PLAYING GAMES: DO GAME CONSOLES HAVE A POSITIVE IMPACT ON GIRLS' LEARNING OUTCOMES AND MOTIVATION?

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Abstract

Games based learning is currently a hotly debated topic in education and is a fertile field of study (Holmes, 2011; Abrams, 2009). Many schools are exploring ways in which games can be embedded into the curriculum, to enhance learning through deeper engagement and higher levels of motivation (Miller & Robertson, 2010). This paper explores the use of game consoles to support learning for young students (ages 8-11) and evaluates their recent success in primary education. Over time game consoles and video games have been portrayed as a male oriented technology. This research investigated the current use of game consoles in learning and how it might positively affect a child's learning and motivation, but focused solely on female students' experiences. In the study we investigated the research question: 'Do game consoles have a positive impact on girls' learning and motivation?' A semi-structured questionnaire was distributed to girls in Key Stage 2 (n=49) across three schools that have already incorporated game consoles into their curriculum. The study found that game consoles and video games can have a positive impact on girls' learning and motivation and are key themes that have been raised by teachers. However, due to several limitations in this research some issues were not fully addressed, and we identify some future areas for research.

Keywords: Games, education, learning, information and communication technology (ICT)

Introduction

The current education system remains rooted in the industrial age and thus education fails to offer learners the tools they need. Collaboration is crucial for children to think divergently, and one way to enable this learning is through specific kinds of technology application. Information and communication technology (ICT) is an educational phenomenon, characterised by an exponential increase in the use and range of technologies employed in schools. ICT tools can empower learning across the curriculum, allowing children to become active learners through interaction and collaboration, providing them with rich learning experiences. Video gaming is a specific application of ICT that departs from traditional modes of education while harnessing the potential to promote interaction and collaboration. Video games are highly familiar to most children, but this is usually outside of the formal education setting. Introducing video games into formal learning contexts thus provides a fertile area for research.

Games in Education

Games-based learning (GBL) is playing an ever increasing role in formal education, but the field can be somewhat confusing for many educators (Becker, 2007). To understand the use of games in education, teachers must first identify the different types and then understand how they might be adopted into mainstream classroom practice. Caillois (1961) proposes that games can be divided into four main categories. These are: agon, alea, mimicry and ilinx. Each type of game, in

its broadest sense, serves a different purpose, and can be correlated more or less to games played today in formal education contexts. Prensky (2001) specifies six key elements that make up a game. These are: rules, goals and objectives, outcomes and feedback, conflict/competition/challenge/opposition, interaction, and representation or story. For many, GBL is a relatively new concept in education. It combines 'serious learning' and 'interactive entertainment' to enable learning (Prensky, 2001). In the last decade there has been a shift in the way teachers are incorporating games into learning.

This is witnessed not only in the proliferation of games in the classroom, but also the adoption of gamification techniques. Gamification places the features of games into real life situations, to engage users with problem solving skills and employs game rules and player experiences to help support active learning (Lee & Hammer, 2011) with lessons designed around the game rules. Gamification however, is beyond the scope of this paper, which will focus exclusively on GBL in formal contexts.

In this paper, we apply the terms 'game console' and 'video game' interchangeably. A game console is an electronic device that is used to play video games and is usually handheld (De Freitas, 2006, p.9). Commercial off the shelf (COTS) game consoles are the most familiar to children, so we focus mainly on these types of games and their use in the primary classroom.

Learning Theory and Games

The social constructivist theory first proposed by Vygotsky (1978) can be used as a framework to explain games based learning. It is based on the premise that society plays a central role in children's learning and development, influencing learning initially through social interaction and then less dependently as the child matures (Vygotsky, 1978). Vygotsky's 'zone of proximal development' (ZPD) proposes three levels. Firstly, the actual developmental level is what the child can achieve at present through problem solving independently. Secondly, the potential developmental level is what the child can achieve with adult guidance from a 'knowledgeable other' in problem solving. Thirdly, there is an area that cannot for the moment be reached. The ZPD is the distance between the first two levels (Vygotsky, 1978) and the knowledgeable other provides scaffolding to support the learner's progress (Bruner, 1966). Although Vygotsky's theory was conceived long before the advent of GBL, it is never the less a credible theory that can be applied quite effectively as an explanatory framework for the use of GBL in schools. For Savery and Duffy (1995) the three components of constructivist learning are interactions within the environment, cognitive conflict and collaboration. We propose that a fourth type of interaction – with the tool, or in this case, the game – can also be applied to the scaffolding of learning.

Multi-user gaming promotes social learning where pupils collaborate (Oblinger, 2004,) but there is confusion around Vygotsky's use of the term 'teacher'. Arguably, contemporary learners may not require teachers, favouring the use of technology to support learning. Theoretically, game consoles and video games could substitute for the 'more capable peer' or teacher. Wood et al. (1976) develop Vygotsky's theory and introduce the term 'scaffolding' which Bruner describes as support offered by teachers during problem solving (Bruner, 1966). Thus children can solve problems that would be impossible without guidance. If technology can supplement the teacher role to become a 'mind tool' (Jonassen et al., 1999) games consoles could scaffold the child's thinking and learning. Scaffolding thus allows for more complex thinking, allowing learners to more deeply engage in learning (Hogan & Pressley, 1997) and to learn how to solve problems that arise from the process. Problem solving and problem finding is essential to enable learning (Rummel & Spada, 2005) and this leads to further discovery, strategic problem solving and the

ability to apply solutions to similar problem spaces that might later be encountered (Gerver, 2011). Indeed, studies have shown that games do not need to be fully representative of reality to be useful in the real world (Sandford et al., 2006).

Game Consoles and Learning

Gee (2003) identifies 36 principles of learning and contends that video games are powerful learning tools for contemporary learning. His opinions are supported by many other commentators, who argue that games can develop digital literacies (O'Brien & Scharber, 2008), critical thinking skills (Prensky, 2001), and freedom to experiment within safe environments (Lewis & Fabos, 2000). There are also those who point out the negative effects of violent video games including Berger (2002) and Shibuya et al. (2008). Further criticism comes from Byron (2008) who holds that video games are inappropriate for children's learning because of their sometimes questionable content. As Abrams (2009) counsels, whilst such criticism is valid it should not prevent us from seriously considering the benefits and application of video games in educational contexts. Whilst there are concerns over the psychological changes that violent and aggressive games content may wreak on young minds, we also need to consider that very little evidence has emerged to suggest that children today are more violent as a result of playing video games. Indeed, demographically it appears that the opposite is true (Davidson, 2011). Furthermore, as Gee contends, we should be aware that learning does not always occur within the content of the game or because of the nature of the content. Students may also learn for example through the use of a game using semiotic domains, or the subsequent application of skills outside of the gaming environment. One example of this can be found in a small scale study into teachers' and students' attitudes to using games for learning. Findings showed that teachers found computer games-based learning improved motor cognitive skills, ICT skills, higher order thinking skills, knowledge and social skills that could be applied in real life contexts (Sandford et al., 2006). However, the majority of this research was based on teachers' and students' opinions and no evidence of students' achievements were gathered. For research that shows the student's achievement whilst using games, access to performance data would be a more valuable proposition. One study that managed to achieve this was by Tüzün et al. (2009) who found significant learning gain from the use of computer games in Geography. They found that children could understand and correctly answer specific questions after playing the game.

Gaming and Motivation

Learner motivation can be defined as the amount of attention and effort that an individual puts into different activities (Brophy, 2010). It is an important aspect to learning and the individual (Maehr & Meyer, 1997) because without motivation, nothing would be achieved. Maslow's well known human needs model is arranged in hierarchical order of physiological, safety, love and belonging, self esteem and self actualisation all of which, he argued, can affect motivation. Atkinson et al. (1990) place motivation in three categories; survival, social and curiosity, identifying the fulfilment of the lower level of needs before progression can be made up the hierarchy. Therefore, in education children may need to be satisfied at the lower level before they will be motivated to learn. However, this should be accepted with caution, because Maslow's theory has some limitations. There is no substantial evidence to indicate to what extent self actualisation can be achieved, and there is also doubt over whether sequential progression through the stages is completely necessary to achieve self actualisation (Rogers & Freiberg, 1993). A recent study illustrates a quadrant of player motivation. It suggests that the four main levels of motivation that players experience are immersion, cooperation, achievement and competition. Many of these features are present in video games.

A more useful explanation for motivation within games playing can be found in Flow Theory. When students are 'in the flow', they tend to be intensely absorbed within their tasks, and also tend to disregard many of the hierarchical needs presented in Maslow's model. It is not unusual for fully engaged gamers to miss meals, sleep and neglect other physiological requirements, to 'reach another level' in the game they are playing. According to Csíkszentmihályi (1975), immersion within this flow is dictated by levels of challenge against skill, and results from a homeostatic balance in a psychological zone or channel between anxiety and boredom. If the game is too simple, and the gamer's skills are not challenged, boredom results, whereas conversely, if the game is too difficult, the gamer tends to give up. Motivation for engagement within games then, can best be achieved where the challenge for users in just within reach of their skills, and incrementally progresses as those skills develop.

Gender Differences and Games

In recent years there has been a growing interest in the use of technologies related to gender. According to Yukselturk and Bulut (2009) there is an increase in female use of technology and this extends to computer games consoles. For many years there have been suggestions that digital games are predominantly a male leisure activity and are targeted towards a male audience (Cassell & Jenkins, 1998). However, this research was based on studies into the use of what is now outdated technology. Recent research by ISFE (2010) revealed that across 8 major European countries surveyed, there are a total of almost 80 million gamers. Out of these, there are more male players than females and females tend to play the Nintendo Wii and Nintendo DS. The statistics show that female game players prefer to play games together and interact socially during the game playing. Where males show an interest in strategy, adventure and simulation type games, females exhibit greater interest in building games (Connelly et al., 2007). In effect, as Wei and Hendrix (2009) discovered, recall of games playing details was affected, with boys between the ages of 6-7 remembering the consequences of 'winning or losing', whilst girls of the same age group focused more on the friendships they had developed. However, although the bias for competitive war based, violence simulation games is still biased towards males, at least 31 percent of females also reported playing 'shoot-em up' games (Bonnano & Kommers, 2005). Moreover, there is evidence in recent literature for a significant increase in female games playing, but significantly, females prefer educational games such as puzzles and quizzes (Lee, 2003) to the faster paced alternatives favoured by male gamers (Bonnano & Kommers, 2005).

Bryce and Rutter (2003) reveal that there are two aspects of gaming that are gender constrained, and these are the nature and context of the game. Their review however, was carried out between the 1980s and 90s, and GBL has advanced significantly since then. Another study showed that there were differences in online game playing between males and females in terms of self-efficacy, playfulness, behaviour and anxiety (Wang & Wang, 2008). Another study explored the gender differences in 'flow' whilst playing computer games (Inal & Cagiltay, 2007) and found that boys were in flow when they were affected by rules and game play and girls by the story theme. Boys and girls playing habits were different, especially within the context of flow. However, the current literature review suggests that in recent years disparity between females and male game playing is disappearing. The review of literature on classroom games reveals a gap in the research around gender differences and using games (Wang & Wang, 2008) but much is still biased toward male gaming. In consideration of the preceding review, this current study set out to investigate whether games consoles had a positive impact on girls' learning and motivation.

Method

The sample represented in this study is made up of girls in the UK that attend a school that uses game consoles to support learning. The convenience sample of participants comprised 49 primary school girls from three schools in Key Stage Two (aged 8-11) drawn from Year Three (n=20), Year Four (n=1), Year Five (n=16) and Year Six (n=12). A convenience sample was selected because it was the method of sampling that was the least time consuming and the number of schools that were willing to take part in the research was limited. However, we acknowledge that there are limitations to this sample, for example Cohen et al. (2007) suggest that this type of sampling may not allow for generalisation to the wider population. The practice of convenience sampling is often considered weak due to the sample not being correctly established (Denscombe, 2007). However, due to the limited time this was the most suitable participant selection method to employ, and statistically, the sample was sufficient to provide an account of any significant statistical effects that might be present (Cohen et al., 2007). Only schools that had incorporated the use of game consoles into their curriculum were asked to take part. The participants were identified using Twitter and via email. Ethical approval was granted but due to the ages of the children the class teacher and head teacher, acting in *loco parentis* gave permission for their participation. Participants were aged 8 to 11, so informed consent was given before each took part in the research and each was informed of their right to withdraw at any stage of the research.

Instrument

We used a semi-structured questionnaire consisting of 18 questions. The questionnaire collected quantitative and qualitative data to discover if game consoles had a positive impact on girls' learning and motivation. A range of questions was asked, fitting different purposes, and allowing for a greater depth of data analysis (Cohen et al., 2007). The types of questions included: dichotomous, scales, multiple choice and open ended. The qualitative data gave an understanding of the attitudes and feelings of the participants which garnered a deeper understanding of their thoughts, lending authenticity and depth to the data received (Cohen et al., 2007). Despite these strengths, research using this method can be very time consuming, therefore, only three qualitative questions were included. Quantitative data was the main source of data collected. This was because it would be easier to analyse (Cohen et al., 2007). However, there are potential limitations when using this method, where questions can be interpreted differently, affecting the validity of the data (Bell, 2010).

Procedure

Prior to distribution of the questionnaire, two Key Stage 2 children (aged 8-11) piloted it to determine whether the instrument was suitable for their age group and to ensure the questions were not ambiguous and could be understood. All participants completed the questionnaire using Google Docs. However, due to the specific sample it took time to receive any data, and it was difficult getting schools to partake in the research. This may be due to many schools feeling invaded when researches try to carry out research on their pupils or the lack of time teachers have. Despite these difficulties a sufficient sample was collected during this research.

Analysis

Data were analysed using a range of tests to gain a better understanding. Firstly, a Pearson-product moment coefficient of correlation test was used to determine if there was a relationship

between two variables and to measure statistical significance. This Pearson test was used because it is reliable and commonly applied to data analysis (Cohen et al., 2007). Cross tabulation tests were carried out with the Chi- square tests to analyse nominal data to detect any significant relationship between any two categories. Lastly, open ended questions were analysed using thematic analysis, seeking patterns and key themes to emerge, thereby allowing us to discover any relationships or emerging patterns within the responses (Garza, 2004).

Results showed that of the 49 girls who participated in the questionnaire, 33 said that they used video games at school and 36 girls used video games at home. The types of game console they used at school and at home are shown in Figure 1 and 2. 27 % of girls used video games at home every day. 41 % used video games once a week and 41 % of girls used video games at school whereas 41 % used them once a month. The majority of girls used game consoles to support learning in Maths and English.
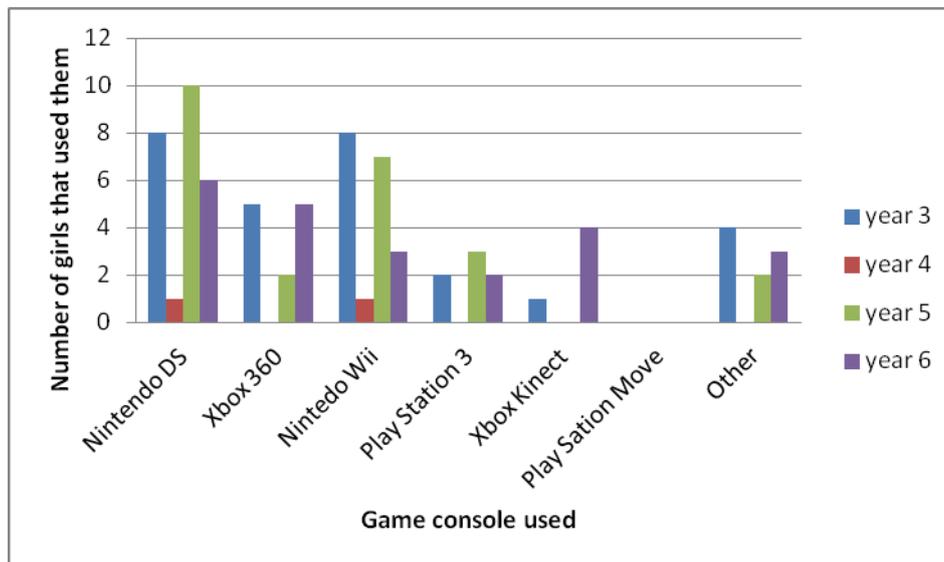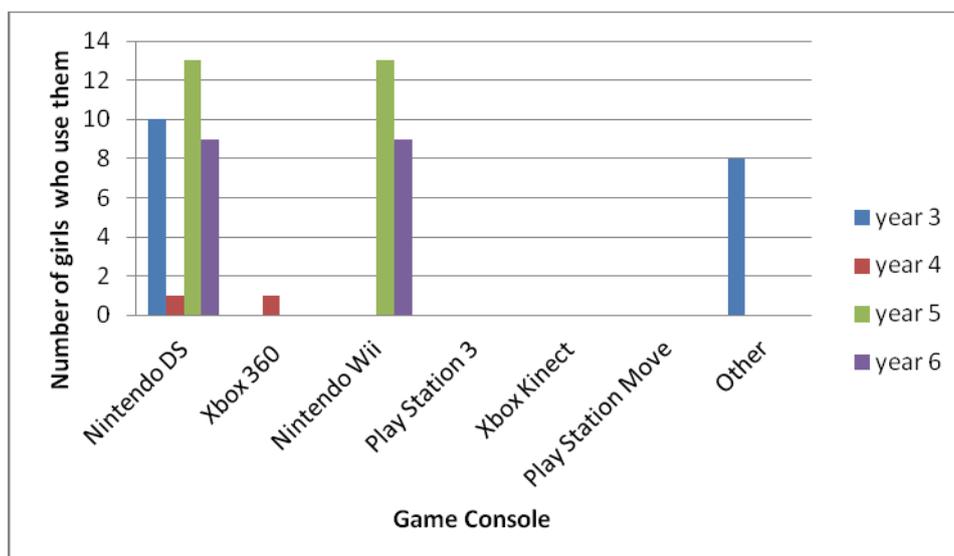

Figure 1. Games Consoles used at home

Figure 2. Games Consoles used in school

Discussion: Quantitative Analysis

Quantitative analysis of the data reveals some statistically significant correlations between school and home in terms of game console usage. Figure 1 shows that the children using video games more frequently at home also found using them enjoyable to use at school. As previously stated there are 16.7 million active gamers in the UK. This suggests that a majority of children already use games for entertainment. Prensky (2001) suggests the 'games generation' are children born around the culture of game playing thus are 'active participants' who are interacting with games and are familiar with games from an early age. This would then suggest that because children are familiar with games, and they think differently from the 'digital immigrants' that they will find it easier to learn when using video games at school. However, there is much debate on the topic as to whether the 'game generation' or 'digital natives' and 'digital immigrants' actually exist (Selwyn, 2010) or are merely anecdotal (Wheeler, 2011). Furthermore, due to the economic background of some pupils this may not be the case. It may be questionable whether implementing technology such as game consoles, into education is beneficial because of an assumption that children use them at home when in fact they may not. Nonetheless, this research indicates that girls enjoy using games consoles at school when they have used them at home and this can motivate and support learning. The schools who participated in the research have used game consoles for a period of time; therefore, the children are still motivated even though the technology has been in the classroom for a while.
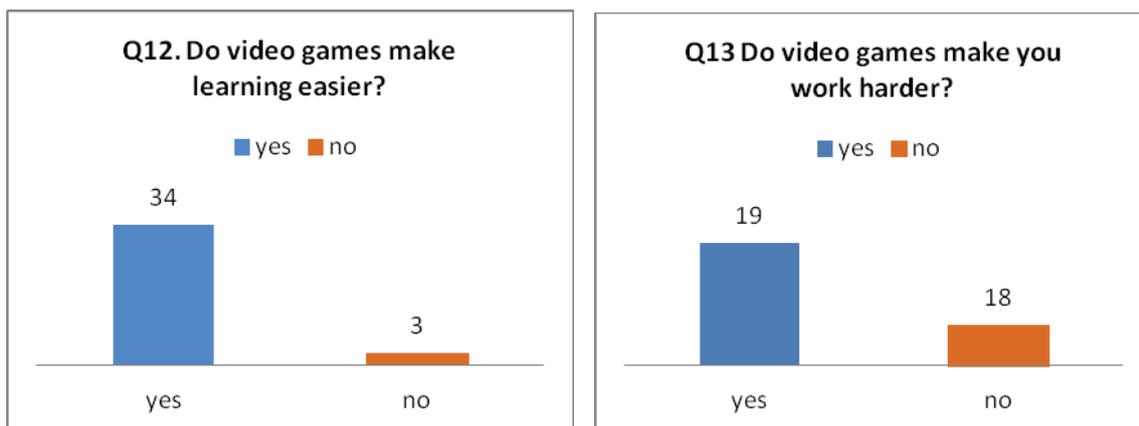
Figures 3 and 4. Do video games make learning easier; do they make you work harder?

The data also indicate that children who agree that 'using video games at home are fun' found that it made them work harder at school and they would rather use them to learn. In this sample therefore, girls' attitudes towards video games are positive, and they see the positive impacts video games have to offer. This is supported by the literature (Sandford et al., 2006) as students in this study reported on the motivating aspects of game consoles. The results also suggest that motivation is likely to rise if children use game consoles that they are familiar with, because of their previous use of consoles at home.

A Pearson Product Moment Correlation Coefficient (one-tailed) test revealed an expected statistically significant correlation between pupils attitudes towards the statement 'video games at home are fun' and how often they played video games at home (r = 380, p < .05).Those pupils who tended to play video games more often found them enjoyable whereas the pupils that did not play them that often did not find them as enjoyable. This could be considered a banal finding, were it not for the fact that practice elements cannot be ignored, and habituation into the use of technology tends to increase cognitive skill and improve dexterity levels. Further research should therefore focus on the practice effect and its possible role in enhancing learning through games consoles.

Another statistically significant correlation relevant to the above effect was found between how often pupils use video games at home and pupils attitudes towards the following statement 'video games at school are fun' (r = 0.358, p < .05). Pupils who used video games often at home found them enjoyable in school, whereas the pupils who did not use them at home did not find them as enjoyable in school. The fun factor is clearly an important index from which the success of games in formal education contexts can be applied. Children are more engaged with games when they are enjoyable, but this effect must be counterbalanced with a learning goal so that children can know when they have achieved their learning target.

Lastly, a statistically significant correlation was observed between pupils' attitudes of using video games at home and using video games at school (r = 0.380, p < .05). This relationship showed that children who enjoy using game consoles at home also found them fun to use at school. Whereas, children who did not find them fun at home, did not enjoy using them at school. There are clearly elements of this finding that are rooted in home context, and further research should focus on the role home experiences of technology can influence experiences of similar technologies within school. Should children for example be allowed to 'bring their own devices' into school more often? Does familiarity with technology enhance its use in unfamiliar contexts?

Qualitative Analysis

Qualitative data were gathered to gain a richer understanding of the girls' reasons for their use of game consoles in school. An analysis of questions 16, 17 and 18 revealed the emergence of key themes related to learning and motivation. A relationship was found between girls' learning and girls' motivation. Many girls suggested that the reason they use video games is because they enjoy them and find them fun. The participants were then asked: Why do you find them fun to use? Some responses are shown below: One year 6 girl said: *"It makes learning fun."* Clearly, this response suggests that games afford a departure from the standard range of experiences available in traditional lessons. We could argue here that the active mode of learning necessary for GBL is qualitatively different from any other active mode available in the standard classroom, because the students are in total control of their own activities, decide their actions and experience the results. This aligns fairly closely to Vygotsky's (1978) perspective on the existence of a zone of proximal development, but not in the traditional sense of a knowledgeable other. In this sense, the scaffolding for learning is provided by the game, and learning is extended beyond an individual's capabilities through risk taking, problem solving, retrying after failure, and decision making. This freedom for decision making thus acts as an autonomous aspect of the child's learning – that is, they learn responsibility and the need to accept consequences for their own actions. The fun element reported by many games users is an overarching experience which although superficial to the deeper goal of learning, none the less acts and a motivational factor in their initial and subsequent engagement. Teachers should be aware that, as Tang et al. (2009) argue, enjoyment is only one aspect of serious games play, and can be translated into meaningful learning activities that promote the development of cognitive skills and the formation of new concepts.

> *A year 5 girl responded to the same question, saying "because it helps my learning and it does it in a fun way and not a boring way."*

This statement suggests a strong relationship between learning and motivation, which appears to be amplified within the games playing context. Further, Csikszentmihalyis' (1975) flow theory as a homeostatic balance between boredom and challenge was a useful theoretical lens through which to view the findings. Students reported that when they were absorbed into the games, they concentrated better – an indication of learning 'in the flow'. Teachers might find this useful in

determining individual ability levels against the games level, providing each student with a challenge that maintains their motivation levels. This finding counters Whitton's (2007) research that showed that there was no significant relationship between learning and motivation. However, these statements are only student's perceptions; the data may therefore fail to provide a complete picture because there is no evidence suggesting a correlation between the rise in attainment and the level of motivation that is occurring.

There were also some interesting responses to the question: Why do you not use video games? A year 3 girl responded by saying:

> *"Because sometimes they are not good for your brain."*

Another opined:

> *"Because they are a waste of money if we buy them"* (Year 6 girl).

It is difficult to ascertain the source of these opinions, or to trace the source of their opinions, but it would be interesting to speculate that perhaps there was parental influence behind the responses, or possibly exposure to media commentary on games. It is possible that teachers, parents and peers may have influenced any of the above answers, or indeed that they may exhibit demand characteristics in response to the questions posed by the researcher (Orne, 2009) which may influence the overall reliability of responses.

One Year 6 girl voiced the pragmatic opinion that although games were fun,

> *"You could do better things like being active."*

However, this position assumes that game playing is entirely sedentary. The advent of kinaesthetically controlled games such as the Nintendo Wii and Xbox 360 Kinnect might provide additional contexts. Active learning is indeed one of the emphasised benefits of playing games according to advocates such as Gee (2003) and Prensky (2001). This position argues that learning is enhanced through engagement with experimentation and practice. Gaming in one sector of development at least, is becoming more physically active, and one might expect that in future iterations of video game playing, developments will be advanced around physical movement, gestural and postural control of games.

Conclusions

The results of this small-scale research cannot be generalised beyond the sample, but the study does give some indication as to why girls use game consoles and their attitudes towards them. This research shows that children feel that they are learning from them and find them fun whilst using them in the classroom. It shows a clear link between the home and school use of game consoles, indicating that children who are familiar with them at home find them useful at school. It is acknowledged however, that we failed to explicitly answer the research questions due to a number of limitations beyond our control. The findings may contribute something to the debate or provide some impetus to teachers who wish to use game consoles in their classrooms to motivate and support learning. How for example might games be effectively incorporated into the curricula of European schools? Might there be cultural differences between this UK study and similar studies conducted in other European countries? We might assume that children in other countries will similarly enjoy and learn from playing subject specific games in school, and that underlying psychological principles would apply to all children of a similar age group. Further research might focus on a comparison of the impact game consoles have on boys and

girls in several European nations, to see if there is still a significant gender difference, or whether the gap is closing. An experiment measuring learning and motivation when using game consoles with a control group could be more suitable to discover specific learning gains across and within year groups. This might then demonstrate any impact game consoles can make not only on motivation but also learning outcomes, thereby providing educators with evidence needed to justify their use. It is clear from an analysis of current trends that video games are proving increasingly popular in schools as a technology enhanced method to encourage and support learning. Future research should focus on how games playing can provide the added impetus needed to help children focus on specific kinds of learning, and can motivate them to persevere and be resilient in their approach to study.

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