulting in a high level of learned competencies.

> 'Online role-plays can be achieved without using a purpose built platform. Scenarios can be played using email, online forums, and Video conferencing software such as Skype. However, these applications will have limitations that may impact on the learning outcomes of the game.
>
> *The Training Room* platform (2009) offers an environment where trainers can define their own on-line role playing scenarios and provide the opportunity for learners to apply factual knowledge and to gain experience through the digital world. Trainers can define new games or adopt and modify sample games without any programming skills. The platform provides a variety of communication means within the scenarios; players can communicate with the use of discussion forums, text and voice chat modules as well as through multi-user video conferencing.
>
> An important feature of this product is the collaborative learning design, which allows participants to exchange information as well as to produce ideas, simplify problems, and resolve the tasks. In this product, the trainer can be an active partner, trainer and advisor of the educational process, or take a passive role and just observe.'
>
> (Pivec and Pivec, 2009)

Salen and Zimmerman (2003) define computer games as systems where a player engages in conflict regulated by a defined set of rules and the result is a defined outcome. They argue that while games and role-plays share the key features that define them both as games, they are different in one critical respect: role-plays do not always have a defined outcome and are not simply practising to improve test scores. However, Salen and Zimmerman concede that this depends on the framework or platform that provides the role-play and suggest that role-plays are more suited towards effective learning. However, they also conclude show that unless the correct game or situation is chosen for the selected topic, the desired learning outcome, be it skill based, knowledge based, or affective, they will not be achieved. Other studies also suggest that an appropriate level of moderation and debriefing by the teacher is required, to reinforce the learning outcomes with the learners (Pivec and Pivec, 2008). Within the meta-game, we have to create the situation asking, *"What do we want the learners to learn?"* Before defining the activities we should reconsider the saying '*Failure opens the gate to learning'* and we should try to provide an answer to the question 'Why?'.

There are many interactive learning techniques that have already been promoted for learning from games. One of those techniques is learning from mistakes, where failure is considered the point where the user gets needed feedback. Some, such as Prensky, suggest that this is the only way we learn from computer games.

Prensky suggests that in game-based learning, making a mistake – or trial and error – is a primary way to learn and is considered the motivation for players to keep on trying. However, as with products like *Inquizitor,* the motivation comes from the reward of recreational game time and some well-chosen phrases using teenage terminology. In a role-play scenario for higher education, the motivation can come from the knowledge of a win–win outcome being achievable and that learning can result from playing computer games. In today's climate of lifelong learning, Game-Based Teaching does not have to result in 'Game-Over' for the player. It can result in the player knowing that the required competencies will be achieved by completing the required tasks.

Conclusions – *level completed*

The improvement of test scores through the use of computer games as drill and practice techniques does not exploit the potential for education that is provided by the game-playing environment. It has not yet been proven through rigorous empirical research whether cognitive training games increase any abilities or knowledge other than that needed to play a particular game or pass a particular test. Furthermore, critics argue that games do not foster learning, cognitive skills nor knowledge acquisition, and it is purely the context in which they are used that stimulates any learning to take place.

Undoubtedly, the game environment provides the motivation necessary for persistent re-engagement by the player and hence achieves the 'practice makes perfect' scenario. However, most game players do not play educational games, as they do not believe they learn from such games and do not find the game play in these games to be compelling. Many of today’s students currently in higher education have been successfully conditioned into thinking that games are only for wasting time – a by-product of our own making as concerned parents. Yet a well-constructed role-play game can do more than simply drill and practice, it can assist with the attainment of much needed competencies in many disciplines.

While many education games and publications (Oblinger, 2004; Gee, 2003; Squire, 2003) trade on the term Game-Based Learning, and frequently quote the outdated and incorrect theories about digital natives, perhaps the teaching methods and the meta-game surrounding the implementation should be celebrated. Computer games have now been accepted as a tool within academia and even industry training. The US military have been using games and role-play scenarios for over a decade, and many of the world’s largest corporations utilise scenarios within computer games to successfully train their staff on everything from safety to conflict resolution. Games are used to train medical surgeons (Rosser, Lynch, Cuddihy and Gentile, 2007), are successfully used as a rehabilitation tool for patients (Griffiths, 2005), and utilised as e-inclusion tools for disabilities (Pearson and Bailey, 2008).

Games for learning, or 'serious games' as they are now called, vary from single player to multi-player games. Different types of games have different sets of features that have to be considered with respect to their application for education. The use of collaborative game-based role-play for learning provides an opportunity for learners to apply acquired knowledge and to experiment and get feedback in the form of consequences or rewards, thus getting the experiences in the 'safe virtual world'. With prospective employers requiring a greater emphasis to be placed on soft skill competencies rather than cognitive abilities, it is time for higher education to embrace the potential these technologies offer. In interdisciplinary learning domains where skills such as critical thinking, debating and decision-making, and the ability to work, communicate and achieve set goals in teams, are in the foreground, Game-Based Learning concepts enveloped within a well-structured collaborative role-play scenario will accelerate the attainment of the learning outcomes (Pivec and Pivec, 2009b). This is called *Game-Based Teaching*.

References – *the credit screen*

Armfield, S., Blocher, M. and Sujo de Montes, L. (2007). The Educational Technology Integration Group, *Inquizitor Research Report*. Northern Arizona University white paper (unpublished).

Beigel, D., Steinbauer, W. and Zinke, K., (2002). 'The effects of brain gym on reading and comprehension'. In: *The Moving Classroom: Results of a Research Project with Suggestions for School Implementation*. Freiburg: VAK Verlags GmbH Kirchzarten.

Buchanan, K. (2004). 'How an educator thinks about computer games', *On the Horizon*

Bushnell, N. (2009). Presentation at Game Based Learning 2009 Conference, London, 19–20 March, 2009.

Demuth, E. (2007). 'Brain Gym for All: From Pre-Birth to Old Age' in *Brain Gym Journal*, March 2007, Volume XXII, No. 1.

Doman, R.J. (1986). *Auditory and Visual Digit Spans. Learning How You Learn series: Processing Information*. National Association for Child Development

ESA (2008). *Industry Facts*. Retrieved May 8, 2008, from http://www.theesa.com/facts

Fortugno, N. and Zimmerman, E. (2005). Learning to Play to Learn – Lessons in Educational Game Design. Retrieved 8 July 2008, from: http://www.gamasutra.com/features/20050405/zimmerman_01.shtml

Futurelab, (2009). *Computer games, schools, and young people: A report for educators*. Retrieved 1 May 2009, from http://emergingtechnologies.becta.org.uk/index.php?section=etr&rid=14543

Gardner, Howard. (1993) *Multiple Intelligences: The Theory Into Practice*. New York: Basic Books.

Gathercole, S.E., Lamont, E. and Alloway, T.P. (2006). Working memory in the classroom. In S. Pickering (ed.). *Working memory and education,* pp. 219–240. Elsevier Press.

Garris, R., Ahlers, R. and Driskell, J. E. (2002). 'Games, motivation, and learning: A research and practice model'. *Simulation & Gaming*, 33(4), 441–467.

Gee, J. (2003). *What Video games have to teach us about learning and literacy*. New York: Palgrave-McMillan.

Griffiths, M. (2005). 'Video games and health', *British Medical Journal,* 331, 122–123.

Jaquith J. (1996). The role of short term memory on academic achievement. Retrieved May 2007 from http://www.nacd.org.

Jenkins, H. (2007). Keynote presented at the Games in Action Conference, Gothenburg, Sweden.

Jensen, E. (2001). *Arts with the brain in mind.* Alexandria VA: Association for Supervision and Curriculum Development.

Kahneman, D. and Beatty, J. (1966). 'Pupil diameter and load on memory', *Science*, 154, 1583–1585.

Klingberg, T., Forssberg, H. and Westerberg, H. (2002). 'Training of working memory in children with ADHD', *Journal of Clinical & Experimental Neuropsychology*, 24, 781–791.

Korczyn, A. D., Peretz, C., Aharonson, V. and Giladi, N. (2007). 'Computer based cognitive training with mindfit improved cognitive performances above the effect of classic video games; prospective, randomized, double-blind intervention study in the elderly'. Paper presented at the 8th International Conference AD/PD 2007, Salzburg, Austria.

Lichtenberger, E. O., Kaufman, A. S. and Lai, Z. C. (2002). *Essentials of WMS-II Assessment*. New York: John Wiley & Sons, Inc.

Linksman, R. (2006). 'The fine line between ADHD and Kinesthetic Learners', *Latitudes*, 1 (6).

Linser, R. (2008). The Magic Circle – Game Design Principles and Online Role-Play Simulations. Proceedings of *World Conference on Educational Multimedia, Hypermedia and telecommunications 2008* Vienna, Austria, 2008, pp. 5290–5297.

Miller, D.J. and Robertson, D.P. (2009). 'Using a games console in the primary classroom: Effects of ‘Brain Training’ programme on computation and self-esteem', *British Journal of Educational Technology.*

Mitra, S. and Rana, V. (2001). 'Children and the Internet: Experiments with minimally invasive education in India', *The British Journal of Educational Technology, 32(2)*, pp.221–232.

Muller, L. (2004). 'ICT accelerating change in society and economies'. Presented to the Pontifica Universidad de Sao Paulo, 15 April, Sao Paulo, Brazil.

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.

Papert, S. (1996). *The Connected Family: Bridging the Digital Generation Gap*. Atlanta, Georgia: Longstreet.

Pearson, E. and Bailey, C. (2008). 'The Potential Of New Generation Games Consoles To Support Disabled Students In Education' in *Proceedings of World Conference on Educational Multimedia, Hypermedia and telecommunications 2008*, Vienna, Austria, pp. 6199–6205

Pivec, P. and Pivec, M. (2009). *Games in Schools*. Commissioned report for Interactive Software Federation of Europe (ISFE) by the European Commission (EC).

Pivec, M. and Pivec, P. (2008). 'Playing to Learn: Guidelines for Designing Educational Games' in *Proceedings of World Conference on Educational Multimedia, Hypermedia and telecommunications 2008* Vienna, Austria, July 2008.

Pivec, P. and Pivec, M. (2009a). 'Immersed but how? That is the question'. In *Human IT Journal for Information Technology Studies as a Human Science*. 10(1):80–104

Pivec, P. and Pivec, M. (2009b). 'Collaborative Online Roleplay for Adult Learners'. Chapter in Zemliansky P. (Ed.), *Design and Implementation of Educational Games: Theoretical and Practical Perspectives*. (In press)

Pivec, P. (2009a). 'From train-your-brain games to role-play scenarios'. Presentation at Game Based Learning 2009 Conference, London, 19–20 March, 2009.

Prensky, M. (2001). 'Digital Natives, Digital Immigrants'. *On the horizon, 9*(5), 1-10.

Prensky, M. (2004). Presentation at NCBL eLearning Summit. 13 July 2004, Orlando, Florida.

Rosser J.C., Lynch P.J., Cuddihy L. and Gentile D.A. (2007). 'The Impact of Video Games on Training Surgeons in the 21st Century'. *Arch Surg.* 142 (Feb. 2007);181-186 (www.archsurg.com).

Rushkoff, D. (1996). *Playing the Future: How Kids' Culture Can Teach Us to Thrive in an Age of Chaos*. New York: HarperCollins.

Rutherford, R., Nicolson, R., and Arnold, E. (2006). AD/HD Study, poster presentation at the American Psychological Association Convention, August 2006.

Salen, K (2008). 'Toward and Ecology of Gaming', in Salen, K. (ed.), *The Ecology of Games: Connecting youth, games, and learning* (MIT press).

Salen, L. and Zimmerman, E. (2003). *Rules of Play, Game Design Fundamentals* (pp. 80-94). Cambridge and London: The MIT Press.

Shaffer, D. W. (2006). *How video games help children learn*. New York: Palgrave Macmillan.

Smith, R., Curtin, P. and 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

The Training Room (2009). Retrieved February 28, 2009, from http://www.gamedesigncampus.com

Wainess, R. (2007). 'The potential of games & simulations for learning and assessment', 2007 CRESST Conference: The Future of Test-based Educational Accountability. Los Angeles, CA.

Wechsler, D. (2003). *Wechsler Intelligence Scale for Children – Fourth Edition, technical and interpretive manual*. San Antonio, TX: Harcourt Assessment, Inc.