Console Game-Based Pedagogy: A Study of Primary and Secondary Classroom Learning through Console Video Games

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ABSTRACT

The main focus of this research project was to identify the educational benefits of console game-based learning in primary and secondary schools. The project also sought to understand how the benefits of educational gaming could transfer to other settings. For this purpose, research was carried out in classrooms in Scotland to explore learning with games played on games consoles, such as PlayStation, Xbox, and Wii. Interviews were carried out with school leaders, classroom teachers, and students in 19 schools and followed up by a series of lesson observations in four of these schools. Findings include significant impact on students' performance and engagement, as well as strong support from participating teachers and school leaders.

Keywords: *Console Games, Curriculum, Education, Game-Based Pedagogy, Learning, Mobile Games*

INTRODUCTION

There has been much interest in the potential of console games[1] for learning and teaching in recent years. They are popular with young people—a recent survey carried out for Futurelab showed that 79% of 737 children aged five to 15 played computer games at home alone 'at least a few times a week' (Ulicsak & Cranmer, 2010).

At the same time, a growing number of research studies show that there are educational benefits to be derived from gaming in classrooms and, informally, at home. Playing computer games at school is seen to be one of a number of technologically oriented activities which can overcome what has been referred to as the 'digital disconnect' whereby children engage in rich and extensive uses of Information and Communication Technologies (ICTs) at home but this knowledge and experience is then kept outside of the school gates (Buckingham, 2007).

The Context

In response to these issues, Learning and Teaching Scotland (LTS) (now known as Education

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Scotland)[2] were keen to explore the benefits and possibilities of using console games in schools and to support innovative practices, so in 2006 it established the Consolarium—a game-based learning center in Dundee, Scotland. This center's aims were to:

- Explore the range of games technologies available and in doing so practically and theoretically inform and influence new curriculum developments and approaches to pedagogy;
- Provide a place where education managers and others involved in education could visit and get hands-on access to a range of GBL resources;
- Act as a catalyst to encourage teachers and educators to begin to engage with the debate about the place of such technology in their class, school or local authority; and
- Develop relationships with academic and industry partners to explore and articulate what effective GBL and practice and resources looked like.

This led to a number of LTS Consolarium supported projects in schools in almost all of the 32 local authorities across Scotland. The center has worked with many teachers to adapt or 'retro-fit' commercial off-the-shelf games for nursery, primary and secondary schools. Some examples include Dr. Kawashima's Brain Training and Nintendogs (Wastiau et al., 2009).

The main focus of this project was to identify the educational benefits of console game-based learning in schools. For this purpose, research was carried out in Scottish classrooms to explore learning with games played on games consoles, such as PlayStations, Xboxes and Wiis. The project also sought to understand how the benefits of educational gaming could transfer to other settings.

Scotland's revamped curriculum, dubbed 'Curriculum for Excellence' (Education Scotland, n.d.a), was introduced at the start of the school year 2010-2011. The new curriculum has been designed to ensure that children and young people have a seamless transition through the different stages of their education from the age of 3 to 18. It has been developed around four main capacities, to enable each young person to be a successful learner, a confident individual, a responsible citizen and an effective contributor.

Learning with and about technologies is embedded across all subjects in the curriculum and the ability of computer games to support the development of skills and knowledge has been highlighted. As a result, LTS commissioned this research in partnership with Futurelab. This paper will briefly discuss the area of Game-Based Learning (GBL) through a summary of the literature, introduce the methods that were used for the collection of data, and then report on interviews with school leaders, teachers, and students. These outputs will then be further analyzed to produce a taxonomy of educational benefits of gaming in schools, a summary of the specific challenges and opportunities as raised in the interviews and, finally, recommendations for the further development of educational gaming strategies and policies in the UK (aimed at policy and school leadership audiences).

What do GBL Projects Look Like?

Schools considered the hardware, software and their local circumstances when deciding to use console games and projects were tailored accordingly. Consoles used include the Nintendo Wii, Nintendo DS, Sony PlayStation and the Xbox. The games for these are commercial packages, not specifically designed for school use, but teachers chose games with a learning potential. The desired learning outcomes for the project are identified and various learning experiences are developed around these, with the game fitting in where appropriate to a greater or lesser degree. Teachers identify collaboration, communication, teamwork, motivation or engagement as reasons for incorporating games into their practice, as well as any curriculum specific objectives. A major factor in the success of these projects is the care taken over classroom management and the organization of pupils, resources and tasks.

There are two main models for the use of games in the schools we visited: the context based approach and the focused learning outcome approach; teachers may use both approaches over the course of a year, depending on their needs and circumstances. Whichever approach is used, teachers are reporting gains in terms of pupils' engagement and motivation as well as specific curricular benefits, and often feel these gains are sustained over time.

The 'Learning Context' Approach

Teachers talk of the game as a 'hook' or a 'stimulus' for a rich, often interdisciplinary, often authentic, program of study or 'learning context,' which is built around the game. The game itself is not necessarily the main focus – actual game-play may be as little as ten or 15 minutes per pupil per week and will often diminish as the project unfolds. This is the most common approach and is used in both primary and secondary settings. It sits well with the requirements for Curriculum for Excellence and offers opportunities for active, collaborative and pupil-led learning. Primary schools tend to be familiar with this way of working, and examples can be seen in the case studies, but there are examples in the secondary sector too, both as single subject and as interdisciplinary initiatives. Classroom projects that implemented console GBL varied in scope, scale and focus, but all would generally be described as inquiry- and/or project-based (see Figure 1 for an example of what these projects looked like in the classroom).

TEACHING WITH GAMES: A REVIEW

The vast array of digital commercial-off-the-shelf games provides the opportunity to use them in a variety of educational ways – depending on the nature of the game and the strategy for its use in the classroom (Figure 2). How these games are designed, as well as how they are implemented in the classroom, can be organized as to how they relate to learning theory (Egenfeldt-Nielsen, 2006; Kirriemuir & McFarlane, 2004):

Behaviorism: A view of learning most well-known for B.F. Skinner's work on "operant conditioning" where rewards reinforce desired behavior. Games designed on this learning principle generally present the player with a task or skill to be repeated until mastered or conquered, receiving rewards after attainment. Those games considered drill-and-skill edutainment often fall into this category. Since these tasks are extrinsically motivated, learning is seen as transmission rather than construction (Good & Brophy, 1990). As such, the critique of this type of game is that it is considered training, rather than the acquisition of deep understanding or skill content – leaving opportunity for learning transfer unlikely.

Cognitivism: In this learner-centered view of learning, the individual actively constructs their understanding in learning experiences. Albert Bandura is most recognized for helping shift the understanding of individuals from being externally influenced to self-organizing, proactive, self-reflecting, and self-regulating. Discovery and inquiry-oriented games fall into this category, where learning and play are integrated to provide a context that allows for the active construction of knowledge. Intrinsic motivation is more often associated with these games, with problem solving as one of the key meta-skills employed (Egenfeldt-Nielsen, 2006).

Constructionism: Akin to the cognitivist perspective, this theory largely developed by Jean Piaget places emphasis on the external tools used to construct knowledge and that human development derives from the interaction of their experiences and their ideas. The gaming and simulation platforms such as StarLogo and Scratch most embody this learning theory

Social-Cultural: Over time, theorists began to integrate perspectives into a more holistic

Figure 1. Example of console game-based learning from this study

Guitar Hero: Piloting a Console Game-Based Learning Project

With support from the LTS Consolarium, a primary school in northern Scotland embarked on creating a project around the game Guitar Hero. After receiving the borrowed game, console and guitars, the Primary7 class (students approximately ages 12-13) was introduced to Guitar Hero – first through several class periods of free play to get used to the game. Game play was then built into a weekly rotation and the class began building the project context – students took on the persona of rock stars, created a virtual band called Full Moon, and began the first Design & Technology project of creating their own guitars (designed to scale) using cardboard and other various materials.

The Primary7 teacher helped the students set up a guitar shop, charging students with the task of writing adverts to sell their guitar—which placed emphasis on developing persuasive language. The class was able to keep extending the storyline into classroom work in numerous ways. For example, after attending the Choices for Life event in Aberdeen where live DJs play, the class decided to build on the notion that Full Moon had played this event and wrote full newspaper reports describing the show. Students wrote and performed Full Moon's first single using musical instruments and as a result of their curiosity about the nature of sound, embarked on a full science investigation of the topic.

The class even incorporated drama into the project, recreating the Brit Awards. The teacher designed the next phase of the project and student groups researched a country that was included on tour, writing letters back to UK fans telling them all about Full Moon's time in each country. At this point, the project was no longer teacher-led but student-driven.

The students next decided they needed a band website, which ultimately posted biographies and reports from their concerts in Paris and Brussels. Pleased with the website's design, the class decided that its launch needed to coincide with the release of the single, and they would need to do an advert for the TV—which they created with a start-stop animation using Plasticine figures. Overall, the school was very excited by the outcomes and impact of this pilot, and encouraged to consider this pedagogy further.

theory, and social constructivism brought together the work of Lev Vygotsky, Jerome Bruner and Jean Piaget. This perspective views learning not as the acquisition or construction of knowledge, but rather the 'tool that mediates activity'. In this way, learning is considered to be 'situated' and inherent in nature to the social activity in which it is embedded (Egenfeldt- Nielsen, 2006). Example titles include Civilization and SimCity. The rich social context that surrounds this game-play is considered to be one of the greatest aspects to GBL and as a result, the game is the tool that creates a viable learning experience.

Looking at digital games through these lenses is useful for understanding why and how they may be implemented in learning environments.

For many games – particularly those not intentionally designed for educational use – much of the learning experience resides beyond the boundaries of the game. More research is needed in order to understand the richness that is embodied by the socio-cultural dynamic that can be generated by GBL. However, one example of an effective pedagogy is present in the use of external notebooks and learning logs that can accompany the game-play. In studying classroom use of the PC game Global Conflicts: Palestine, researchers found that students using paper and pencil were able to use these tools to actively construct their knowledge in the game, and the artifact could then be used in other areas of teaching (Buch & Egenfeldt-Nielsen, 2006).

Figure 2. Types of implementations of games as learning systems

Games as learning systems
Games as authoring systems (generating artifacts) – Using games to construct an artifact, for which a rubric can be generated to assess the learning and skill development of each learner (such as building a city in SimCity or a creature in Spore).
Games as content systems (content) – The game provides specific content to help deliver understanding in that curriculum area (such as marine life in Endless Ocean or urban planning in SimCity).
Games as manipulating systems (simulations) – Some games create dynamic, complex systems in which the player can interact with and test the principles of these systems (such as building working rollercoasters in RollerCoaster Tycoon and trying physics-based theories with Soda Play).
Games as trigger systems (content) – Games can be used to create a scenario or experiential context for understanding around a topic, issue, or principle that a teacher can build on; in this fashion, the game is the theme upon which classroom enquiry is built.
Games as gateway systems (learning technology) – In this way, the focus is the technology and providing learners with the opportunity to learn a specific platform or how to use a specific device (such as learning how to use game-authoring tools like Scratch or how to use a mobile device like a Pocket PC).
Games as reflective systems (illustration) – Teachers can use the context for decision-making and as a way to discuss why decisions were made in a certain way, or other reflective aspects of the game.
Games as point-of-view systems (perspective) – By taking on an avatar and new identity in the game, a teacher can use the game to develop perspective in students and ask them to re-play the same scenario choosing different avatars and roles to gain an understanding of different perspectives.
Games as code systems (programming) – In this context, writing is the primary mechanic and artifact of game-play, which can then be assessed to capture student understanding.
Games as documentary systems (documentary) – Games can be used to document evidence of student ideas and understanding. For example, storyboarding with screenshots can be used to capture the details of a game situation, which then can be used as the basis for additional discussion or reflection.
Games as ideological systems (text) – Rich game scenarios can be "read" as texts that express certain underlying ideologies, values, beliefs, etc. Games used this way can provide students with opportunities for reflection on and discussion in spaces external to the game.
Games as research systems (research) – Research skills and methods can be taught in scenarios where students are tasked with designing games and are required to consider what players will be learning from their games, how this affects credibility and point of view, etc.
Games as assessment systems (evaluation) – Certain games afford the opportunity to use the game as an environment where learners can demonstrate their understanding (such as successfully playing Quest Atlantis to demonstrate acquisition of certain science concepts).

The TEEM report found that one of the primary uses of games in today's classrooms is to stimulate discussion, writing and collaboration. Many educators use games as the core within a wider set of activities relating to the context or subject under discussion (McFarlane et al., 2002). However, many games are rich, immersive worlds, which can be used in various ways as 'learning systems'—such as drawing on the games' content-generating aspect or by building classroom structures around the game, such as reflection and discussion, using the game as the context (Figure 2).

The Importance of the Teacher

Teachers are also consistently found to be critical components in effective GBL. Where the game is just the tool, the teacher is essential to effective implementation of the game through direction of the learning approach, discussion and debrief, and the support in construction of the social learning culture that surrounds the game-play. However, this does not always come intuitively and often educators need support in understanding how to ensure that the use of

games in class is effective (Sandford & Williamson, 2006; Pivec & Pivec, 2009).

Strategies for Effective Game-Based Pedagogy

The strategies offered by games as depicted in Figure 2 are quite diverse and play out differently in classroom practice. However, there are some central strategies that promote successful implementation of games for learning in the classroom.

A recent Futurelab report, *Teaching with Games: Using commercial off-the-shelf computer games in formal education* (Sandford, Ulicsak, Facer, & Rudd, 2006), provides several suggestions for teachers and schools, including:

- Be clear about the learning objectives that learners are intending to achieve over the course of the work.
- Use games as appropriate: they do not have to be used in their entirety in order to achieve educational goals and stimulate motivation. Certain game aspects can be extracted or isolated from the game as a whole.
- Allow for sufficient time for both you and your students to become familiar with the game.
- Reflection time must be purposefully structured into lesson plans and class time, as well as contingency plans set aside for technical issues.
- Encourage students to be the trainers and leaders in implementation of the game; they will be the experts in the game rules and content, and taking this leader/educative role helps generate the 'community of learners' dynamic in the classroom—critical to creating a culture of enquiry.
- Teacher support is essential—from technical staff as well as other teachers working with GBL.
- Greater flexibility in timetabling and lesson organization can be helpful in supporting teachers to explore the full potential of working with games over longer periods of time.
- Encouraging a larger culture of collaboration and providing the means to support professional collaboration with peers is critical to supporting the growth of a larger GBL culture in the school.

Additional successful strategies noted by others include engaging students in collaborative play in pairs and in small groups, followed by whole-group discussion (Klawe & Phillips, 1995).

Evaluation and assessment also need to be able to capture the richness of the learning experience; this means allowing students to demonstrate learning outcomes through essays, presentations, multimedia artifacts and portfolios (Gee, 2004).

Challenges to Game-Based Pedagogy

Practitioners and researchers have cited several barriers to fitting GBL into the classroom including short lessons, physical space, and variations in game competence among students, installation, costs, and teacher preparation time (Egenfeldt-Nielsen, 2006). Obstacles to GBL most frequently cited (adapted from Kirriemuir & McFarlane, 2004; Klopfer et al., 2009) include:

- The challenge for teachers to identify how a certain game would connect to the curriculum.
- Difficulty with integrating the play of the game into the time structure of the day, often in 45-min classes.
- The challenge for teachers to identify the accuracy and appropriateness of the content of the game.
- Irrelevant or distracting content from the game that could not be removed.
- The challenge in persuading other school stakeholders to the value of the game in the classroom.

- Lack of available time for teachers to learn the game and generate best practices with it.
- Lack of specific training and support on the effective use of games in the classroom.
- Traditional assessments do not often align with GBL, so new models and approaches must be considered.

From a general perspective, the 'grammar' of games – the structure and modus operandi of games – is often in direct contrast to the classroom environment, where the spirit of play is uncomfortable in many classrooms. Likewise, there is a rub in logistics of game-play with a traditional 'linear' curricula where learners are progressively exposed to topics in each discipline (Klopfer, Osterweil, & Salen, 2009).

Supporting Teachers and Effective GBL

For traditional schools, console games as well as game-based pedagogy are distinct innovations to be accommodated. Such innovations have considerable challenges and barriers and often need certain supports in order to go beyond the successful implementation of the lone teacher and become effectively adopted by a learning environment (Kirkland & Sutch, 2009; Groff & Mouza, 2008).

Teachers are indeed the key to effective game-based pedagogy. The opportunity for generating authentic, rich tasks in powerful learning environments is highly contingent upon the teacher's capacity to harness such environments successfully (Smeets, 20005); teachers will require training and support to do this effectively (Robertson & Howells, 2008). As such, supporting teacher growth in practice is critical to a sustainable and enriching use of GBL in a classroom, school or education system. Howells and Robertson (in press) observe that there are elements of risk for teachers in adopting the use of computer games in their classrooms, and for some this new medium takes them beyond their pedagogical comfort zone; but the evident/increased engagement, motivation and wealth of learning opportunities on offer should place an imperative on the education community to rise to the challenges involved. Teachers have demonstrated their need for peer support, as some GBL researchers are finding that teachers are organizing themselves into communities of practice—using online collaboration and social networking to share insights, resources and supports for being successful with GBL (Joyce, Gerhard, & Debry, 2009).

Console Games

Interestingly, the use of console games in an educational context has been much different than the rest of the digital game spectrum, with their use being generally less pervasive and the methods on *how* they are used being much different as well. While many of the arguments and evidence discussed here have either included console games and/or are connected through games that have been created for game consoles, research directed specifically at the use of console games in the classroom is limited. However, initial studies of the use of brain training console games have demonstrated positive effects; for example, a study of 71 primary school children (10–11 years old) which examined the effects on mathematical computation and self-perceptions after a ten-week period using console-gaming, demonstrated significant gains in both skills as compared to the control group (Miller & Robertson, 2009). A larger-scale (634 students) follow-up study to this was conducted using a brain-training console game, which found that while both the control and treatment groups showed considerable gains, the treatment group demonstrated over 50% greater accuracy and twice as fast response times (Miller & Robertson, 2011).

The popularity of console and handheld games in recent years has tended to "redefine the nature of games, opening up the possibility for new kinds of games in the marketplace and putting powerful and inexpensive platforms in the hands of tens of millions of people," (Klopfer et al., 2009, p. 8). The affordability and low-technical barriers to console games, as well as the portability of handheld consoles, have put

video gaming in many of the homes of today's learners. This ease-of-use has also led to lower barriers to implementation in the classroom (Faux, McFarlane, Roche, & Facer, 2006).

Future Directions for Understanding GBL

While the research into GBL shows some positive results, leaders in the field have noted that studies conducted thus far leave a margin of skepticism due to lack of control groups, researcher bias, weak assessments, short exposure time, and individual adaptation to learner needs (Egenfeldt-Nielsen, 2006; Magerko, 2008). Further research is required that accounts for these variables and which better examines GBL, and the various approaches to it, directly against other traditional pedagogies and teaching styles.

As noted earlier, given the popularity of games and the potential for learning that this may present, considerably more research is needed to understand the nature, effects, strategies and outcomes of this pedagogical approach.

Summary of Literature Review

The burgeoning field of GBL has demonstrated considerable effects on learning and classroom practice. The opportunity afforded by many games is summarized by Klopfer et al. (2009, p. 1):

"...game environments enable players to construct understanding actively, and at individual paces, and that well-designed games enable players to advance on different paths at different rates in response to each player's interests and abilities, while also fostering collaboration and just-in-time learning."

Many games have been shown to be robust educational tools—both inherently by their design as well as their effective implementation in the classroom. Thus far, research on the impact and outcomes of this pedagogy is somewhat limited but promising. Further projects and evaluations are needed to provide the support needed to encourage more teachers and schools to adopt these practices, if indeed the early results are to be confirmed in further studies. Additionally, further analysis of effective classroom strategies and pedagogies, as well as effective external supports for GBL, are needed to make this innovation scalable.

METHODS

Given our research questions – to identify the educational benefits of console game-based learning in primary and secondary schools – it was decided to adopt a multi-method qualitative approach in order to study GBL within its typical contexts, schools and classrooms. Initially, two researchers visited 19 schools (i.e., one nursery, ten primary, eight secondary) to carry out interviews with school leaders, teachers and students (ages five to 16) followed by return visits to four of the schools to undertake detailed classroom observations. All visits took place between April and July 2010. Table 1 shows the number of participants in each category.

The schools were selected in association with the LTS Consolarium on the basis of whether or not they had recently undertaken a GBL initiative. As the focus of the project was to investigate the benefits of games for education and learning, it was decided only to visit schools where such initiatives were underway and could be explored. This led to the slight dominance of primary schools within the sample where more GBL approaches were

Table 1. Description of sample

School leaders	Teachers	Students
19	48	150

reportedly underway. The schools selected for return visits were chosen according to several criteria, which included the range and richness of the initiatives underway combined with the practicality of whether such programs of work were running when the researchers were available to visit. The selection was also influenced by whether the school could accommodate the researchers given that the summer term was drawing to a close and school trips and other activities were underway. Unfortunately, we were unable to identify a secondary school for a return visit due to timetabling issues and the fact that secondary schools were using GBL approaches much less in general. This highlighted a general problem, also reflected in the data, that it is much more difficult to sustain GBL initiatives in secondary schools, mainly due to the organization of the curriculum.

Using a multiple method or 'triangulated' design was intended to highlight the different dimensions of GBL from the different perspectives of school leaders, teachers and students. This allowed for the validity of the findings to be strengthened by the corroboration of data collected in a variety of ways (Rosenblatt & Fischer, 1993). School leaders and teachers were interviewed individually and group interviews were carried out with students mostly in clusters of three or four. Semi-structured interviews were conducted to allow respondents to talk about their own perceptions of GBL, raise their own issues in relation to this and explain their viewpoints in their own words (Copeland & White, 1991). While the interviews covered a range of questions and topics related to this GBL, this paper will specifically discuss the findings on: (1) the impact on pupils, (2) the impact on teachers, and (3) the changes to practices of teaching and learning.

Observational data was collected to ensure that GBL could be explored in situ and also to counter growing reservations about the reliability of self-reporting in interviews (Buckingham et al., 2005). Questions were designed to explore the benefits, opportunities and challenges posed by GBL approaches in classrooms, the impact on teaching and learning, the organization of the curriculum, and the activities themselves.

KEY FINDINGS

Each group of interviewees – school leaders, teachers, and students – shared several key themes in regards to the impact of this work on student learning, teacher performance, and teaching and learning practices. These findings are summarized here.

Summary of Findings from the Interviews with School Leaders

The majority of school leaders viewed these projects as highly successful and were enthusiastic about their impact: "I've never been so convinced about the way forward with things. My absolute dream is to have a games console in every class permanently." Success with GBL was repeatedly linked by senior leaders to the pedagogical skill of the teacher involved. The game was often described as the hook or the stimulus and was never an end in itself.

Interestingly, some games/projects at times were not seen as successful—such as implementations of Brain Training. However, based on feedback from teachers, this may be a result of the approach and methodology taken by the teacher in those specific projects.

Successful projects provide rich and realistic contexts for learning and embody the principles of Curriculum for Excellence. The principles of active learning and AifL (Assessment is for Learning) also sit comfortably and many projects offered realistic enterprise opportunities. Projects could also provide a relevant purpose for using Glow (the national Learning Management System). Greatly increased motivation, engagement and enthusiasm were strongly identified as benefits, as well as social interaction, problem- solving, communication, cooperation, collaboration, planning, responsibility and increased confidence and self-esteem. Improvements in writing and numeracy skills were regularly mentioned. Opportunities arose for multisensory learning and provision could

be made for a range of different learning styles. Pupils and teachers learned alongside each other and pupils often had opportunities to lead the learning, as well as becoming more independent learners themselves. Some secondary schools in particular have reported improved teacher-pupil relationships. Leaders have also noted some improvements in classroom practice, in both primary and secondary sectors.

Impact on the Pupils

The stories of enthused, engaged and highly motivated pupils were manifold: pupils who had been reluctant to come to school turning up at 8.30am to rehearse; pupils who rarely wrote more than a paragraph writing at length; pupils who never did their homework bringing in the fruits of their research unprompted; pupils who found group work impossible blending in to group tasks and even supporting others; pupils with behavior problems settling down; summer term P7 pupils on task and inspired. One primary headteacher reflected the views of many of the school leaders when he said, "As a motivational tool it has been unsurpassed...these kids are learning without realizing."

School leaders agreed that it would be difficult to attribute all of these things directly to the use of the game itself, but they strongly felt that there was a connection. Leaders also drew attention to the fact that children actually spend very little time using the game, quite disproportionate to the motivation it provided. There were accounts of hierarchies being flattened, as less academic and under-confident children increasingly demonstrated their game skills with confidence and self- esteem growing through natural peer-tutoring opportunities afforded by the game.

Where Wiis and PlayStations were being used, children were initially distracted by the game but this soon wore off as it became a familiar part of classroom life; children tended only to be drawn in when something exciting happened or when they saw that a problem had arisen. These interventions were brief and seem to impact little on the wider work of the class.

Impact on the Teachers

Repeatedly, school leaders said their teachers had been enthused just like the pupils. One teacher took a game console home for the first time and the headteacher noted: "She came back in buzzing, just full of ideas." Teachers have eagerly developed rich projects around these games and have felt rewarded as the projects have progressed. One headteacher felt the additional creativity of these projects gave teachers extra motivation.

For many leaders, the professional discussion that arose from these projects was vital; teachers were thinking about what they were offering and are talking about the impact; in secondary schools this was making important connections across departments. In more than one instance, leaders saw an improvement in teachers' classroom practice.

Where a teacher had not been so keen to be involved, school leaders note that an element of peer and pupil pressure could add impetus to the development of a project, particularly in an open plan school. With regard to any teacher adopting new practices a secondary head commented: "I think you do have to recognize that not everybody will be at the same place at the same time."

Changes to Practice in Learning and Teaching

Interestingly, in many cases the actual game was often used very little in comparison to instructional time—often just 10-20 min per week, per student. Senior leaders were keen to clarify the role of the game, as one primary headteacher explained: "It's a tool, it's very much a tool, it's not an end product, it's a tool to engage children in learning." The game was the hook or the stimulus, both for the learner and, in many cases particularly at primary level, for developing a rich and wide learning context.

In some secondary classes the game provided a particular focus in one subject (e.g., math or French) but it was still valued as a hook or a stimulus for learning.

In the majority of schools visited, any changes in learning and teaching were attributed to the introduction of Curriculum for Excellence and the development of active and interdisciplinary learning rather than GBL per se, although many have commented how well GBL sat within the new frameworks and approaches: "This has come along at the right time...our staff have a lot of freedom to be innovative and creative – [Curriculum for Excellence] has helped to open up the topics and give more of a rich interdisciplinary element."

GBL gives teachers the opportunity to let the children take a lead with curriculum planning and activities and teachers have often found themselves in more of a supporting role. A primary headteacher reflected "Historically teachers have been the planners, facilitators, have done everything...some teachers' still want security of certainty, but are beginning to be able to respond in a more flexible way." A secondary head echoed this change: "It's more active learning for the youngsters so the teachers need to teach in a different way. It's less didactic."

School leaders were impressed by their teachers' willingness to learn from the pupils: "Staff not being scared to say 'Oh, show me how to do that.'" They have noted that although this took some teachers out of their comfort zone, they were willing to take that chance and have reflected positively on the experience. One secondary head said of his staff: "We now have more staff who are quite confident at not being competent when it begins ... because they know that there'll be a kid there that will help them."

Developing the role of the teacher is vital to the success of GBL, as one primary headteacher observed: "You can put children on to use games and play games but unless the teacher has an understanding of how to develop the thinking and learning, it won't have any benefits."

Summary of Findings from the Interviews with Classroom Teachers

The teachers interviewed range from Nursery to S5, and from the newly initiated to those who have been using console games in teaching and learning for three years. The great majority were very enthusiastic about the impact of GBL on their pupils and on their practice, and whilst they cautioned against overuse, they felt it currently had a valid place within Curriculum for Excellence.

Impact on Students

Regardless of approach, the words 'motivation,' 'enthusiasm,' 'engagement' and 'fun' came up time and again in response to questions about the impact of GBL on pupils.

- "The kids just adored it... the motivation level was really, really high"
- "I do think you get youngsters engaged... and although they're only using the game for a few minutes, it's enough to motivate and capture their interest."
- "The children love it. I think that using the console just gets them so excited about their topic."

It would seem that these elements of motivation, engagement and fun are a crucial part of the success of the games projects – the children get hooked into wider learning opportunities because they find the game experience itself so enjoyable, with rewards for pupils and teachers alike.

Teachers identified many benefits relating to teamwork and skills for life, including problem-solving, communication, collaboration and negotiation, which were observed in various ways by teachers:

- "...they were working together, which was so great, they were discussing things and pointing out things and noticing things

and supporting each other's decisions and things. So I'd say like role-wise, they became a bit more appreciative of other people's ideas...they were actually coming up and telling me and they were definitely working well together effectively, sharing things, making decisions, a lot of critical thinking was going on as well," P4 teacher.

- "And it was the children who actually organized it themselves... they were dividing their tasks up into you find out about this and we'll do that," P7 teacher.
- "I saw the 2s really using their skills and their language abilities of persuasion and just the way that they were mature enough to negotiate. On the whole, there was the odd one or two that didn't get on but, on the whole the 2s were very good organizers and they made sure the task actually got done," P1/P2 teacher.
- "It sort of developed that resilience in the children as well and the problem solving and trial and error, 'Give it a go, oh it didn't work, let's try something else, how could we change it to improve it?' " P4 teacher.

The team work and opportunities to support their peers often brought unexpected children to the fore, children who were not usually seen as the leaders or achievers, children who were normally shy or children who previously found it difficult to work in groups. These new roles and unexpected successes added to the confidence of many children. An indicator of this was given by a principal teacher: "He doesn't just want to do the tasks that I'm setting him, he's then gone off and become an independent learner." Many teachers described that children are teaching each other, both within the class and as buddies and mentors coming from other classes and schools.

Many teachers spoke of the impact on pupils' writing – their willingness to write, the length and the quality of their writing, particularly for boys. One chartered teacher commented: "It really transformed their writing." The number of Level D passes (Level 4 in England, Wales and Northern Ireland) at P6 has risen markedly in one school, attributable at least in part to a contextualized approach to games. They were suggesting that it was the game, combined with the rich learning context, which provided the stimulus and sense of purpose that might be lacking in some other writing tasks.

The authenticity of the context provided by the game was often commented upon as having a very positive impact on the pupils. They were taking on 'real' identities as rock stars or racing drivers, they were looking after 'real' pets with 'real' needs and managing 'real' budgets in order to make a profit or purchases, so the learning took place in a context that they were committed to in role and could make meaning of through their adopted personae or pets. As a result, the writing was more enjoyable, the math made more sense, and the children felt they had 'real' reasons for doing these tasks.

Boys and girls enjoyed the projects in equal measure, despite some initial reservations on the part of their teachers about gender-biased content that favored boys (FIFA World Cup, Mario Kart). A P7 teacher was delighted to see two highly skeptical girls becoming skilled and enthusiastic players, who ultimately engaged well with the wider football project and the related international study. But another P7 teacher cautioned, "I'm not so worried about the girls now, but I'm very aware when we're doing an activity that it must be wide enough to include them." By contrast, games such as Little Big Planet, Endless Ocean or Gardening Mama might have a more immediate appeal to girls; teachers should give careful thought to the software choices they make over time and to the nature of associated activities, to ensure that both girls and boys can relate to them and gender stereotypes are not reinforced.

Concerns about the game distracting learners proved to be largely unfounded. The initial excitement soon settled down, children got used to their new routines and they generally ignored the game-play area unless something particularly exciting happened (like discovering a whale, or the drama of 'race day'). Where necessary, teachers have rearranged furniture,

rotated seating plans or set up a screened area in a corner of the class to minimize distraction.

Impact on Teachers and Teaching Practices

Participating teachers have indicated they valued participating in the projects as much as their pupils, due in no small part to the enjoyment and motivation they saw in the children. Many also described the authenticity factor as being highly valued: "Give me a context that you could teach children about budgets that's no' dead boring...it's real life learning, but it's in a context and to be honest they don't actually realize that they're learning about it."

Teachers found that their role was changing in various ways. A secondary teacher enjoyed the chance to interact more with groups: "It meant I was up at the board a lot less, and I was doing a lot less talking to whole group, I was more focused on smaller groups and seeing how they were getting on and that was quite nice as well because I don't really get to do a lot of small group work." This has now influenced her wider practice. A P1 teacher also noted: "It has changed me as a teacher because I see myself far more as a facilitator."

The change in role wasn't always comfortable but it was felt to be worthwhile, as a secondary teacher reflected: "I just took a back seat and so it [the learning] was completely active...I mean I had a totally hands off role... It was quite scary...but I soon realized that they were managing fine. As soon as they understood what their goals were, they were off...it's definitely changed the way I'm going to be teaching."

For the great majority of teachers the overall experience was positive. Very few teachers felt any reluctance to take part and in this study only one seemed to have really struggled to enjoy it, though even then her children's enjoyment was recognized. She explained, "the children have thoroughly enjoyed it and more so because of the Nintendo Wii," citing that she felt rather swept along by a powerful new initiative that she didn't understand.

Summary of Findings from the Interviews with Students

The overall student perspective on console GBL in the classroom was a positive one. Many students reported that the overall project associated with the game was 'very fun'—often noting that it was a more fun way to learn math, writing, or whichever associated content/skill. While the enjoyment described by students referenced the game play, it was the associated curricular work and learning that most excited them. Of all the positive aspects identified by learners to console GBL, the most critical was the impact on learning and concepts and topics were explored more deeply because they were connected through the project theme. Many students described a range of perceived educational benefits, including increased collaboration, creativity and communication. Also, just as the teachers have described, impact on writing for many students has been one of the most dramatic outcomes of many console GBL projects. Many students are quite aware of the impact it has had on their writing as well — not only in level of enjoyment, but in quantity and quality of their work as well.

Some students noticed the impact this pedagogy had on their role in the classroom. In many of the larger theme-based projects where the game is used as the storyline or the theme upon which all inquiry is built, teachers and students explained that over time the direction of the inquiry is co-developed as a class, based on students' interests, questions and areas of momentum in the content. Other students explained how the GBL project they encountered contrasted with their traditional classroom activities, placing more emphasis on their role, and activities are often more student-driven and directed. Students have more say in the direction and progression of the learning and tasks, but teachers carefully guide the facilitation of this by balancing the curriculum and learning goals with student interests and motivations.

There were also negatives described by students, including that some found aspects of the projects repetitive, while some were also

distracted by students playing the game during their work time.

DISCUSSION

From the interviews, observations and classroom analysis, it appears that GBL can have a powerful impact on both pupils and teachers. Some teachers have come to it not really knowing what they were trying, and very few are game-players themselves but, having tried it, teachers view it as a highly effective tool for learning and want to add it to their repertoire.

Overall, school leaders responded very positively in regards to the potential and impact observed thus far by GBL initiatives in their respective schools. Outcomes observed in students included the development of confidence and self-esteem, and increased motivation, enthusiasm and peer-tutoring. The observed impact on teachers included increased enthusiasm, change in teacher role and pedagogy towards a more constructivist, student-centered approach. Assessment at the primary level was often integrated into the projects built around the game theme; however, some secondary head-teachers expressed concern around the need for better assessments in this approach to teaching and learning. Leadership emphasized the need for risk-taking, supporting pioneer teachers, internal and external support and training for the GBL initiatives to be successful. Likewise, professional collaboration and sharing as well as parent communication tended to be key areas of focus.

School leaders are adopting and embedding GBL, as one primary head observed: "... we're aware now of the learning potential that is there, so we'll use it." Schools are developing new projects and making sure existing ones are rigorous in terms of experiences and outcomes and continuing to be relevant and fresh. In some cases schools are planning to assess impact more closely, notably with Brain Training but also writing. They are looking at the timing and distribution of projects across the school and thinking about breadth and progression as well as the issues of composite classes and transition. Some schools plan to give more information to parents at the start and change how and when they involve parents in open events to ensure a good turnout. Leaders are working to stay informed and keep abreast of developments and in some cases schools are setting up development groups — staff are being sent on training courses or working alongside more experienced teachers. Leaders are asking staff and children to reflect and feedback, and are consulting them about next steps. Leaders are also looking at resourcing.

For many of the teachers, once they had completed one GBL project, they sought opportunities to participate in other GBL projects and to find other ways to incorporate games into their curriculum. In many cases teachers are beginning to plan for continuity and progression in GBL across the school and even across school boundaries, where transition projects are involved.

Where there are teachers looking for new games to include, those in the early stages often feel there are not enough suitable games for infants, and in secondary schools some subject teachers, for example in chemistry, have been unable to find a game to use despite being extremely keen to add GBL to their repertoire. Teachers of children with additional support needs have also indicated that there is little choice of games for children at the lowest levels of achievement, though they continue to look.

Where teachers have used a focused outcome approach, they are planning to develop tests that will allow them to gain additional information about the pupils. Additionally, many teachers are planning ways to share practice within the school, including working with staff to try small projects, providing materials, organizing training sessions and using pupils as trainers and supporters.

Overall, students were very positive about GBL—not only with the game play itself, but even more so the learning and activities that were built on this approach, commenting on the increased connections in learning, greater collaboration and teamwork, and the student-driven

nature of the projects. Students also reported a perceived increase in understanding the various content areas explored through GBL, and other benefits such as increased concentration, focus, creativity, communication, organization, and so on. Some students commented on their observations of how this impacted their learning, their ability to learn, and their capacity as a writer.

When asked about how this approach compares to their classroom learning experiences to date, students were highly enthusiastic about console GBL and felt it was a refreshing addition to the learning experiences that they are presented with in school. Many of the reasons for this are the aforementioned attributes of the game and the project design, which for many students, were seen to be in contrast to traditional pedagogies. Most students responded that they greatly prefer this methodology to others used previously in the classroom; while at the same time advocating that it be used in balance with other approaches.

Taxonomy of Outcomes

The shared themes of educational benefits in this study, drawing on the perspectives of the school leaders and classroom teachers, have been aggregated into the following taxonomy (Table 2).

What this Suggests of Console Games

This study specifically focused on the work of the Consolarium—a Scottish organization specifically devoted to the use of console games in the classroom. What largely differentiates this genre of games from other GBL is the manner in which it was employed in the classroom, and the use of the game as a pedagogical tool. Whereas many of the games used were not specifically designed for educational purposes, and in some cases arguably offered little if any educational value (such as Mario Kart), the clear consensus of the participants in this study is that the games served as a motivational hook and context upon which the teachers could build powerful learning experiences. We know from considerable research in the learning sciences that not only is such a hook to be engaged and motivated by critical in order for deep, meaningful learning to occur, but so is having a relevant context in which the content, skills and principles the learner is engaged with can be cognitively attached to so that the experience is grounded and relevant for retention of learning (Bransford et al., 2000; Brown, Collins, & Duguid, 1989). The findings of this field-based research demonstrates a reinforcing loop of the findings of the learning sciences, confirming our understanding that with the appropriate hook and context, meaningful learning experiences ensue.

While there have been notable successful implementations of commercial-off-the-shelf (COTS) games in education, there is a commonly cited tension often described between the viability of commercial games in the classroom, as they were not intended for that use. The Consolarium's use of console GBL is a noteworthy example of where that tension was not a barrier. In one sense, that is liberating for educators who no longer need to feel dependent upon external products and developers to leverage digital tools for their students' benefits. In this way, there is a shared goal between the game developers and the educators considering using this pedagogy—to create a motivating and engaging game that has a context that hooks kids.

The real barriers to implementation of this pedagogy in today's schools are the attitudes and beliefs of education stakeholders – teachers, parents, school leadership, policy-makers, etc. – that create a culture where it is challenging for educators who would want to try this, to feel like they have the space, time and opportunity to do so. For headmasters and school administrators who are encouraged by this research, we advocate they seek to create a culture where the use of games is not stigmatized and teachers can collaborate and discuss the benefits of using this type of pedagogy in their classrooms.

This is of note for policy-makers as well, as is the emphasis for creating curriculum structures that advocate for this type of interdisciplinary, project-based enquiry, where the game

Table 2. Taxonomy of educational benefits of gaming drawn from the data

School leaders and classroom teachers	
Benefit	**Description**
Active learning	GBL can promote active learning in students, where teachers plan for it
Authentic learning contexts	Game-based activities provide a context for learning which is meaningful to students and young people
Closing the culture gap	GBL has the potential to tap into students' own culture and interests and narrow the gap between home, school and elsewhere
Collaboration and social interaction	GBL can promote collaboration between teachers and students; and between students and their peers
Communication and cooperation	Games provide the opportunity for students to communicate with each other and to work in teams whilst organizing themselves to complete projects
Critical thinking	GBL absorbs students and this leads to thinking more critically and engaging more deeply with activities
Digital literacy skills	Familiarity with games and other ICTs, particularly supported by peers and teachers, can enhance digital literacy skills
Engagement and motivation	Games engage students and building activities around them can provide a good platform for learning
Improving relationships	GBL can improve relationships between teachers and students because teachers may need to rely on students' knowledge and this can break down formal barriers
Increased confidence and self-esteem	Engagement in GBL can help students to develop confidence generally, and with ICTs in particular, and improve their self-esteem more widely
Increased teacher motivation	Teachers have become enthusiastic and full of ideas about how to creatively design learning activities around games
Interdisciplinary learning	GBL has the potential for work that allows for integrated and connected curricular activities, which span the breadth of the curriculum
Leveling	Students who are not usually seen as leaders or achievers can find new roles and positive affirmation, particularly if they are skilled games players and can contribute this to the group
Literacy and numeracy	GBL can improve numeracy skills and literacy skills – pupils particularly like reading on the screen compared with texts and GBL environments help students generate content for their writing
Responsibility / independent learning	Carrying out games related projects enables students to have the opportunity to plan their own work and take responsibility of their learning
Preparation for the future	GBL can help prepare students by giving them confidence with ICTs, and more specifically, prepare them for education and work particularly in areas of Scotland where game design acts as a major employer
Problem-solving and trial and error	GBL can help students to understand how to identify and solve issues and problems. Also it helps students to understand that sometimes you have to try out different things before you can find a solution
Pupil-teacher roles	GBL activities allow students to drive their own learning, increasing teachers' confidence to facilitate and support their students – building on students' own skills and knowledge of games – rather than being more didactic
Resilience	Game-based activities can develop resilience in students as they negotiate their failures within games and try again. They appear to transfer this resilience to other activities

served as the context upon which it would take place. Our interviews with teachers and senior leadership repeatedly reinforced the notion that part of the great success of this initiative was due to it's timing—it coincided with the introduction of the new national curriculum in Scotland, named "Curriculum for Excellence." This curriculum (similar to district and national standards in other contexts), identified the core skills and knowledge of the disciplines, but organized how them in a slightly different way be placing emphasis on more "meta" themes that should direct the construction of learning experiences in actual Scottish classrooms in order to achieve the objectives of the Scottish curriculum; these themes were framed as overall competencies and capacities to be developed by each student (Education Scotland, n.d.b):

- Successful learners
- Confident individuals
- Responsible citizens
- Effective contributors

CONCLUSION

It is clear from the data that console GBL presents an opportunity to engage students in activities, which can enhance their learning. Like any successful pedagogy, outcomes need to be well planned and classrooms carefully organized to enable all students to engage in learning. What is notable about using games for learning is the potential they have for allowing many children to bring their existing interests, skills and knowledge into the classroom and then use games as a hook or stimulus to build the activities for learning around them. In many ways these findings reflect those of earlier media education programs, which sought to capitalize on children's own interest in television and film and build activities around them. It also demonstrated that teachers are developing their practices as a result of engaging with console GBL (e.g., allowing pupils to lead, learning from the pupils, etc.).

What is not clear from the data is how far the aims of media education that included helping children to understand narrative, representation and audience are migrating to GBL in schools. What comes across more strongly in the data provided is that students value the opportunity to play console games and teachers are using this enthusiasm as a motivator for teaching and learning. Future works could include longitudinal analysis of games used in classrooms, to mitigate the novelty effect.

Console GBL is not without its challenges—they require space to set up and play the console, and can be distracting to other students doing work in the classroom while the game is being played. At the same time, it is relatively low cost compared to other games and classroom technologies, and often did not require (i.e., be demanded by students) to be played frequently—teachers reported that once the students bought into the story line, playing the game became superfluous and for most students much less interesting than the actual work of the project.

Nevertheless, while this approach appears promising, is also clear that school leaders and teachers have to negotiate particular barriers in order to bring and sustain GBL approaches in classrooms—an enthusiastic and skilled lead teacher, with the support and trust of a senior leader help immensely. Often, overcoming initial barriers can actually enable opportunities in the longer term. For instance, many of the school leaders and teachers said that they had worked alongside parents by bringing them into schools or sending letters home in order to communicate the potential benefits of GBL to them. Parents had concerns that children were already spending too much time playing computer games at home and were anxious about more time being spent playing games in school. Even so, teachers were able to communicate with parents what the learning outcomes of GBL could be and then parents became convinced when they saw how motivated their children were and the kinds of activities which were being built around games. Therefore, in these ways, GBL increased the communication

between parents and teachers and school leaders and possibly increased parental engagement in children's learning as parents understood and could talk more to their children about what they were doing in school.

Despite the potential challenges, console GBL approaches like those described in this study demonstrate significant positive impact on multiple dimensions in education—particularly key challenges areas like student engagement and drive, as well as collaboration and writing. As such, this pedagogy should be given further attention in coordination with system level curricula to better design engaging, motivating and relevant learning experiences.

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ENDNOTES

1 The term 'console games' is used in this report to describe video, computer and digital games of any genre played on games consoles such as Xboxes, PlayStations and Wiis.

2 Learning and Teaching Scotland is a non-departmental public body sponsored by the Scottish Government Schools Directorate and is the lead organization for curriculum development in Scotland, offering support and guidance to teachers, early years practitioners, schools and education authorities to help improve achievement for all.

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