Coursework wiki

Introduction

Video games have high mass appeal – which will be dealt with in greater detail below, in **History** and **Culture** -, engrossing players numbering in the millions. Even the most basic of video games can be thought of as a complex system where the rules of the real world (be they in terms of the laws of physics or social morality) need not always apply. How then, can a player move from system to system (or game to game) without encountering major roadblocks? The basic answer would be that games necessarily need to embed pedagogical practices known to be effective in other settings (Mayo, 2009). For a quick – and charmingly animated - look at the role of pedagogy in teaching a player, a good, albeit not academic presentation can be found here (**Before watching the video, however, be warned that it is littered with a fair bit of profanity, so if you happen to be a sensitive soul, you might want to give it a miss, and for the best part, the most useful info can be found from 6:00-15:45)**:

If you decide to take a look, it should provide an interesting perspective of the role of teaching practices in showing the inherent rules of the game to a player, and doing so in a manner where the player herself need never know she is actively learning at all.

As will be illustrated below, the potential for teaching and learning in the context of video games has recently received a high degree of attention, including efforts to design educational games (e.g. Numedeon's (1999) *Whyville,* which adopts a game-based approach to science and mathematics education). On the other hand, games developed for the entertainment market have, understandably, been the subject of less research. Does experience playing video games benefit the player in further education? In other words, are skills learned during game play transferable, or in the traditional frame of reference for the subject area, are they a waste of time? To avoid bogging the reader down in too much material, here, we shall try to stick to specific cognitive domains, whilst looking at education through a constructivist stance. Before continuing, however, a brief detour into the history and culture of video games will be provided.

Culture

According to Hofstede (2008), there are **5 dimensions of national culture that influence teaching and learnin**g. These 5 dimensions essentially surface from the same 5 issues- **inequality, need for security, relationship with others, emotional gender roles, and time horizons**. However, **different national cultures choose different resolutions**, thereby contributing to their idiosyncrasies. One should, however, be cautious and remember that there are individual variations within a certain population, and that not everyone fits into the particular national culture that they are grouped into.

The reason why we bring **Hofstede's 5 dimensions to attention is because they can be important considerations for professionals who may wish to implement a video game in an educational setting**. In order to bring our point across more clearly, we will use one of the dimensions- **emotional gender roles**- to generate an example. According to Hofstede, **students in a masculine culture tend to support class competition whereas students in a feminine culture tend to curb it by isolating those who are over ambitious**. This difference may determine the kind of video games that will be popular to the student population. We would think that **students in a masculine culture would prefer a video game that involves competition whereas students in a feminine culture would prefer a video game that involves co-operation.**

Since culture seems to permeate the teaching and learning environment, **it would be prudent to factor it in as an independent variable in experiments which investigate the impact that video games have on students' learning**.

Clark et al.'s (2011) study entitled 'Exploring Newtonian mechanics in a conceptually-integrated digital game: Comparison of learning and affective outcomes for students in Taiwan and the United States' attempted to do just that. **In their experiment, students in Taiwan and United States were engaged in a physics game named SURGE**. The comparison between pre- and post- test scores revealed differences in the learning outcomes between the students in Taiwan and United States. When total scores between the pre- and post items were taken into consideration, it was found that students in Taiwan achieved significant learning gains, whereas the students in the United States did not, even though students in the United States reported a more positive response towards SURGE. **We propose that this could be a result of the difference in the dimension of time horizon between the cultures of Taiwan and United States**- Taiwanese students tend to have a long term orientation whereas students from the United States tend to have a short term one. A long term orientation would making studying hard a norm for the Taiwanese students, whereas a short term orientation would make enjoying a norm for the students from the United States. Hence, it is not surprising that Taiwanese students report statistically significant learning gains although they did not report a higher positive response than the students from the United States.

Despite the differences, there were also some similarities. More specifically, there were specific questions in which students from both Taiwan and the United States achieved significant improvement. This could be a random effect, but the fact that they all involved the performance of a similar task -to predict the motion of an object when acted upon a new force- seems to demonstrate that there is something more at play here. Predicting the motion of an object when acted upon a new force was remarkably similar to the process that players had to perform in order to effectively play SURGE. Moreover, the questions also had the presence of elements reminiscent of the control scheme used in SURGE. Hence, students as a whole may have performed better because these questions addressed physics concepts in a manner that students were familiar with, whereas other questions addressed physics concept that were conceptually similar but were presented in an unfamiliar manner. **This seems to suggest that the way that students engaged and reflected on physics concepts in SURGE was not contingent on specific cultural cues. If this is true, one can argue that students do learn the same way despite of distinct cultural differences. However, one should note that the physics concepts are largely universal, and hence, the results may not be generalized across other subject areas.**

To conclude, **culture is definitely one of the variables that one should take into account when one intends to use video games in an educational setting**.

History

It is widely accepted that humans and animals learn through play, which is an integral part of primary-level education (Bruce, 1987). Much of the prior research into the use of video games as a learning tool has focussed on children of this age, leaving research on subsequent academic achievement neglected. In 2006, Boris Johnson - whilst manning the position of Shadow Minister for Higher Education in the UK - gave the following analysis of video game players:

"They become like blinking lizards, motionless, absorbed, only the twitching of their hands showing they are still conscious. These machines teach them nothing. They stimulate no ratiocination, discovery or feat of memory – though some of them may cunningly pretend to be educational."

Despite a lack of evidence for this summation, there is likewise a lack of evidence supporting the proposition that video games can be advantageous to learning. However, one point which does ring true is that interest in video games does not appear to lessen with age (Gee, 2008) – **69% of American heads of households play video games for an average of 7 hours a week** (Entertainment Software Association, 2007). This interest could be easily cast as an individual's **motivation to learn**. Malone and Lepper (1987) support this point, suggesting that the **intrinsic motivation to learn is the most powerful force in terms of learning from games**.

Where then, does the academic study of video games currently sit? Some useful theoretical points will be discussed briefly below, before a more detailed account in the **Theories** section.

Theoretical Viewpoints

Mastery learning

Master learning is a concept best related to Bloom (1968) who estimated that **90% of a class had the potential to master a subject, though realistically, few achieve this**. Mastering a learning outcome is predicated by the fulfilment of an individual's requirements for *sufficient time* and *support tailored to their individual needs*. Other principals of master learning include *frequent assessment* (Slavin, 1987) and *prompt formative feedback* (Guskey, 2007). These principles are frequently engendered in video game design: Games adapt to the pace of a user across auditory and visual modalities, as well as giving a player continuous, immediate feedback, and prevents a player from progressing before mastering a skill (Mayo, 2009).

Experiential education

Dewey (1938) is regarded as one of the key thinkers in the debate between the two poles of education: the traditional, instructivist teacher-led approach and the less-structured student-led approach. Dewey viewed an individual's learning environment and how both students and teachers could and should adapt to differences as key. Kolb (1983) created the learning cycle and associated model of learning - which was built directly on Dewey's work - which suggests that in order to learn effectively, a balance must be struck between active experimentation (e.g. playing a video game) and reflective observation (thinking about what happened during the game).

Instructivist and Constructivist models

The Instructivist model (Gagne, 1977) refers to learning as the acquisition of knowledge and is the method of learning mostly found in education; the teacher stands in front of a group of students and dispenses knowledge to a passive audience. The constructivist model refers to the idea that learning should be self-directed (Piaget, 1956), with the learner taking an active, independent role in knowledge acquisition. This latter model is often used as a reason for why video games are a useful learning tool, as they depend on self-directed learning and problem solving. **This theory is dealt with in greater detail below**.

What about the contemporary scene?

Today in the world we spend **three billion hours a week** playing online games. The University of Carnegie Mellon recently published a paper wherein they stated that the average young person in a country with a strong gaming culture will spend **10,000 hours playing online games before they reach the age of 21**. This is analogous to the **10,080 hours that a young person in the US will spend at school if they have full attendance from the fifth grade up until high school graduation**. For any reader's familiar with Gladwell's (2008) book "Outliers", this is on par with his '10,000 hour rule', which suggests that 10,000 hours of study, before age 21, in any field will render us experts.

Key Paper

In 2009, the *Science* journal produced a special issue on the role of technology in learning not limited to video games. For readers interested in pursuing this topic beyond this wiki, I would advise giving some of these articles a read over. Either login to your GU library account on the same computer you are on now, or signing up to the journal (it is a little bit of a hassle, but it is free). The special issue can be found here (http://www.sciencemag.org/content/323/5910.toc).

From a beginner's point of view, we felt that this summarised article would best foster the readers' understanding of the topic.

Video games: A route to large-scale STEM education?

Mayo, M. J. (2009). Video games: A route to large-scale STEM education? *Science*, 323 (5910), 79-82.

Aims:

The aim of this paper is to review learning outcomes for video games in the disciplines of technology, science, and engineering and STEM (maths), as well as reviewing the difficulties which may be encountered in the wider implementations of this new strategy.

Reviewing Learning outcomes:

- Evidence has suggested that there is some existing sophisticated video game content in subjects ranging from immunology to numerical methods.
- It has also been suggested that video games can yield a 7 – 40% positive learning increase over a lecture program.
- A game named the RiverCity ecology game actually increased learners' D grades up to B grades.
- Learning benefits are attributed to effective pedagogical practices embedded in the game design, and the design of the game plays a large part in whether or not it produces effecting learning outcomes.
- Suggested benefits:
  - Games can be adapted to the pace of the user – "just-in-time principle"
  - Information can be presented simultaneously in multiple visual and auditory modes through games; capitalising on different learning styles – "multimodal principle"
  - Games can produce information in stages, with complex tasks being presented first as a small core experience which can be practiced multiple times before becoming a more complicated and time-consuming sequence.
  - Games can reinforce information acquisition – the rich environment of objects and activities within games gives the information a "situated meaning".
  - Due to constant and continuous feedback, content is further reinforced throughout the game.
  - Positive rewards accompany games' rapid feedback, encouraging students.

Meta-study by J. J. Vogel et al. (2006)

- Found learner control/autonomy to be one of the few easily identified predictors of enhanced learning outcomes.
- R. M. Ryan et al. (2006) also found that learner autonomy was critical to enjoyment and motivation.

Games as a style of learning:

- Games as a learning style are considered to be active and participatory.
- This is different from the traditional passive learning style of a lecture.
- Games can involve the formation of hypotheses, experimentation and discovering consequences of actions taken – similar to inquiry based learning.
- More and more gaming activities are multiplayer in design, allowing team work for problem-solving.
- This team work allows users to learn from each other and share strategies – in this situation the teacher plays the role of a "wise guide" participating alongside students.
- Collaborative learning as a whole has been shown to yield a 50% improvement over solo learning.
- Students are also more likely to spend more time on a task if it involves gaming.

What about traditional lectures?

- Seymour and Hewitt (1997) found that 98% of undergraduates who left university early from the science and engineering faculties cited "poor teaching by faculty" as a core concern, with 86% of students who stayed citing the very same problem.
- Hake's (1998) meta-study of 6542 students in 62 introductory physics classes showed that switching to an interactive mode of instruction improved learning outcomes by 108%.

So what needs to be done to ensure video games are recognised as a learning vehicle of choice?

- Quantity:
  - Many assume that games with academic content are uninteresting
  - Yet 4 million children voluntarily play math-and-science-based games on Whyville.net.
  - Rather than content challenges, it is believed that academically-based games suffer from infrastructural challenges in respect to mass adoption.
  - There is a lack of any distribution mechanism for the product, lack of product discoverability, expense of content creation, etc.
  - Academic games are often relegated to the office shelf or personal website of their creator once the grant is finished – since grants will not cover costs of mass adoption.
  - 3D content is not discoverable by search engines, meaning that a metadata tagging system is needed to allow users to search for these 3D games on search engines.
  - 3D games are more expensive to create since there is no standard file format meaning it has a limited ability to repurpose content between applications.

- Quality:
  - The ability to distinguish between high and low-quality product will be essential to the growth and credibility of game-based learning.
  - The first step in delivering quality is being able to measure it and assessment data are expensive to obtain.
  - The Ewing Marion Kauffman Foundation are investigating the creation of a software infrastructure to automate assessment tasks, making assessment standardised and lowering the cost of assessment per game.
  - Games may also extend assessment into new areas – such as user actions and communications.
  - For example, games can track how often a user attempts a given problem – Attempt frequency correlates highly to improved problem solving.
- Sustainability:
  - In order to expand the use of games-based learning, sustainable business models must be created.
  - Academic game development currently depends on living from one grant to the next and is unsustainable.
  - Funders instead should lay the foundations in an initial grant so that the same learning materials could transition to profit-generation models that could be used to expand the material's reach after small-scale academic development is reached.
  - The models could include corporate sponsorship, dual pay, subscriptions, site licensing, or the sale of virtual goods.

Theories

In the spirit of keeping this wiki at an appropriate length, we will mainly be appealing to a few useful frameworks in the literature; **Bloom's Taxonomy of Learning**, **Constructivist Theories of Learning** and **Social Learning** (**Communities of Practice).** In the process of briefly discussing these theories in the context of video games, anecdotal evidence will be provided, followed by a discussion of empirical work and further reading below.

Bloom's Taxonomy of Learning (1956)

The goal of a taxonomy of learning is to describe the degree of attainment across a range of educational settings. The most frequently cited is Bloom's Taxonomy of educational objectives (1956). The taxonomy itself is comprised of 3 domains; Cognitive, Affective, and Psychomotor (skills). For the purposes of this wiki we shall be dealing with the most oft-cited in the literature: the cognitive domain, whose primary concern is knowledge. Bloom (1956) suggested that there are 6 hierarchical processes involved with cognitive attainment (listed from lowest to highest): **knowledge**, **comprehension**, **application**, **analysis**, **synthesis**, and **evaluation**. At the lowest rung, knowledge, the learner is only able to recall and recite knowledge, basically being able to reproduce previously heard facts. As the learner proceeds through the hierarchy, they first achieve comprehension of the subject material (comprehension), then to apply it in novel contexts, and so on, until the end goal of evaluation is achieved. At this stage, the learner should be able to evaluate and critique their own knowledge. More recently, Anderson et al., (2001) adjusted the model to have a greater emphasis on knowledge generation. Here, the 6 stages (from lowest to highest) are: **Remembering, Understanding, Applying, Analysing, Evaluating**, and **Creating**. How then, are these processes represented in the efforts of a gamer?

Remembering would be comprised of learning the most basic elements of game play, such as control scheme, with understanding covering basic knowledge of the games core mechanics, rules and internal logic. Applying is playing the game itself. From here, the progression to analysing could be demarked by players noting, for example, the patterning of enemy or friendly behaviour, as well as being able to forge their own aims (a theme which will be dealt with in greater detail below, in **Constructivism**). Evaluating may be best engendered as players developing the ability to identify flaws in the game's design itself, or in drawing comparisons between games in the same genre or series. The final stage, creating, can refer to the level few players progress to where they may pursue content creation, game modification, reviewing the game, etc (this will be dealt with in more detail in the **Social Learning** section). For the most part, it should be clear to the reader that **for the best part of the taxonomy, the player is learning purely about the game itself, not anything extrinsically valuable**. In other words, they are learning **non-transferable skills**. When, however, a player progresses to the **level of creating, they are gaining skills that are relevant in some external contexts** (M. Barr, personal communication, March 17, 2014). Indeed, it is becoming more common practice for large games companies to hire experienced "modders" (individuals who create new content or modify existing content) as part of their staff for forthcoming projects, e.g. after his work overhauling Bethesda Softworks' (2006) *The Elder Scrolls IV: Oblivion*, in the 2006 modification *Oscuro's Oblivion Overhaul*, Jorge "Oscuro" Salgado was taken on to work as a designer on the Obsidian Entertainment's (2010) *Fallout: New Vegas.*

Constructivism

Two main theories exist in the educational literature: Constructivism and Instructivism. The latter refers to traditional lecture structure, with the teacher acting as the sole distributer of knowledge. Constructivism, on the other hand, conceives knowledge as being constructed by the learner through the active process of the application of prior knowledge to novel problems (M. Barr, personal communication, March 17, 2014). Bruner (1960, p.17) argues that knowledge the learner has previously encountered benefits later performance in terms of the **'non-specific transfer'** of **"principles and attitudes"**. In this view, learning is the act of acquiring a general idea, from which the leaner can use as a method for identifying problems that are special cases of that base idea (Bruner, 1960). In other words, the learner first gains a general concept, and learns to apply it in an abstract fashion to other, similar problems. Savery & Duffy (1995) defined 3 essential elements of a Constructivist Learning environment:

1. Understanding is in our interaction with the environment
2. Cognitive conflict is the stimulus for learning and determines the organisation of what is learned
3. Knowledge evolves through social negotiation and through the evaluation of the viability of individual understanding

Knowledge acquisition through video games is clearly most amenable to active, constructivist theories, as opposed to passive, instructivist theories. Mayo (2009) notes that game-based tasks require the player to form hypotheses, test them, and discover the action's consequences. **This, Mayo (2009) argues is analogous to the inquiry-based learning that is emblematic of scientific education at present**. Clearly games like Valve Corporation's (2007) *Portal* – a physics based puzzle game which require players to make use of concepts such as the conservation of momentum to progress – require understanding to be developed in the player's immediate environment, and challenge a player cognitively, fulfilling (1) and (2). Premise (3) will be dealt with below in **Social Learning.**

Savery & Duffy (1995) also emphasise **the importance of the goals of the learner**, a view echoed by Vogel et al. (2006), who found **leaner autonomy to be one of the few easily identifiable predictors of enhanced learning outcomes**. Ryan et al., (2006) further found that **learner goals were critical to the enjoyment and motivation of a learner**. Goals in games can often be achieved through multiple, simultaneously available routes (Mayo, 2009). It has been argued that these branching decision structures afford the player the opportunity to make choices based on the estimation of relative consequences, which could be considered to evidence engagement at the highest level of Bloom's taxonomy (1956; see above) (Mayo, 2009).

Social Learning

A key model of social learning that has arisen in recent years is Lave & Wenger's (1991) **Communities of Practice** (CoP) model, in which learning is viewed entirely as a social practice. Learning here is conceptualised as an apprenticeship-like process. The learner being the apprentice; a peripheral member of the community, entrusted with low importance, simple tasks. **A CoP is defined as being a group of people who share a common passion, goal or set of problems who develop and refine their knowledge through interacting on an ongoing basis** (Kim, Song, & Suh, 2012). In context, a new member of the CoP, such as a student, starts out on the outer strata of the community, and through **participation, production of cultural artefacts** (for a good illustration, check out this wiki page detailing the history of a player faction in CCP's (2003) *EVE Online*: https://wiki.eveonline.com/en/wiki/Goonswarm_%28Player_alliance%29 (https://wiki.eveonline.com/en/wiki/Goonswarm_%28Player_alliance%29), or perhaps take a look at *Egoraptor*'s youtube channel for video game based musical comedy accompanied with animated music videos), and **development of knowledge**, they gradually move closer to the core of the community. **It is important to note that any given community need not gather with the explicit intention to learn, that may be purely incidental.**

Here the spectre of online gaming can be appealed to; games are becoming progressively more social, with varying team sizes from a handful of players to teams of over forty players (known colloquially as "clans", "guilds", or "alliances"). The resulting teams interact verbally through text or voice, share strategies, or pursue joint goals, learning from one another as they engage in the activity (Mayo, 2009), essentially fulfilling (3) noted above, which is not surprising due to the CoP framework's emphasis on learning through active participation. Though no game-based data is available, classroom studies have shown that **collaborative learning yields up to 50% improvement over solitary learning** (Johnson et al., 1981).

Perhaps the most grand scale CoPs with which this can be demonstrated are those of CCP's (2003) *EVE Online* - a vast space massive multiplayer online role playing game, or MMORPG. In the past few years, a hugely fascinating set of phenomena has arisen. As a brief preface, *EVE Online* makes use of real world currency, to buy in-game currency, which can be used to purchase resources, thus military and economic units etc. To gain power in the game-world, players are left to choose as to whether they will achieve their goals through diplomatic, economic, or military routes, underpinned by quest progress and research trees. Two camps arose out of this game, who essentially managed to create a game-wide monopoly on the game's most valuable resource, helping to maintain peace between them. However, the two sides became bored with this peace, and decided to draw up treaties of war; logistical and economic assets were out of bounds, but military units were fair game, so as to not upset the economic stability of the game world. **Here we see, albeit anecdotal evidence of two in game communities creating advanced systems of economy, warfare, and essentially law**. Whilst it may be true that players may have brought their outside experience to *EVE Online*, it is highly likely that many players developed skills or knowledge through participating in these communities. In fact, **Xanthopoulou & Papagianidis (2012) found a direct spillover of transformational leadership active learning behaviours following increased (though not decreased) performance in an MMORPG**. It is also worth noting that two particular battles over the past year have incurred **$22,000 and $18,300 of real world monetary loss**, the details of which can be found in these two links to a gaming news show, Checkpoint (**Again, a little heads up for language**):

penny-arcade the-accidental-war (http://www.penny-arcade.com/patv/episode/the-accidental-war)

penny-arcade mystery-intrigue-isk (http://penny-arcade.com/patv/episode/mystery-intrigue-isk)

Papers for further reading

To aid the reader in their further reading, we thought it wise to separate the papers into Bloom's (1956) cognitive domains; **cognitive**, **psychophysical**, and **affective**.

Psychophysical Domain (Skills)

Lynch, J., Aughwane, P., & Hammond, T. M. (2010). Video games and surgical ability: a literature review. *Journal of Surgical Education*, *67***(3), 184-189**.

Aim

This paper investigates the possibility of using **video games as a way to train surgeons**, due to the popular conception that video game usage is linked to good performance in operating.

Methodology

The paper is a literature review and looked at journal articles on the database MEDLINE which concerned video games and surgical

abilities before the date of November 2009. Out of the 12 journals which were found to be relevant; it transpired that previous research had investigated the relationship of video game usage with laparoscopic, gastrointestinal endoscopic, endovascular and robotic surgery.

Results

The conclusions found that **video game users acquired endoscopic techniques, but not robotic techniques at a faster rate** and it was also found that **training on video games improved overall performance**.

More research must be done into the exact effects of video game usage and training. One suggested future study was to investigate the effects of a **video game being used as a 'warm-up'** minutes to hours before operating, which is **thought to increase dexterity and reduce the chance of mistakes**.

Strengths and Weaknesses

The main strength of the study is that it gathers together a large number of observations in the field, and attempts to create a cohesive whole of the findings. Overall, the study's major weakness is the fact it is a literature review. As such, it presents a variety of studies employing different methodologies, some of which may not be fit for comparisons. Notably, some of the studies employed therein were based on students performing surgeries on animal organs, whereas some were conducted using virtual reality simulations. In the latter, it is possible that the study itself may bias the results in favour of experienced gamers who would most likely be more familiar with the mode of presentation, i.e. a simulated 3D world as opposed to genuine environmental interaction. Further weaknesses were also present in terms of appropriate control measures, in that some studies failed to appropriately control for baseline ability, as well as prior exposure to computer and video game technology.

Affective Domain

Xanthopoulou, D., & Papagiannidis, S. (2012). Play online, work better? Examining the spillover of active learning and transformational leadership. *Technological forecasting and social change, 79 (7),* **1328-1339.**

Aim

The aim of this paper was to investigate the degree of spillover effects from MMORPG performance to two primary work domains; *transformational leadership* and *active learning*. In other words, **the goal was to assess how an individual's performance in a game affected their real-life employment**. Based on work suggesting behavioural and affective spillover from family to work domains (Hansen, Hammer & Colton, 2006), it was assumed that the **positive psychological states and their associated behaviours gained from game performance would transfer to performance at work**, i.e. these gains can be generalised across domains. This spillover is thought to be more robust when situational cues synchronise across domains (e.g. a specific leadership challenge arising across an MMORPG and a workplace situation).

Active learners **are those who engage in behaviours offering mastery experiences of competence and proficiency without overtaxing their capabilities**. Due to the open-ended nature of MMORPGs, players are offered unique opportunities to test behavioural outcomes, such as repeating quests in a different fashion and comparing their outcomes until a desirable outcome is achieved (Xanthopoulou & Papagiannidis, 2012). Based on input-process output model of Garris et al. (2002), it was thought that participation in a game initiates active learning both within and out with the game. The nature of online games trigger a cycle including 3 elements; user reactions (interests), user behaviours (persistence with a task or active search for information necessary for task completion, and system feedback. It is thought that this cycle enhances a user's engagement with a game, boosting their grasp of learning outcomes. Finally, the debriefing process in games (e.g. recognition of mistakes and corrective actions) fuels learning, and encourages players to link this knowledge to real world outcomes.

Transformational leaders **are those who transform the norms and values of their followers, and motivate them to perform beyond their own expectations by making them more aware of the task's outcomes**. Dvir et al. (2002) have defined the transformational leader as a charismatic character, who arouse inspirational motivation, offers intellectual stimulation, and shows tailored concern for their followers. These behaviours allow them to leverage influence on their supporters by increasing their feelings of self-efficacy and by broadening their goals. This leadership style was studied as it is found to relate positively to follower motivation. In the context of MMORPGs, this may be displayed through tasks where a high-level player is required to perform administration (e.g. role allocation), as well as with high-level strategy issues (e.g. motivating group members, increasing cohesion).

The study aimed to test 4 hypothesis; (1) **Active learning in the game spills over to active learning in work over time**; (2) **Transformational leadership in the game spills over to transformational leadership over time**; (3) **Performance in the game moderates the spillover of active learning in a way that high performance boosts this spillover effect**; (4) **Performance in the game moderates the spillover of transformational leadership, in a way that high performance boosts this spillover effect**.

Methods

To test these assumptions a longitudinal design was employed. 79 (61 males and 18 females, with a mean age of 33.8 years) participants were recruited from forums pertaining to MMORPGs. The sample matches the largest concentration of MMORPG players, who tend to be in their 30s, have above average education, 80% of whom are male, and 50% of whom hold down full-time jobs (Xanthopoulou & Papagiannidis, 2012). Participants' were given 2 electronic questionnaires, one at the start of the study, the second a month later. The questionnaires were designed to measure; *Personality*, *Game Addiction* (**a control variable**), *Game Active Learning*, *Game Transformational Leadership* and *Game Performance.*

Results

The results were highly interesting. No main effect was found of active learning on subsequent active learning at work over time, rejecting hypothesis 1. It is important to note that **there was a positive interaction effect between game performance and active learning at work, which explained 5% of variance in the spilloever effect from game performance to work performance**, **supporting hypothesis 3**. Of interest was the finding that **when active learning behaviours were present in the context of reduced game performance, this negatively affected active learning behaviours at work**. For transformational leadership, **results supported hypothesis 2**, transformational leadership in game directly spilled-over to work, after controlling for personal characteristics and game addiction. Finally, transformational leadership also had a positive interaction with game performance, indicating that participants adopted successful in-game leadership strategies in their real-world employment, **supporting hypothesis 4**. Analyses were conducted to assess as to whether it may have been workplace behaviours affecting in-game performance. The results did not support the bi-directionality of active learning; only in game changes in performance affected workplace performance. However, transformational leadership abilities were found to be significantly bi-directional, though transfer from game-to-work was found to be more probable than work-to-game.

Strengths and Weaknesses

This study had several strengths. First of all, it linked in-game performance to real-world employment outcomes, giving the reader some indication of the transferability of knowledge gained in game. It is also an extension of spillover research, which was previously mainly studied from family-to-work contexts. The longitudinal design of the study also allowed for better analyses of the direction of the effects present. No study, however, is without its flaws. For one, self-report questionnaires were employed, which always raises concerns of how reliable the data is. Another key weakness was that in-game performance was only assessed by the second electronic questionnaire; it is possible that this may explain some of the data in the study. Additionally, it was a certain weakness of the study that only around half of the participants held any official in game leadership position, raising questions about the usefulness of the data, so we must question as to whether it is safe to generalize these findings.

Cognitive Domain

Robertson, D, & Miller, D. (2009). Learning gains from using game consoles in primary classrooms: A randomised controlled study. *Procedia Social and Behavioral Sciences, 1,* **1641-1644.**

This article suggests that COTS computer games improved children's mental computation skills significantly. Other benefits include an improvement in attitude of the students towards school and their academic work, reduction in truancy and lateness, increased keenness to take responsibility for management aspects in the classroom, more positive interpersonal relationships and an increased faith in their own competency.

Aim:

To investigate the effects of a commercial off-the-shelf (COTS) computer game on children's mental computation skills and on aspects of their self-perceptions.

Methodology:

A randomised controlled trial using a stratified random sample was conducted, with participants falling under one of two conditions; experimental or control. The experimental group used Nintendo for 30 minutes a day, 5 days a week, for 9 weeks. For the teachers in the experimental group, a training session was provided. The game employed was *Dr Kawashima's Brain Training.* In the control group, teachers were told not to change their normal routine.

Participants were assessed on a variety of measures; (1) pre- and post-test measures of computation; (2) various self measures (e.g. mathematics self-concept); (3) Children's prior performance against national standards; (4) Children's frequency of home computer usage.

Results:

In terms of accuracy (number correct): Both groups achieved statistically significant gains, though the mean gain in the experimental group was approximately 50% greater than the control group, a statistically significant result.

In terms of speed of processing (time taken to complete number test): Both groups achieved statistically significant improvements, with the mean improvement in the experimental group being more than twice that of the control group, another significant difference.

In terms of accuracy, a general trend was present illustrating that the less able children tended to improve more than the more able children. Another general trend was present; in terms of speed children falling in the middle ability group tended to improve more than the children at the bottom and top of the ability range. The general trend observed in terms of accuracy should not be surprising because there should be more room of improvement for the less able children in terms of accuracy. The general trend observed in terms of speed could be due to the fact that middle ability children tend to have more room for improvement than the children who were already at the top of the ability range. However, **it would be interesting to investigate why the children at the bottom of the ability range did not improve as much as the middle ability children in this case**. There was a slight but statistically significant **improvement in attitude towards school in the experimental group**, but not in the control group. **No significant differences were present between genders**.

Strengths and Weaknesses:

This study had **several strengths**. The sample was of P6 children in 32 schools and 4 education authorities. As compared to

experiments that tend to use undergraduate students as subjects, the fact that the sample was as such adds **external validity** to the results. The study **attempts to provide empirical evidence of the educational value of COTS computer games**. The evidence of the educational value of COTS computer games is neither extensive nor robust (Condie & Munro, 2007) and **most benefits extolled about COTS computer games are beliefs and attitudes of teachers, pupils and parents** (e.g. McFarlane, Sparrowhawk & Heald, 2002; Facer, 2003; Sandford et al., 2006). The findings suggest **a possible way to encourage students who fall under the lowest socioeconomic strata to go to school**.

The study was not, however, without its weaknesses. The schools that were identified were in the lowest quartile in terms of socio-economic status. Therefore, the findings may not be generalized to students who are in the middle or highest quartile in terms of socio-economic status. This is because students who are in the lowest quartile in terms of socio-economic status are less likely to own a Nintendo DS lite games console, and hence, will be more motivated to go to school because it offers them an opportunity to play something that they will otherwise not have the opportunity to. It would be interesting to see if students in the middle and highest quartile in terms of socio-economic status derive the same results. Finally, there was no mention of the normal routine of the students (condition of the control group). It would be interesting to note what the teachers were doing with the students in the control group when the experimental group were on the Nintendo. I would propose another condition whereby students do something measurably productive and related to brain training without the use of a Nintendo game console to see how things measure up.

Robertson, J, & Howells, C. (2008). Computer game design: Opportunities for successful learning. *Computers & Education, 50,* **559-578.**

This article suggests that **children can benefit not only from the passive engagement in video games, but also from the active construction of them**. The reason behind the success of game making as an educational medium lies in it being/creating a "powerful learning environment". According to Smeets (2005), "**powerful learning environments are those which foster optimal learning processes; learners are actively engaged (independently or collaboratively) on authentic, rich tasks which have been adapted to their individual needs**." Game making is inherently an active engagement. It is authentic, in the sense that the end product is of value in the popular culture and can be enjoyed by one's friends and family. It is also rich, in the sense that it allows children to exercise a wide spectrum of skills. Offering children the opportunity to design computer games equips children with skills for successful learning that are transferable to wider learning contexts.

Aim:

This article investigates the innovative use of technology to make a video game in a classroom setting. Questions of interest were as to whether game making leads to successful learning and how professionals in the educational setting can better support children through the creative process of game design

Methodology:

To allow students to produce the games, training sessions were delivered across a wide range of time. Students were given a 2 hour introductory session during the summer term, and eight 2-hour sessions spread throughout the autumn term. Each session operated in a fashion that the entire class was given a 20 minute introduction, followed by two 40 minute sessions in which half of the class had hands-on time with the software due to time constraints. After this, a 20 minute feedback and knowledge sharing discussion was undertaken between researchers and the class. Over the course of the experiment, the children were required to take of the role of a peer reviewer, testing and offering constructive criticism for another child's game. The final session saw the children's parents and educationalists from the local authority invited to see the products of the study, and offered the children the chance to teach these guests how to make games. **Data was taken from a few routes; the material products themselves – worksheets -, researchers' observation notes, questionnaires given to the children, and transcripts of interviews with the children, teachers and the visiting educationalists. Thematic analysis was used to find the type of learning taking place over the course of the study**, specifically in terms of *A Curriculum for Excellence* (Hayes, 2000).

Results:

A key result here was that all children, **regardless of their ability level were enthusiastic and engaged**, often showing **determination to reach a high standard of work**. The children developed their strategies and attitudes towards collaboration; they were able to work alone whilst collaborating with peers – sharing knowledge about the program, but working on their own product -, and started helping not only their friends, but others in the class. The process of peer-assessment of others' games, paired with the mandatory evaluations and constructive criticism the children had to give **developed their critical thinking skills**. The children took initiative in terms of finding their own way with the program, a mark of **independent thinking**. The children came to value the learning opportunities afforded by the identification of errors, realising it offers opportunities to improve their work. Finally, and perhaps of the most importance was the observation that **the children were able to transfer skills learned during the course of the study to other contexts, such as essay writing**.

Strengths and Weaknesses:

The paper's key strength is that it challenges the conventional thinking that children can only actively engage in and learn from video games as a consumer. Now, knowing that it is possible that the young children are able to produce their own games and that the skills that are acquired impact other aspects of their lives, we perhaps see a valuable educational tool. However, there was no mention about

what half of the class was doing when they were not engaged with the software. This is important because what the children were doing during this period would give us an insight into other possible learning avenues that the children undertook during the 40 minutes 'free time'. Furthermore, there were too many variables that were present to single out which exactly was the most beneficial to the children's learning. The results may not be generalizable. In order to ascertain that game making is indeed a power educational tool, more replications have to be produced. Otherwise, it is difficult to discern whether this is just an isolated case in which the children are exceptionally motivated, so as to generate such a positive outcome.

Gaps Between Theory and Empirical Evidence

One of the key points that we can raise with studies involving video games and education is as to whether they are really tapping into learning attributable to video games. Take for example Lynch et al. (2010). Several of the studies in their review failed to find significant results in terms of a positive relationship between video game usage and surgical ability. One of the oft-cited reasons that was in the modern world computer usage is so widespread that any measurable gains in surgical ability may simply be produced by familiarity with computers; typing, for example, is a skill which requires a high degree of manual dexterity. **This presents a roadblock in these kinds of studies; producing a sufficiently high degree of control to attribute any gains directly to video game usage**. A further, and related issue is that of being able to prove this kind of relationship; surgical students may have played video games in their past as they may have a higher natural level of psychophysical performance, which may also lead to their choice of career. **Further studies conducted need to find more rigorous measures, or at least adopt a design employing surgical students with little-to-no gaming experience, so as to be able to properly establish baseline performance for comparisons. Without this, any results obtained are at best questionable**. A further issue that can arise is also with the validity of any observations about the transferability of behaviour. Whilst self-report measures have been shown to be quite reliable, the worry of the truth of reports is always an issue. Though logistically challenging, there is a possible route to assuage these doubts. The technology already exists for players of a game to record video footage of their in-game performance. I would suggest a logical advancement of these studies would be to employ such technologies whilst participants take part in the study, allowing investigators a more neutral - albeit more observational - method of assessing participants behaviour, which would hopefully lend its hand in assessing how transferable skills are. At present, this may not be a useful tactic; to concurrently record footage and play is taxing on a computer, thus it would require a lab-based setting with high grade computers, plus the recording equipment. Most likely this would be an expense outside the bounds of most funding bodies.

These issue of drawing inferences from studies on learning and video games is ever present; in the Robertson & Miller (2009) paper summarised above, there are clear design issues preventing this. Of note is the fact that the activities of the control group were not documented. If the control group were given, say, 40 minutes of unstructured play, this may result in the groups being incommensurable. For solid inferences to be drawn, a third group should have been employed; traditional teaching methods. Given that the study pertained to computational skills, a teaching regime could have been developed. **The results of which would provide a means of assessing the effect of learning from games over standard pedagogical practices, which, if anything should be the main aim of studies into learning from games in school age childre**n. This study also had the ambition of comparing the effectiveness of off the shelf games in improving computational ability. The use of games for the entertainment market presents an interesting field of study, so it might be profitable to use games not specifically built to produce cognitive gains. For example, classic survival horror titles mainly hinge on a combination of problem solving and inventory management (which is essentially tied to mathematical ability), or Role Playing Games which traditionally use interacting mathematical equations (in terms of player attributes such as strength, dexterity, etc. for an illustration see: here (http://fallout.wikia.com/wiki/Fallout_derived_statistics) to determine anything from the damage of an attack to the chance of finding a 'good' item in a chest. If a player's mathematical ability was generally found to improve, this would open up new avenues of studying experiential education, and to help discover the learning processes that games utilise. This, however, would likely not be practicable to conduct with school age children as these genres of games typically have mature content.

A final issue arises when trying to test the predictions of the different schools of learning. Whilst in this article we have made efforts to provide working definitions of theories such as instruvctivism and constructivism, **it would be incredibly misleading for us to claim they are united fields. Within each approach to education, several views are presented, and concepts mobilised differently**. Take for example, Bloom's (1956) taxonomy. Some authors (e.g., Mayo, 2009) argue that a player becoming able to navigate branching decision paths and forging their own goals is evidence that a player is working at the top layer of the taxonomy (evaluation), whereas others claim that a player has only reached the top of the hierarchy once they have progressed to the level of content creation such as wiki pages (M. Barr, personal communication, March 17, 2014). Naturally, within any field conceptual differences are present, though here it would seem to generate some quite specific roadblocks. A way to avoid this, is of course for authors to clearly state what definition they are employing. **At present, however, it would be my assessment that the development of a standardised definition would be highly profitable, though unlikely. This is especially the case of educational research involving video games, as it is, by all accounts a study in its early days**.

Closing Remarks

What then, is the takeaway message of this article? Overall, the study of the relationship between video games and learning is an interesting, and potentially fruitful field of study. **Video games play on the intrinsic motivation to learn, and many have a considerable advantage over traditional teaching practices in terms of learner engagement**. Potentially, **online games can influence active learning outwith the game, as can the use of off the shelf products when employed in classroom**s. Whilst this field of study appears promising, **issues arise in terms of the validity of data, and as to whether we can generalise findings, in addition to problems with conceptual agreement between studies**. Whilst this article can offer readers an insight into the field, at the end of the day it is up to the reader to draw up their own conclusions. One thing that is for certain is that we will likely see an increase in research in this area due to the ever-growing number of people playing video games, particularly online.

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