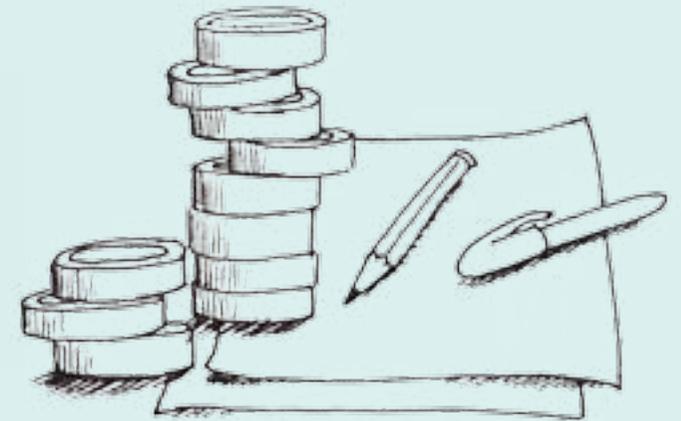


# Games-based experiences for learning



FINAL REPORT



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## Executive summary

In recent years there has been increasing interest in how digital games can be used to support learning and teaching in formal education environments. This report brings together key publications in this area and presents findings from expert interviews about games-based learning experiences.

The report is intended for classroom teachers working in primary and secondary schools, teacher trainers and training agencies, as well as policy makers and academics.

The report aims to provide:

- an overview of what makes a digital game a motivating and engaging learning experience
- a taxonomy of learning elements of digital games
- a set of design principles for digital games-based learning experiences.

The following learning elements of digital games have been identified in the literature reviewed and in the expert interviews:

**Challenge:** A test of the learner's skills, set at a level to stretch his/ her abilities.

**Fantasy/ Narrative:** Imaginary environment, characters or story which can stand as a metaphor for the real world.

**Feedback:** Response to the learner's actions or progress within the game.

**Goals:** Clear aims that are meaningful and achievable but stretch the learner's abilities.

**Sensori stimuli:** Engaging visual and sound effects.

**Social aspects/ community:** Playing with or against other people and social interaction inside and outside the game.

Additional learning elements that can be found in digital games:

**Active learning:** Learning 'by doing', ie actively engaging in the game-related task.

**Adaptivity/ Individualisation:** The difficulty of the game or task adjusts itself to suit the learner's ability level.

**Assessment:** Learners can review how well they are doing in the game and compare it with others.

**Authenticity/ Realism/ Fidelity:** Visual, sound and tactile effects and character behaviour that contribute to making the game more lifelike and convincing.

**Competition:** Can be with others or with oneself, with the aim of outperforming others or self-improvement.

**Control:** The learner is able to manage and direct his/ her own actions in the game.

**Creativity:** Using imagination to solve problems or produce (and share) artefacts in the game.

**Mystery/ Curiosity:** Element of novelty, surprise and informational complexity within the game.

**Puzzle-solving:** Mental puzzles, riddles or problems need to be solved to progress in the game.

**Rapid decision-making:** Having to make a series of choices fast and continuously to move forward in the game.

**Relevance/ Interest to the learner:** Being able to relate to the game in a meaningful way.

**Reward:** Prize or incentive given in return for what the learner has achieved, matching his/ her increasing skills level.

**Role:** The learner takes on a specific part in the game and thus acquires skills and knowledge relevant in the real world.

**Rules:** Conditions and restrictions that direct the actions the learner can take within the game.

**Safety:** Consequences of risk-taking in the game have no impact on the real world.

**Scaffolding and sense of improvement:** Gradually increasing level of difficulty and seeing oneself make progress in the game.

**Transfer:** Learning from the game can be applied in other games or in a real world context.

This report offers an accessible description of each element based on the literature. The expert interviews elaborate the above learning elements further and offer practical examples from different types of games used in primary, secondary and higher education (eg educational games, online multiplayer games, immersive fantasy games, serious games and simulations, handheld games and consoles with a more intuitive interface, and a games design tool).

Further research with teachers and students will evaluate the relative importance of each learning element and explore how they can be used in formal education settings to support the creation of games-based learning experiences that can, but don't have to, include digital games (see Kirkland 2010).

The report offers the design principles that digital games-based learning experiences in schools should:

- use fantasy and narrative to create an engaging context for the learning experience
- relate to prior interests of the learner
- be visually stimulating, eg through the use of multimedia features
- be challenging with adaptable and increasing levels of difficulty
- have clear and meaningful goals
- provide immediate feedback to give the learner a sense of control
- provide opportunities for learners to make decisions that influence the learning experience
- encourage social interaction between learners by providing opportunities for collaboration and discussion – as part of the game, in the classroom and/or online
- focus on progression and self-improvement rather than competition between learners.

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The report concludes that there is a whole range of motivational elements in digital games that encourage learning. The publications reviewed and the experts interviewed consider different elements to be important although there is some degree of commonality. Common elements identified include challenge, fantasy/ narrative, feedback, goals, sensori stimuli and social aspects/ community.

In order to create an engaging games-based learning experience, it need not necessarily accommodate all of the above elements. Instead it should include a mix and a balance of elements in order to engage different types of learners. Finally, it is important that games-based learning experiences are mediated by a teacher to facilitate learning and are supported by other digital tools and teaching methods.

## Introduction

In recent years there has been an increasing interest in how digital games can be used to support learning and teaching in formal education environments. They have been applied to aid the development of subject knowledge and subject specific skills or to learning collaborative skills, such as problem-solving and team working. The research literature on digital games recognises that they can be an engaging way to support learning and teaching although there is no conclusive evidence whether they are an effective way of learning (see eg Ulicsak and Wright 2010; Groff, Howells and Cranmer 2010).

To maximise their potential for learning there needs to be an improved understanding of what elements of games are engaging and motivating, and how they can be practically used in the learning process (Van Eck 2006). Equally, there is a growing interest in whether the core principles of engaging games design can be used as a pedagogic model to create game-like learning experiences to motivate students (see for example the US-based Quest to Learn schools, [www.q2l.org](http://www.q2l.org)).

### Audience, aims and scope

This report is intended to be read by classroom teachers working in primary and secondary schools, teacher trainers and training agencies, as well as policy makers and academics.

The aims of this report are:

- to develop an overview of what makes a digital game a motivating and engaging learning experience
- to build a taxonomy of learning elements of digital games, including a systematic, accessible description of each element

- based on the above, to develop a set of design principles for digital games-based learning experiences (which can in turn be used to structure a resource for teachers).

The report forms the basis for further research with teachers and students to evaluate the relative importance of each learning element and explore how the elements can be used in formal education settings to support the creation of games-based learning experiences that can, but don't have to, include digital games (see Kirkland 2010).

This report is not intended as a 'best practice' guide to game-based learning. Instead it brings together key research publications and views from games experts on the elements and principles of engaging games-based learning experiences.

## Literature review

### Methodological approach

The report is based on a summary review of the available research literature on digital games-based learning and interviews with eight experts, including game developers, researchers in the field and teachers.

### Definitions

For the purposes of this report the definition of digital games by Kirriemuir and McFarlane (2004) will be adopted. A digital game, also often referred to as a video game or computer game, is defined as one that:

- “provides some visual digital information or substance to one or more players
- takes some input from players
- processes the input according to a set of programmed game rules
- alters the digital information provided to the players” (p6).

Further, the authors also define digital games as programmes that operate on:

- video game consoles, eg Sony PlayStation, Microsoft Xbox, Nintendo GameCube, and more recently the Nintendo Wii
- personal computers
- mobile, handheld devices, eg Nintendo GameBoy, and more recently the Nintendo DS, Sony PSP (PlayStation Portable), mobile phones and tablets.

Digital games-based learning experiences will be defined as based on activities that:

- have a digital game (as defined above) at their core, either as the main activity or as a stimulus for other related activities.
- can take place in a formal (eg school) or informal (eg home) learning environment
- have learning as a desired or incidental outcome.

Further, it is important to distinguish between learning directly from playing the game and learning from teacher-led activities associated with the game.

### What makes a digital game a motivating and engaging learning experience?

Why are games engaging? There are numerous authors who argue that games are motivational (eg Gee 2007, Squire 2005, Shaffer 2006). Prensky (2001, p106) provides an accessible list of attributes which correspond to those also used by other authors. Many of these will be analysed in this report:

- “Games are a form of fun. That gives us enjoyment and pleasure.
- Games are a form of play. That gives us intense and passionate involvement.
- Games have rules. That gives us structure.
- Games have goals. That gives us motivation.

- Games are interactive. That gives us doing.
- Games have outcomes and feedback. That gives us learning.
- Games are adaptive. That gives us flow.
- Games have win states. That gives us ego gratification.
- Games have conflict/competition/challenge/opposition. That gives us adrenaline.
- Games have problem solving. That sparks our creativity.
- Games have interaction. That gives us social groups.
- Games have representation and story. That gives us emotion.”

Prensky starts his list with the element of fun. However, fun is an elusive concept. Instead, much of the research literature on digital games refers to the idea of ‘flow’, citing Csikszentmihalyi (1990). Flow is the state of “being completely involved in an action for its own sake” (Paras and Bizzocchi, 2005, p2). In this state of flow, the player concentrates on the game fully and is able to shut out the rest of the world. This is where learning can take place.

Paras and Bizzocchi (2005) express the potential for learning from ‘well-designed educational games’ in the following diagram:

**Games → Play → Flow → Motivation → Learning**

“Games foster play, which produces a state of flow, which increases motivation, which supports the learning process,” (p4). They add that “well-designed game mechanics can result in learning experiences which are intrinsically motivating,” (ibid).

An activity or experience, according to Csikszentmihalyi (1993), must have the following elements to enable the state of flow:

- clear goals with manageable rules
- be adaptable to the player’s ability
- provide immediate feedback
- screen out distraction to enable concentration

These elements can equally be applied to games-based learning experiences as will be shown throughout this report.

### Learning elements of digital games

A small number of publications were reviewed which identified the following: defining characteristics of games, elements or principles of digital games that make these engaging and/or lead to learning or elements/principles that are necessary to achieve flow in games. These ‘learning elements of digital games’, as identified in the literature, will be included in the Taxonomy section of this report.

Details of the publications reviewed follow:

- Douch, Attewell and Dawson (2010) focus on handheld game technologies (eg Nintendo DS and Sony PSP) and apply principles for effective learning devised by Oblinger (2004) to games (p17f).
- Garris, Ahlers and Driskell (2002) focus on “the use of instructional games that are designed for training or to promote learning” (p443) and, based on a review of the literature, identify game characteristics that engage users and lead to learning (p447).

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— Gee (2007) proposes 36 learning principles (p221ff) built into 'good' video games that are also relevant to learning in the classroom. He refers to commercial off the shelf games. A number of these principles have been selected for inclusion in the taxonomy where they correspond to the elements of the other authors.

— In a study of early computer games and what makes them intrinsically motivating, Malone (1982) devises a "checklist for designing enjoyable educational programs" (p32).

— Prensky's (2001) 'Digital Games-Based Learning' for business, government, military and education lists "six key structural elements of games" (p119) that are crucial for engagement. Many of the examples included in the book are commercial off the shelf games.

— In his 2006 publication, 'Don't Bother Me Mom - I'm Learning!', about children's use of digital games, Prensky writes about 'complex' games, referring again to commercial off the shelf games. He identifies a number of features of 'complex' games that keep players engaged (p59ff).

— Stone (2008) describes the human-centered development of serious games. He focuses predominantly on games for the military.

— Shaffer (2005) describes epistemic games, ie games that use authentic situations and roles to provide an engaging activity and a compelling learning environment.

— Sweetser and Wyeth (2005) identify a number of game characteristics that are necessary to facilitate flow and test these on fantasy-based strategy games (p5f).

— Whitton's (2010) guide to using digital games for learning in higher education includes a list of defining games characteristics commonly found in the literature on digital games (p23) and, based on her experience in alternate reality games, a number of factors that lead to engagement with games (p145).

The elements mentioned most often, or which the authors identified as most important, are challenge, fantasy/narrative, feedback, goals, sensory stimuli and social aspects. These, and other elements, will be discussed further in the expert interviews that follow.

Whereas this report mainly focuses on the elements within the game, there is of course other research on games-based learning that takes a different approach to evaluating games. For example, de Freitas and Oliver (2006) consider a number of external factors besides the game itself, such as the context in which the learning takes place, the learners themselves, including their learning styles and preferences, and pedagogic approaches.

## Expert interviews

Telephone interviews were conducted with the people included in Table 3. The semi-structured interviews focused on the following areas:

- the professional background of the interviewees and how they became involved in the area of digital games
- details about the games-related projects they were working, or had worked, on
- the games they had developed, researched, used in their teaching or liked playing themselves
- the context in which the games had been used
- the elements the interviewees saw as most important for making the above games engaging learning experiences.

In the section that follows, each interview is presented in the form of a case study, focusing on the elements the interviewees identified as most important for engaging and effective games-based learning experiences. The case studies are presented in the order the interviews were conducted.

**Table 3: Experts interviewed**

(listed in the order the interviews were conducted)

Name	Area of expertise
Tim Rylands, former teacher, now ICT and education consultant	Uses games (eg Myst, Wild Earth: African Safari) and Web 2.0 applications to improve learning outcomes
Fiona Seymour, Department for Transport	Commissioned Code of Everand, an online role-playing game to teach 9-13 year olds about road safety
Kimmo Oksanen, University of Jyväskylä, Finland	Has developed and conducted research on games for vocational education
Kam Star, Playgen	Developers of serious games, social games and simulations, including Choices and Voices to teach young people about the consequences of anti-social behaviour
Nicola Whitton, Manchester Metropolitan University	Has conducted research in the area of games-based learning in higher education
Donna Burton-Wilcock, Immersive Education	Developers of MissionMaker, a software tool for making role-playing and adventure computer games
Derek Roberts, Learning and Teaching Scotland	Leads games-based learning initiatives in Scottish schools through the Consolarium, the Scottish Centre for Games and Learning. Projects include the use of Guitar Hero and Dr Kawashima's Brain Training in the classroom
Dawn Hallybone, Primary school teacher and ICT coordinator	Uses Nintendo DS and Nintendo Wii games, such as Dr Kawashima's Brain Training, Professor Layton and the Curious Village, Nintendogs and MarioKart, in her school

#### Tim Rylands

Former teacher, now ICT and education consultant

Tim Rylands is a former teacher, turned ICT and education consultant following a Becta ICT in Practice Award. Together with a fellow teacher, Sarah Neild, he advises schools and educational authorities on the use of ICT in learning. He is known for using the immersive landscape game *Myst* to inspire children's writing, but also uses other games, such as *Wild Earth: African Safari*, and *Web 2.0* applications to improve learning outcomes (see [www.timrylands.com/blog](http://www.timrylands.com/blog)).

During his work with schools, Rylands asked a group of children what made a good computer game. He presented the answers at the 2010 Games-based Learning conference:<sup>1</sup>

- Action
- Adventure
- Exciting
- Cool characters
- Tense/suspense
- Strategy
- Not impossible but not easy
- Challenging
- Not necessarily fighting
- Makes you imagine you are in the game
- Makes you want to be there

The most important element, he was surprised to find out from the children, was that the game had to be challenging.

#### Challenge

When asked why challenge is important, Rylands refers to a quote by Seymour Papert featured in his blog:<sup>2</sup>

“Every maker of video games knows something that the makers of curriculum don't seem to understand. You'll never see a video game being advertised as being easy. Children who do not like school will tell you it's not because it's too hard. It's because it's boring.”

Rylands continues:

“It's not just children, it's as human beings we like challenge, and the best engineered challenges are set at a level that engages, involves, gets us frustrated, because I think to me, frustration comes with involvement, comes with engagement. Boredom comes with not wanting to do something, it is at the point where if you're going to engineer a challenge, it's knowing how far to take that challenge.”

On challenge in and around the *Myst* game he says:

“*Myst* itself has challenge elements hidden within it, in that to get to a new location you are set challenges to solve problems. [...] The challenge is relevant and hidden. [...] In the *Myst* experiences they desperately want to find their way to a different landscape and they become passionate about solving the problem, however I don't think the problem-solving is the challenge – the challenge is that the children start to bring their worlds alive through the power of words. It's giving them real reasons to want to polish up their writing, develop their descriptive skills, think about [...]”

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everything 'cause we use it for everything; writing, music. [...] It's not a specific challenge in the game, it's the challenge related to the games."

### Games supported by other tools

Rylands is also adamant that games should only be one part of the learning experience which needs to be supported by other teaching methods:

"It is only one of the many tools that we use to develop children's speaking, listening, writing, confidence, general connection with learning. We use a lot of games, but they are only one element of the whole learning process, and they are only one element of the technology. So for example, whether it's the later games in the Myst series [... or the] Wii game Wild Earth: African Safari, which is another immersive, involving experience, that they are the core, the stimulus, the centre of the process. But we use a lot of other Web 2.0 technologies or analogue methods for the children to be able to record their experiences and their involvement with the process."

Rylands adds:

"If it's just games, games, games and they're in isolation, then you're not gonna get effective learning. [...] Those games should be perhaps a core, a pivotal hub, but if they're just used as the game in its isolation, I don't think you get always as effective teaching and learning as you can if it's used as part of the whole process [...]. [It's] important what learning experiences happen around it."

### Collaborative learning

Rylands also thinks that the social aspects of the learning experience, such as collaboration, are crucial to engaging children. An example of a Web 2.0 tool he uses to support games-based learning experiences is PrimaryPad:

"[In PrimaryPad] children can write at the same time as everybody else, interact, share ideas, build a document, write at the same time – literally – as other people. [...] It also gives you the opportunity to have a chat channel along the side but also to draw using a link-up with a thing called Scribblar, which means that they can draw interactively as well. So for example, when we're using the Wild Earth game and the children are researching, they take notes into [PrimaryPad] and they can, instead of taking lots of parallel paragraphs about the same thing, they can be adding to the same text and correcting and chipping in, contributing to a thing. But you can also get a teacher to drop in a diagram or an illustration and children can annotate that using Scribblar. And again you could say this isn't games-based – it is exactly that – it is games-based in that the base is the game. What happens around it is the important aspect."



**Image 1: Tim Rylands and two children during a successful learning experience with Wild Earth: African Safari.**

(image reproduced with kind permission of Tim Rylands)

### Fiona Seymour

Head of Marketing, Department for Transport

Fiona Seymour, the Head of Marketing at the UK Government's Department for Transport, was in charge of commissioning Code of Everand, a fantasy online role-playing game to teach 9 to 13 year-olds about road safety ([www.codeofeverand.co.uk](http://www.codeofeverand.co.uk)).

#### Fantasy

The game is based in a fantasy world where the player has to fight monsters which stand as a metaphor for cars, as Seymour explains:

"Although it's a fantasy world, it does in many ways replicate the real world. The Spirit Channels, when you look at the map, they are in fact roads really, and all of the monsters in the Spirit Channels are based on car designs – a bus or a motor cycle, [...] and you've got things like areas where it's dark, so [...] to be able to defeat the monster safely, you need to be wearing reflective clothing, and there's different types of Spirit Channels. Some are like rural roads, others like a motorway which are really, really dangerous, and you can elect to cross anywhere in Everand, but you pay a very high price to defeat the monsters. So it pays to find the easier places to cross, maybe plan your journey so you go on the non-scary monster-infested roads, [...] and there are different types of crossings [...] where your view is slightly obscured [...]. We worked very closely with policy colleagues to replicate and metaphor the reality children encounter on the roads."

Seymour adds:

"The idea is to get it as close to real life experience as you can, but it had to be virtual."

The element of fantasy is crucial to the engagement in the game and was used to make a 'boring subject' interesting:

"[We created a fantasy world] because it would be quite dull otherwise. It makes the narrative a bit more interesting, that the world was perfect until these Spirit Channels appeared and made it unsafe and that only Pathfinders can do things for the whole of their community, [...] and if you make it look like a real village, [...] it's quite difficult to make it fun. [...] It's an intrinsically boring subject, road safety."

#### Transfer

Seymour hopes that the knowledge and skills players learn from playing the game are then transferred to the real world, ie when children cross the road:

Doing these behaviours, looking both ways [...], it's important for their Pathfinder character 'cause it's also important in the real world [...] for a Spirit Channel to be sufficiently similar to a real road that when they as a real child rather than their avatar get to the curb, that they then automatically do what they've been trained to do as an avatar in the game. [...] [Interviewer: At the roadside, would they then think of monsters?] Maybe not even on a conscious level, because that's how habit works, you just do it, that's what we're aiming for, that it's as automatic as cleaning your teeth."

Whether this transfer of learning is happening still needs to be evaluated, but Seymour believes that learning from games has the potential to be more effective compared with other forms of communication, such as advertising:

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“Children were picking up from the advertising we were doing the theory of road safety. They could all talk about ‘Stop, Look and Listen’ and find a safe place to cross, but it hadn’t been internalised, it wasn’t on the hard drive, [...] ‘cause it’s not a cognitive process, it should become a habit that you stop. So we experimented with quite a lot of advertising campaigns to see if we could break through that barrier of making the theory relevant, but you’re always making an appeal to the rational and that wasn’t serving its purpose in terms of instilling habits in children. So we realised that conventional advertising or marketing wasn’t gonna work, so we looked around at what children were actually doing, and almost universally they were gaming, and we looked at examples where in other disciplines gaming had been used as a way of training ‘cause this isn’t really learning information, this is actually training behaviour, that potentially offered an opportunity in the virtual world beginning to internalise the whole business why you should stop at the edge of a curb, why you should look around for traffic, why you should cross at certain places, not others, why you should plan your journey, [...] hence Code of Everand.”

#### The game as part of the learning experience

Similar to Rylands’ argument previously, Code of Everand is only one way of engaging children in learning. The Department for Transport has other campaigns and programmes to teach children about road safety (see [www.dft.gov.uk/think](http://www.dft.gov.uk/think)). Code of Everand is a way of reaching children directly without teacher intervention, Seymour says:

“We wanted children to play it in their own time, we wanted them to chose to play it rather than being told to in classroom time. We have a whole other programme for it – school learning. [...] The idea was that this would be a relationship directly with children, not through any intermediaries. [...] We try and reach

children through as many channels as possible. [...] We found it was also important to have that direct relationship with children where they weren’t being told to do it, but they were electing to do it.”



Image 2: Code of Everand

(image reproduced with kind permission of Fiona Seymour)

#### Kimmo Oksanen

Researcher, Finnish Institute for Educational Research, University of Jyväskylä

Kimmo Oksanen is a researcher at the Finnish Institute for Educational Research at the University of Jyväskylä. He has worked on a game development project, Pedagames ([www.snap.fi/services/pedagames](http://www.snap.fi/services/pedagames)), which ran until 2007. The project team developed three collaborative computer games for vocational education that have been tested in Finnish schools with 15 to 18 year-olds. The games deal with work safety in construction ('Secure'), the electrification of a small house ('Voltage') and planning and budgeting for the decoration of an apartment ('Decore').

#### Appropriate level of challenge

When asked what the students found most engaging about the games, Oksanen refers to the element of challenge:

“Students found it engaging mostly because of the game tasks which were difficult enough, not too easy but not too difficult. [...] For flow it's important that the difficulty of the game is just about right for a player, not too easy but not too difficult because if it is too hard, it's frustrating.”

However, getting the level of difficulty right presents a challenge in itself for the games designer, as Oksanen explains:

“When developing educational games it's always a big mystery to find the correct level of difficulty. That's why we have noticed that these games are supposed to be developed in cycles, so we make a first version of the game, we do an experimental study, we correct and fix the game after the experiment with this feedback. So we have to develop it further because it's always hard to know which is the correct difficulty level.”

#### Collaboration and role

Another engaging element was that of collaboration, says Oksanen:

“[The students] also liked the opportunity to play the game with their friends, like collaboratively, that was the main thing for the students.”

The games have a built-in element of collaboration so that the goal of the game can only be reached if the players work collaboratively. Oksanen explains how this was applied in the 'Decore' game:

“Players needed to work collaboratively. The players were doing up an apartment, they were supposed to paint the walls, choose the paint colour – decorating. And the collaborative tasks were, for example, one player could see the prices for the paints and another player could see the size of the wall and maybe the third one had a calculator, so only he can calculate the area.”

Oksanen adds:

“The players were having a Skype connection or some other VoIP connection between [them], and the game tasks are designed in a way that they can't be solved individually, so the players need to collaborate to solve the tasks.”

This type of role-play also gives students the opportunity to engage in and practice “the core skills, habits, and understandings of a post-industrial society” (Shaffer, 2005, p2).

#### Teacher involvement and discussion

Oksanen believes that the learning doesn't just come from playing the game, but requires teacher mediation and discussion afterwards:

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“I think that just playing the game is not enough, there’s still need for teachers. [...] When students have played the game, there are in many cases reasons for having some kind of feedback conversation afterwards with the teacher, and the teacher can pop up some things from the game and, for example, ask the students, ‘What do you think in this situation? What makes you act this way?’, [...] discuss things afterwards, after the game. Just playing the game is not enough.”

### Feedback

Classroom discussion is favourable to having feedback built into the game when resources for game development are limited, Oksanen adds:

“[Feedback is] always kind of automatic when it’s in the game because the game can’t really read the minds or react to the players, and it’s also a matter of resource when developing the game, like building a large enough feedback system, it’s a really, really big job.”



**Image 3: Decore**

(image reproduced with kind permission of Kimmo Oksanen)

### **Kam Star**

CEO and Founder, Playgen

Kam Star is CEO and founder of Playgen ([playgen.com](http://playgen.com)), a London-based company that develops serious games, social games and simulations for different audiences.

#### **Safety**

Serious games deal with situations that have can have 'serious consequences' in the real world, according to Star. The safety element is important here, ie players can work through risky scenarios without consequences in the real world (Whitton, 2010). Star explains the concept of serious games:

"[In real life] the cost of failure is high. So if you make a mistake, you might kill somebody [... or] you lose a lot of money [... or] you might lose your credibility [...], so if the consequence of that is a loss in some way, then the game becomes serious. So anything that is related to a consequence of considerable proportions can be constructed as a serious [game], anything with trivial consequences is not serious."

#### **Fidelity/authenticity and relevance to the player**

The interview focused mainly on Choices and Voices, a serious game to teach 12 to 16 year-olds about the consequences of anti-social behaviour. An important aspect that makes the Choices and Voices game engaging is its fidelity, that is, it is highly authentic and specifically tailored to its target audience, as Star's answer illustrates:

"If you construct something for a specific group of people, and I mean really specific group of people, you have a very good chance of engaging them. [...] So for instance, the Choices and Voices we made for Birmingham, it has backgrounds from Birmingham

city [...], it has references to the football teams that play for Birmingham, it has references to the cities that are around Birmingham itself. The characters have accents that match the Birmingham accent, they are local actors that have done the characters' [voices]. [...] The words they use, the colloquialisms that they use, we researched this, it matches, it's what they say when they're talking to each other. [...] We actually got young people, we sat them down, we ran workshops, 'How would you say this?'"

This made the game relevant and meaningful to young people:

"The feedback we got, 'I really like it, it's like round here, it's about me'. They sit down, within a few minutes [they would say], 'This didn't come from Mars, this isn't somebody from London going, you must think like this. This is about me, my people, my community, I recognise that'. [...] That level of realism, particularly for the older group of kids [is important]."

Star continues:

"One of the biggest draws was that it's about them. It's not about some random world of aliens that have got nothing [to do] with reality or lots of cutesy, happy [characters] that are just jumping around. The reality is actually it's a bit dirty, it's a bit grimy and people say, 'That's a bit whack'."

The game was then customised for other parts of the country:

"When we developed it for other parts of the country [...] and when we did the South West [...], we did exactly the same thing, we talked to the kids in Bristol, we went to Plymouth, we went to a whole series of cities, had workshops with the kids, talked about the way they say stuff, recorded their voices, it matched

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their accents, got some of the kids, local kids, to record it, so it's completely genuine [...]. [The scenarios] they're exactly the same [just the background is different and the voices], and that seems enough to make you feel [it's authentic]. So that's a really, really simple but effective way to get that kind of engagement."

### Discussion

Similarly to Oksanen previously, Star thinks that the learning takes place in the discussion after the game, but that the game is a catalyst for this discussion, and consequently for the learning:

"[The discussions were] about the decisions that were made, about what it means, what some of the role play means, really opening up the underlying attitudes, underlying behaviours and underlying beliefs that may lead someone to become violent, and because each person has a different outcome, the conversation actually becomes about choices. But it isn't one that needs to be lead by the teacher because the students are all discussing between [themselves] about, 'Oh, I did that'. An easy one in the first scenario is, as soon as it's finished [...], 'So who burned the school down?' – some hands go up and people whose hands don't go up kind of look, 'And who got evicted?' – [they] look round who didn't get evicted, 'And what did you do? How come you didn't get evicted?' They want to know."

### Rapid decision-making

A further element that makes games engaging is that the player has to interact with the game and make decisions, unlike watching a video where one can just 'sit back'. Star explains:

"You have to make a decision every 20 seconds or less, and if you don't make a decision it will make a decision for you, and it's out of your hands, so you don't want it to do that. So because it's continuously getting you to interact with it, and it's responding to

the way you're playing. Whatever you do, it responds to what you did. [...] I think that it's really important, that it responds to you."

### Narrative

Another important element is the story, the narrative behind the game. Here Star refers to NanoMission, a series of science games for young people developed by Playgen:

"If you add a story to it and if you contextualise [it] with a story, [...] we wrap a story round it. [...] There's a Doctor Neevil [...], now you start to get into the game side of things [...], 'cause now you have a narrative, there is a plot, there's an antagonist, you're the protagonist, you have to rescue somebody or rescue the world or rescue a friend [...]. The context is really important."

### Social aspects

Playgen has recently started developing social, ie multiplayer, games. Star describes the appeal of playing digital games with other people and how this can be done:

"We really see that the catalyst for somebody wanting to engage in something becomes a lot, lot stronger if their friends are doing it or if in some way they can involve their friends, and it can be done in lots and lots of different ways. The first simplest thing is to just have a score and a leader board, that's pretty basic, you can still have that in a single player [game], that's a kind of stepping stone. What you could then do is add mechanisms into the game which [are] about collaboration, add mechanisms into the game which [are] about conflict, but conflict not with the system, but conflict with you and other players. You could create teams and groups, and you can create kind of an environment where you're in a multiplayer world, so that you have many levels. It could be we're all playing the same game, what you do could affect my game in some ways. It could be that we're all playing different games, but

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I maybe send you a gift that will help you in your progress or it might be that we can collaborate together. We can form a group to beat the system or beat another group.”

Playing against other people is more rewarding than just playing against the computer, as Star argues:

“It’s about interaction. It’s so much more rewarding, knowing that there’s another person, that you’re interacting with a real person, even if you can’t see them. [...] If you play some of the two-player games, on Yahoo you can play chess or backgammon, you never see the other person. You just play chess, but you know the other person that’s moving it is another human being, so when you put them into check mate, you know that they’re sat there going, ‘Damn it! I lost!’, and you know how that feels, and they know how you feel because you’ve triumphed, and that’s so much more rewarding than playing against the computer.”



**Image 4: Choices and Voices**

(image reproduced with kind permission of Kam Star)

#### Nicola Whitton

Researcher, Institute of Education, Manchester Metropolitan University

Nicola Whitton is a researcher at the Institute of Education at Manchester Metropolitan University and previously at Napier University in Edinburgh. She has worked on a number of research projects in the area of games-based learning in higher education.

#### Competition

At Napier University Whitton was involved in evaluating the use of an educational game, Marketplace, to teach an applied marketing course. The students, working in groups, had to set up and run virtual businesses. Whitton found that competition was a motivating element for some students while being demotivating for others. She says of the students involved in the project:

“They were pretty competitive [...] It was partly the group angle, and I was quite surprised ‘cause [...] my experience with group work is that it’s brilliant for some people and not for others. [...] There was competition, but it was competition between groups. [...] Competition [...] is quite often off-putting for some people, but that seemed to be one of the things that drove people on. [...] For the groups that were doing really well, competition was highly motivating, but for those that weren’t it was demotivating, [...] ‘Well, we know we can’t win’.”

In her doctoral research, Whitton conducted focus groups with adult learners around what makes digital games engaging. She found that women especially were put off by competitive elements in games:

“Particularly women [...], there were several in the group that were saying they wouldn’t want to engage in any game that was in any form competitive, they just found it a complete turn off. So I think competition can go either way [...]. You can’t just assume that competition is engaging for everybody.”

#### Sense of improvement and being in control

In the focus groups Whitton identified two universal factors that made digital games engaging for all her respondents, the first one being ‘swift and steady improvement’, ie getting better quickly:

“Swift and steady improvement – for instance, being able to complete the first few levels really, really quickly or playing a role-playing game and being able to [...] join a new guild very quickly or being able to get very quick rewards.”

The second one was the idea of ‘being good’, ie expertise and the pleasure of being in control:

“The other one was this idea of being good, which is different because it’s seeing yourself as an expert or being good, [...] so it’s a kind of self-endorsement feeling rather than necessarily being able to get better quickly [...]. That’s the perception of seeing yourself as an expert, so the pleasure you get from a feeling of being in control, of being good, of mastery. [...] I suppose how you might create that in a game is, if you’re improving quickly, then you would see yourself as being good, but there could be other things like you’re playing the game with somebody that’s much more experienced who says, ‘Wow, you’re really good at this’.”

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In her focus groups, Whitton also investigated what demotivated people when playing digital games.

“The demotivating things were difficulty getting started and getting stuck. They’re kind of related to each other, [...] and this is beyond the kind of getting stuck and having a problem and solving it. This is much to do with absolutely getting stuck, and that’s a point at which people give up playing [...]. And then one I hadn’t come across before is this idea of lack of trust, [...] and I think in computer games that’s really important because if it doesn’t seem fair, [...] and if you felt you should be able to do something in a game, but actually the game wouldn’t let you do it, so that was very demotivating. [...] For instance, if you’re in a maze and you see a door and the door doesn’t open and there’s no reason for it not to open other than that the designer hasn’t put a room behind there, [...] when it’s not consistent with your mental model of how the world works.”

#### Interest and relevance to the learner

Another demotivating factor Whitton identified was lack of interest in the game or the subject matter, showing that relevance to the learner is an important factor for engagement:

“ ‘I don’t want to play this, I’m not interested in racing games, you can make them as beautiful as you like, I’m still not going to be interested in them’ – or [lack of] interest in subject matter, which I thought was quite interesting ‘cause a lot of the games-based learning stuff says, actually, you can make anything into a game and it will be really interesting.”

#### Puzzle-solving

Whitton likes playing digital games herself and particularly enjoys the puzzle-solving element:

“[When I was younger] I used to play with my mum, it was great fun. We used to sit down in the evening and we’d play an adventure game together, and it was very satisfying to be working on a puzzle for a long time and talking about it and thinking about lots of things, trial and error, thinking about possible solutions, and it was just fun, it was a fun way, social way to do – spend time really.”

#### Reward

The longer people have been gamers, the more reward they get from in-game references, as Whitton explains:

“The more adventure games you play, the more self-references you get from newer adventure games to older adventure games, and there’s lots of in-jokes in adventure games. For instance, a very common one is getting a bucket of water to put out a fire, and there’s lots of variants on that. [The more you] get into playing one genre [...], the more deeply engrossed you get within it. [...] There’s plenty of jokes to other games and older games and hommages to other games in that genre. [...] One I’m thinking of is that I was playing some desert island game recently, and there was a little sign on a tree saying Guybrush Threepwood was here. Guybrush Threepwood is the character of some of the Monkey Island games which is kind of 1990 [when] they started, [... he’s] very, very famous. So it’s a completely different game, made by a completely different company, but it’s got this little nod to game history. [...] It is a bit like Easter eggs that you get for playing for a long time.”

#### Discussion and reflection

Whitton agrees, like the other interviewees, that discussion is an important aspect of games-based learning as it leads to reflection:

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“[In] any learning activity, [...] it allows you to clarify your thoughts, [...] to get on board the thoughts of other people and just to get a richer and deeper understanding. [...] I strongly believe that reflection and discussion are essential components of games-based learning and ones that aren’t necessarily built in. [...] That’s the big problem with learning with games, how do you transfer what you learnt from the game into real life? And again the collaboration and reflection is one way to do that.”

In the classroom this can happen through discussion mediated by the teacher, but children playing on their own at home can still benefit from the feedback and input of other people via online gaming communities, as Whitton believes:

“I think they will be learning things, I think they will be learning a lot more when they go on the internet and they read around the discussion forums or when they go on the cheat sites and look at alternative ways of doing it, or when they talk to their friends, ‘I can’t do this bit, how did you approach that?’.”

### Narrative and mystery

In 2008/09 Whitton ran ARGOSI ([argosi.playthinklearn.net](http://argosi.playthinklearn.net)) at Manchester Metropolitan University, an Alternate Reality Game (ARG) to aid the student induction process. In the evaluation, she identified six elements that made the game engaging: community/collaboration, puzzle-solving, creativity, collecting a set, competition and narrative:

“One was the community factor, again the collaborative element, one was to do with puzzle-solving specifically, one was to do with the ability to be creative, because part of the ARG is going out and creating artefacts and using digital photography, video etc. Part was to do with collecting a set, the idea of being able to complete something. ARGOSI was based around the idea of having a map.

When you had found the six map pieces you could reorient them, and that would allow you to then see a map reference. [...] Then there’s competition and there was a narrative element, people wanted to see how the story carried out.”

The story behind the game is about a new student, Viola, who comes to the university and discovers a piece of an old map at her grandmother’s house. This is the start of a journey of discovery for the players. The narrative holds the game together and provides an element of mystery, as Whitton explains:

“That’s quite key to this game form, it’s based around sort of a story that emerges as the game carries on. [...] It held everything together. Without a story line there wasn’t a context. You’d just be doing, well, here’s a treasure hunt and here’s a photographic task and here’s a website that’s got a hidden code in it, and they’d be thinking what’s the point, what am I doing this for? So it’s kind of the mystery, the curiosity angle – I want to find out what happened next.”

### Balance of learning elements

However, even though narrative was crucial for a cohesive game experience, it wasn’t the most important element for creating engagement. Whitton believes that the mix and balance of elements is key:

“The idea with these six [elements] was, everybody said that the story was important– it was like the glue that held everything together. Again, I remember some people saying, ‘It was brilliant, I was so competitive’, and others saying, ‘That really put me off, I didn’t like the fact that it was competitive’, and likewise I’m thinking the creative bit, some people liked it and some people hated it. So what we’ve come up with is kind of these six things, and the advice that we give to people in terms of designing new

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[Alternate Reality Games] is make sure there's a balance of those, something in there for everybody. [...] Some people will like different, not mutually exclusive [elements]. One person might like a bit of competition and some creativity but really, really hate puzzle solving 'cause it's too hard for them to do. [...] I don't think you can have a game that everybody will like, but what you can have is a game where you're at least providing a bit of something for everybody."



**Image 5: A postcard and part of the map of the Alternate Reality Game ARGOSI**

(image reproduced with kind permission of Nicola Whitton)

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### Donna Burton-Wilcock CEO, Immersive Education

Donna Burton-Wilcock is CEO of Immersive Education, the developers of MissionMaker. MissionMaker is a game authoring tool for schools that allows students to design their own 3D role-playing and action adventure games ([www.immersiveeducation.com/missionmaker](http://www.immersiveeducation.com/missionmaker)).

#### Visual element

Games can be motivating, especially for less academic students, as they offer a different way of communicating, Burton-Wilcock claims. The visual element is particularly engaging:

“I worked a lot with disaffected young people who I would say were as intelligent as some of the kids who were seen as traditionally academic, but because they hadn’t had a background of valuing books or learning to read early, they needed different ways of communicating, and different ways of communicating understanding, and I think something as motivating as a game and as different and [that] doesn’t have all the hang-ups and baggage that a lot of school subjects have for those sorts of children. I think the visual angle immediately engages their interest.”

MissionMaker uses high quality graphics both in its user interface and for the finished games to engage young people, and particularly disaffected students. It gives them confidence to create something that ‘looks good’, as Burton-Wilcock explains:

“It’s one of the reasons why we go for really high quality graphics and 3D graphics in everything we do. [...] I think in terms of motivating, and particularly disaffected young people, self-esteem is important, and if they can create something relatively

quickly that looks professional, that looks good, it gives them the confidence and the determination to persevere with that.”

#### Teacher involvement

The students are also encouraged to think about how to make the game engaging for others when designing their own game. The role of the teacher is important here, as Burton-Wilcock argues:

“I think that’s where the teacher mediation comes in. You’re always questioning [the students], and it’s sort of a facilitative role that you need as a teacher. You’re saying to them, ok how do they know how to do this ‘cause that’s the other thing that children have to do when they’re making games. They’re always hypothesising, they’re always thinking how is the player going to know what to do, how is the player going to respond? If he gets to this point and gets stuck or is lost, what’s going to happen? [...] It is a tool, like Word is or Excel. The benefits depend very much upon the task set, teacher mediation, the type of game, and therefore [...] we say it needs a good teacher. [...] You can’t just plug the kids in.”

#### Audience

Burton-Wilcock thinks that publishing their own games on the internet, or just seeing their classmates play their games, is motivating for learners as it gives them an audience for their work which, in turn, gives them purpose:

“To see somebody actually using something that you’ve made, and enjoying using something that you’ve made, it’s giving it authentic purpose. Too often in schools, and it’s a necessity more than desire, too often in schools the sort of tasks that we set them, we talk about purpose and audience, but actually most of the purpose is to pass an exam, and your audience is your teacher, and that’s

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very limiting and limited. Here they've got an authentic purpose – to make a game – and a real audience of their peers, and if they can publish it more widely on the web or on their intranet at school so that other people can go there and download the games and play them for free, it's giving them a wider audience as well, and some recognition for what they're doing.”

### Creativity, collaboration and sharing

A future development planned for MissionMaker is giving users the opportunity to add their own backgrounds and 3D characters that they have created with other design software tools now increasingly used in schools. This could lead to collaboration and sharing between different schools. Burton-Wilcock illustrates this point:

“And then they could share, it would be a sort of social networking, they could share backgrounds, so you could have a primary school working with a college, saying we want some Tudor characters or some Tudor backgrounds 'cause we want to make a history game, and I think again that sort of collaboration and real need would be a useful learning space.”

This also has the potential to give young people “some useful industrial work skills in terms of developing 3D programming skills”, Burton-Wilcock adds.



Image 5: The MissionMaker interface

(image reproduced with kind permission of Donna Burton-Wilcock)

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### Derek Robertson

National Adviser for Emerging Technologies and Learning, Learning and Teaching Scotland

Derek Robertson runs the Scottish Centre for Games and Learning, the Consolarium ([www.ltscotland.org.uk/usingglowandict/gamesbasedlearning/consolarium.asp](http://www.ltscotland.org.uk/usingglowandict/gamesbasedlearning/consolarium.asp)), from where he leads games-based learning initiatives in Scottish schools. Projects include the use of Guitar Hero on the Nintendo Wii or Dr Kawashima's Brain Training on the Nintendo DS in the classroom.

#### Contextualising learning through fantasy and relevance to the learner

Robertson advocates the use of digital games in school as they create a context for children's learning:

"In primary school [...] learners cope with learning, new learning, when you link it [...] to previous learning, when we link it to things they know about, when the experiences they've had, and the things that they can do, when we can build on these things."

This is where games come in, with their ability to suspend disbelief by creating fantasy. The games also relate to children's popular culture and thus make the learning relevant to them. Robertson refers to the game Guitar Hero in his example:

"Now for me Guitar Hero was amazing. I bought Guitar Hero and [...] before I knew it, [it was] on the widescreen in my Consolarium. I was a rock star playing in a rock venue, playing songs that I knew [...]. If you can get learners to suspend their disbelief, then the teacher can take children places, and that for me is a huge thing, suspension of disbelief, cultural resonance, all these things, 'cause we forget that children are still children [...]. When we put it

in primaries, we found the children loved this because rock music is quite big with kids. Their mums and dads are wearing Ramones T-Shirts, Thin Lizzie, Deep Purple, Nirvana [...]. When I was wee, I didn't really like my parents' music, but kids now are liking what their mum and dad [like]. [...] I think you got to tap into what's happening culturally in school and you recognise that and where appropriate try and use it."

#### Competition and the goal of self-improvement

Competition is part of the appeal of games. However, the competition doesn't necessarily have to be against others but can be with oneself. Robertson describes this drive to self-improve in relation to Dr Kawashima's Brain Training:

"What we're finding with games is the kids aren't really that bothered about having the highest score and beating people, but what we found, and this comes back to Dr Kawashima, was that children are more concerned with self-improvement than they were with beating their peers. So that idea of competition, it's a healthy competition, but is healthy in that they don't necessarily want to have the highest score. They'd like it, but they just want to get better."

The children's goal was to have a low 'brain age', which is the game's metaphor for a high overall score. This motivated them to practice their math skills outside of the game as well, says Robertson:

"Children became focused on mental maths. It became a cool aspiration [...] for you to have a low 'brain age'. To have a low 'brain age', you had to be good at your mental maths. So we've got stories of children practicing in school and away from the computer and away from the DS, taking home ready reckoners [...].

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so they could do their times tables, practicing on their own so they could get better [...]. When do you hear of children choosing to do their sums?"

#### Reward and curiosity

The 'brain age' is part of the highly engaging reward structure of the game. As illustrated above, the children found it rewarding to see their 'brain age' go down. After each activity the player also sees how well they did expressed in the form of an animation that uses speed as a metaphor ('walking speed', 'bicycle speed', 'train speed', etc). Robertson illustrates this point:

"If you were slow, you were walking speed, and when somebody was faster, they got bicycle speed, 'Oh, bicycle speed!', and so all these things happen, and it was this intrinsic motivation on the part of the learner to self-improve, it wasn't extrinsic. They weren't doing it to satisfy their teacher or their mum and dad [...]. They wanted to intrinsically improve, they wanted to better themselves. I think that's a fantastic culture to have [...]. The competition was with yourself."

Further, the game contains 'Easter eggs', ie new activities are unlocked the longer the game is played, in a form of 'staged gratification':

"[There are] a lot of Easter eggs hidden in the game. [... It's] this degree of staged gratification [...]. You've got three games to begin with. When you play the first time, another game opened, 'Oh, a different game!', then you saw the rest of them with the question marks, 'I wonder what they are?', so that kind of intrinsic curiosity that's in us all, inquisitiveness, it's whetted."

#### Feedback

Another engaging element of Dr Kawashima's Brain Training is that the feedback is immediate, always positive and encouraging, Robertson claims:

"[The children] love the immediacy of the response. When they get a sum correct, bang, another one comes in. With Dr Kawashima, when they didn't get things correct, they didn't have that sense, I've not got it right, the way they would maybe with their teacher or with their jotter or with their textbooks. They knew they had the chance, and there was no kind of negative feedback, it was always encouraging, always something that was kind of supportive, and if they didn't do well, they would come back to it. I've heard very, very, very few accounts of children not coming back to it and not making progress."

#### Adaptivity

Like in effective classroom teaching, games also adapt to and differentiate according to ability level of the player, as Robertson explains:

"When you're a class teacher, children do have different abilities, and so [...] I would maybe have my ability groups separated, so that in order to help children progress at their pace, and to get them moving the best they can, I wouldn't give my one group [...] the book they couldn't cope with [...], whereas I'd give it to another group that could cope with it [...]. So you differentiate in terms of the level of task and demand that's placed on the learner, depending on how you perceive their abilities and their needs. [Games] have it built in because if you keep failing you won't go back to it. As humans we hate to fail, and I think that's one of the reasons as well why school doesn't work for some kids also [...]."

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They fail a lot and they know that. They're in the bottom group and it has an impact on how they see themselves. With the games world, they're given that structure in such a way, ok let's help you, let's take back a step, let's present it to you in a lot more simplistic way so you get success and build up your competence level. And it does that in a non-threatening way, in a very supportive way [...]. The feedback they get about their progress [...], they seem to accept it in a different way than they maybe would from what would traditionally be offered at school."

### Collaboration

Instead of competition, as discussed above, Robertson says the teachers also started seeing collaboration between the children who began to share knowledge and expertise. Robertson illustrates this point referring to the Nintendo DS puzzle adventure game Professor Layton and the Curious Village and the game Nintendogs:

"Children are in the Professor Layton world and they're making their way through the mystery and they're solving puzzles and they're finding out about this story, unlocking lots of events, meeting different characters. However, they'll easily support their colleagues, their peers, to help them move forward and learn from each other. And same with Nintendogs, [...] we're finding that children are becoming very collegiate, very supportive, encouraging [...]. They don't see these hierarchies, they're all equal in terms of their abilities, [...] there's very little sense of hubris, 'Oh, look at me, look how good I am.' They seem to be very accommodating and sharing, and it's almost as if adults haven't really understood the way that young people engage with games, in the way in which they share knowledge, and readily share knowledge, and share expertise and experiences."

### Sensory stimulus and realism

With Nintendogs, the functionality of the Nintendo DS games console, 'a beautiful, interactive device', according to Robertson, makes the game highly responsive and engages the senses.

This also heightens the realism of the gaming experience:

"You can speak to [your dog], you can control it with your voice, you can touch it with the stylus, you can blow on the pressure sensitive mic. The aesthetics are beautiful. It rolls on its back, it reacts to wherever you touch it. So it's such a beautifully engaging, tactile experience. You're touching it, it's almost as if it's part of you, and so for the children, it's almost as if they believe it's a dog."

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### Dawn Hallybone Teacher and ICT Coordinator

Dawn Hallybone is a teacher and ICT Coordinator at an east London primary school. Her school uses Nintendo DS and Nintendo Wii games consoles with games such as Dr Kawashima's Brain Training, Professor Layton and the Curious Village, Nintendogs and Mario Kart to enhance learning. Here she describes how MarioKart, a racing game for the Nintendo Wii, was used for cross-curricular teaching:

"We used MarioKart in Year 6 this term. We had a whole term's work called forces – cars and carting forces and friction – and we did lots of timing work, we planned circuits, we did our own adverts for MarioKart. Each week we raced the same circuit with the same car, and we had leader boards around the classroom, and they had to work out what their average time was, who was the fastest, and each person each week got a certificate for being the fastest, and at the end of the topic we actually went carting on the school playground and compared the times of carting on the playground to carting in the Wii. In movable vehicles and design technology they made their own cars. They wrote about the characters [...], we wrote a story about Bowser's Island, so it was all linked cross-curricular."

The children came up with the expression 'secret learning' to illustrate the games-based learning process:

"One of the children in my class [...] came up with this brilliant phrase called secret learning. It's like they say, 'We know we're learning, but it's like secret learning, isn't it Miss, because you say we're playing a game'."

### Control

The appeal of games-based learning, especially with the Nintendo

DS games console, is that it gives children a sense of control, putting 'the learning into their hands'. Hallybone illustrates this point below:

"[What] they quite like about it is, they say the learning is in their hands. [...] Whereas before if a teacher's doing a mental maths test, we would read out the questions, and they all had the same time to answer them. With the times 20 and times 100 [in Dr Kawashima's Brain Training] they work at their own pace and although it's competitive, they're competing against themselves, not against other people. So it really felt like, especially for the older children, that the learning had been given back to them [...]. A lot of them have the game at home or their parents have the game at home, and it was something that they could all relate to [...]. The children actually said the learning is in our hands now, they're in charge of the console, they're in charge of the games. I always put up, when I'm doing it as a mental [activity] or starting a plenary, three games that I've chosen that I want them to do with a learning objective matched to it, and then they always have free choice."

### Assessment

Digital games allow players to assess their own progress within a game, eg via their score, and to compare it with other players (see Douch et al, 2010). Scores can also be used for school-based assessment, as Hallybone explains in relation to Dr Kawashima's Brain Training:

"With the times 20 and times 100 we ask them to keep a note of their scores, so their times that it takes them to do it, and we evaluate that at the end of every six week block [...]. It's not with every child, but on average they improve their speed, but we also then get them to write their own – if you were to write 20 [maths] questions, what would you write?"

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However, comparing their score with others seems less important for the children. This makes it more engaging for students who are less comfortable with maths, Hallybone adds. Similar to Robertson's observation above, competing against oneself and self-improvement takes priority:

"[It's] less important, only if they want to. I don't ask them to read out their scores 'cause it's all about them competing against themselves and not against the rest of the class. My score's always completely transparent, and then if someone gets within it [...] they call out and go, 'I beat you, Miss'. If they want to, they can talk about [their scores], but it's almost taken that element away with it, so [it's better for] those children that aren't comfortable with maths and are always thinking, 'Oh God, I've got the worst time again' because they have 15, 20 minutes to work through the three games."

#### Visual and narrative elements

The school also used Professor Layton and the Curious Village to, amongst other things, inspire children's writing. Hallybone believes that it is the graphic and narrative elements that make the game so engaging:

"It's the graphics and it tells a story, and for those children whose literacy skills may not be the best, they've got a source straight away. For those that struggle coming up with ideas and imagination, they have that rich subtext all ready for them, and they can see the picture and describe what does he look like, what do you think he's feeling, and they've got that as a basis. And for the Gifted and Talented writers, just the richness of the text and the images and the story got them. [...] The writing that came out of it was amazing."

#### Rules and collaboration

When they first played Professor Layton and the Curious Village, and learned the rules of the game, the children were encouraged to collaborate with each other instead of all knowledge being imparted by the teacher. Hallybone describes this process:

"They all had to learn together, so we went through the introduction together. I had a copy [of the game] and they all had a copy. If I want to show them, I often make use of a visualiser and [put] the console on the visualiser which brings it up on the interactive white board, and we talked through it, and then I said, 'Right, you now have to go off and find out how', so they have to do it as teams [...] but also using other children in the class. So if someone found out the puzzle, we'd say, 'Well, you might want to go and ask them to give [you] clues'. So they were all working with each other and learning from each other instead of us [...], the teacher, being that fountain of knowledge [...]. We wanted to step away from that role and learn with them."



**Image 6: Children playing on the Nintendo DS**

(image reproduced with kind permission of Dawn Hallybone)

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### Summary of expert interviews

The learning elements the interviewees referred to most frequently or identified as most important to were:

- **Challenge**, ie providing an appropriate level of difficulty in the game
- **Fantasy and narrative**, ie an imaginary environment or the story behind the game
- **Sensory stimuli**, ie engaging visual and sound effects
- **Social aspects**, ie the appeal of playing the game with or against other people, including collaboration and discussion.

Other learning elements, discussed by more than one interviewee included:

- **Authenticity/ realism/ fidelity**, ie game effects and character behaviour that contribute to making the game more realistic
- **Competition**, which can be with other players or with oneself
- **Control**, ie a feeling of being in control of one's actions
- **Creativity**, ie creating artefacts in the game
- **Feedback**, ie receiving information on how well one is doing in the game
- **Mystery and curiosity**, ie the player wanting to find out what happens next

- **Relevance/ interest to the learner**, ie being able to relate to the game in a meaningful way
- **Reward**, ie receiving a prize or incentive in return for one's achievements
- **Sense of improvement**, ie feeling oneself get better at the game.

Further elements discussed in the interviews are included in the taxonomy in the next section of this report.

Many interviewees also agreed that discussion was an important aspect of games-based learning as it lead to reflection and consequently to learning. Discussion can take place in online communities or discussion forums or it can be classroom-based and teacher-led. Furthermore, games are only one way of engaging learners and should be supported by other tools or teaching methods. Finally, the mix and balance of learning elements was seen as key, in order to engage different types of learners.

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## Taxonomy of learning elements of digital games

Based on the literature review and the expert interviews this report proposes a taxonomy of learning elements of digital games (see Table 4 and Table 5).

The left column in the two tables below lists the learning elements identified as important in the literature reviewed in this report (see pages 7-9) or in the expert interviews (see pages 10-31). It also includes a short description of each element.

The middle column lists the definitions or descriptions that the authors who have been reviewed offer for the learning elements. It presents the richness of descriptions and definitions and the variety of attributes different authors place emphasis on in relation to each learning element.

The right column includes shortened quotes from the expert interviews to illustrate each element and give practical examples.

The elements referred to most often, or which the authors and experts interviewed identify as most important (ie challenge, fantasy/narrative, feedback, goals, sensory stimuli and social aspects) are listed in Table 4. The additional elements can be found in Table 5.

Further research was conducted to assess the relative importance teachers and students place on each learning element (see Kirkland 2010).

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Table 4: Learning elements of digital games – six key elements

Element	Description based on literature	Description based on expert interviews
<p><b>Challenge</b></p> <p>A test of the learner's skills, set at a level to stretch his/her abilities</p>	<p>"Tasks require effort and are non-trivial" (Whitton, 2010, p23)</p> <p>"Optimal level of difficulty and uncertain goal attainment" (Garris et al, 2002, p447)</p> <p>"The learner gets ample opportunity to operate within, but at the outer edge, of his or her resources, so that [...] things are felt as challenging but not 'undoable'" (Gee, 2003, p223)</p> <p>"Always being kept in a narrow zone between the game's being too hard ('I give up') and too easy ('I'm not challenged at all')" (Prensky, 2006, p59)</p> <p>"Does the program have a variable difficult level?", "Does the program include randomness?", "Does the program include hidden information selectively revealed?" (Malone, 1984, p32)</p> <p>"Games should be sufficiently challenging, match the player's skill level, vary the level of difficulty, and keep an appropriate pace" (Sweetser and Wyeth, 2005, p6)</p>	<p>"As human beings we like challenge, and the best engineered challenges are set at a level that engages, involves, gets us frustrated." (Rylands)</p> <p>"Students found it engaging mostly because of the game tasks which were difficult enough, not too easy but not too difficult." (Oksanen)</p>
<p><b>Fantasy/narrative</b></p> <p>Imaginary environment, characters or story which can stand as a metaphor for the real world</p>	<p>"Existence of a make-believe environment, characters or narrative" (Whitton, 2010, p23)</p> <p>"Imaginary or fantasy context, themes, or characters" (Garris et al, 2002, p447)</p> <p>"Does the program include an emotionally appealing fantasy?", "Does the fantasy provide a useful metaphor?" (Malone, 1984, p32)</p>	<p>"Although it's a fantasy world, it does in many ways replicate the real world. The Spirit Channels [...], they are in fact roads really, and all of the monsters in the Spirit Channels are based on car designs [...] because it would be quite dull otherwise. It makes the narrative a bit more interesting." (Seymour on Code of Everand)</p> <p>"There is a plot, there's an antagonist, you're the protagonist." (Star)</p> <p>"People wanted to see how the story carried out. [...] It's based around sort of a story that emerges as the game carries on [...], it held everything together. Without a story line there wasn't a context." (Whitton)</p>

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Element	Description based on literature	Description based on expert interviews
<b>Fantasy/ narrative cont'd</b>		<p>"If you can get learners to suspend their disbelief, then the teacher can take children places." (Robertson)</p> <p>"The richness of the text and the images and the story got them." (Hallybone)</p>
<b>Feedback</b> Response to the learner's actions or progress within the game	<p>Games provide "immediate, relevant and clear" feedback, "enabling players to learn from their successes and mistakes" (Douch et al, 2010, p17)</p> <p>"Performance feedback should be presented in a way that minimizes the possibility of damage to one's self-esteem" (Malone, 1984, p33)</p> <p>"Players should receive feedback on progress toward their goals, [...] immediate feedback on their actions [...] and] should always know their status or score" (Sweetser and Wyeth, 2005, p6)</p> <p>"Feedback lets us know immediately whether what we have done is positive or negative for us in the game, whether we are staying within or breaking the rules [...], moving closer to the goal or further away [...], and how we are doing versus the competition" (Prensky, 2001, p121)</p>	<p>"They love the immediacy of the response. When they get a sum correct, bang, another one comes in [...] and there was no kind of negative feedback, it was always encouraging always something that was kind of supportive." (Robertson on Dr Kawashima's Brain Training)</p> <p>"[Feedback is] always kind of automatic when it's in the game because the game can't really read the minds or react to the players, and it's also a matter of resource when developing the game, like building a large enough feedback system, it's a really, really big job." (Oksanen)</p>
<b>Goals</b> Clear aims that are meaningful and achievable but stretch the learner's abilities	<p>"There are explicit aims and objectives" (Whitton, 2010, p23)</p> <p>"Games should provide the player with clear goals at appropriate times" (Sweetser and Wyeth, 2005, p6)</p> <p>"Good goals are [...] personally meaningful. For example, the best are often practical or fantasy goals (like reaching the moon in a rocket [...]) rather than simply goals of using a skill (like solving arithmetic problems)" (Malone, 1984, p32)</p> <p>"Worthwhile goals, i.e. goals the players really want to achieve [...], goals kids can relate to personally and emotionally [...], making sure the player's goals are clear and compelling" (Prensky, 2006, p60)</p>	<p>"Children became focused on mental maths. It became a cool aspiration [...] for you to have a low 'brain age'." (Robertson on Dr Kawashima's Brain Training)</p>

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Element	Description based on literature	Description based on expert interviews
<p><b>Goals cont'd</b></p>	<p>"The goal is often stated at the beginning of the rules: Your goal is to get the highest score, to reach the end, to beat the big boss, to capture the flag, to get the best hand, and so on" (Prensky, 2001, p120)</p> <p>"Clear, specific, and difficult goals lead to enhanced performance" (Garris et al, 2002, p449)</p>	
<p><b>Sensori stimuli</b></p> <p>Engaging visual and sound effects</p>	<p>"Dramatic or novel visual and auditory stimuli" (Garris et al, 2002, p447)</p> <p>"Sensory curiosity: audio and visual effects" (Malone, 1984, p32)</p> <p>"Graphics – the stunning visual representations of what the game is about and the increasingly lifelike representations of the game's characters. This lush world of 3D animation and video is known in the games business as 'eye candy'" (Prensky, 2006, p86)</p>	<p>"We go for really high quality graphics [...]. If they can create something relatively quickly that looks professional, that looks good, it gives them the confidence and the determination to persevere with that." (Burton-Wilcock on MissionMaker)</p> <p>"You can speak to [your dog], you can control it with your voice, you can touch it with the stylus, you can blow on the pressure sensitive mic. The aesthetics are beautiful." (Robertson on Nintendogs)</p>
<p><b>Social aspects/ community</b></p> <p>Playing with or against other people and social interaction inside and outside the game</p>	<p>"Games should support and create opportunities for social interaction", including "competition and cooperation", "social interaction between the players (chat, etc)" and "social communities inside and outside the game" (Sweetser and Wyeth, 2005, p6)</p> <p>"People: Other individuals take part" (Whitton, 2010, p23)</p> <p>"The inherently social aspect of games – you do them with other people" (Prensky, 2001, p123)</p> <p>"Community: Supporting play outwith the game and encouraging players to talk to one another and work collaboratively [... eg in] forums or other online community space, and tasks that require collaboration" (Whitton, 2010, p146)</p>	<p>Social aspects in general:</p> <p>"The catalyst for somebody wanting to engage in something becomes a lot, lot stronger if their friends are doing it or if in some way they can involve their friends." (Star)</p> <p>"It's so much more rewarding, knowing that there's another person, that you're interacting with a real person, even if you can't see them [...] and that's so much more rewarding than playing against the computer." (Star)</p> <p>Audience:</p> <p>"To see somebody actually using something that you've made, and enjoying using something that you've made, it's giving it authentic purpose [...] and some recognition for what they're doing." (Burton-Wilcock on MissionMaker)</p>

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Element	Description based on literature	Description based on expert interviews
<p><b>Social aspects/ community cont'd</b></p>	<p>“Games can be played in multiplayer mode [...]. Some online games rely on large communities of players who work together to achieve goals” (Douch et al, 2010, p18)</p> <p>“Knowledge is dispersed in the sense that the learner shares it with others outside the domain/ game” (Gee, 2003, p227)</p> <p>“Learners constitute an ‘affinity group’, that is, a group that is bonded primarily through shared endeavors, goals, and practices” (Gee, 2003, p227)</p>	<p>Collaboration:</p> <p>“When we’re using the Wild Earth game and the children are researching, they take notes into [PrimaryPad] and [...] they can be adding to the same text and correcting and chipping in, contributing.” (Rylands)</p> <p>“[The students] also liked the opportunity to play the game with their friends.” (Oksanen)</p> <p>“They’ll easily support their colleagues, their peers, to help them move forward and learn from each other, [...] children are becoming very collegiate, very supportive, encouraging, [...] they share knowledge and [...] expertise and experiences.” (Robertson)</p> <p>“If someone found out the puzzle, we’d say, ‘Well, you might want to go and ask them to give [you] clues’. So they were all working with each other and learning from each other instead of us [...], the teacher, being that fountain of knowledge.” (Hallybone)</p> <p>Discussion:</p> <p>“When students have played the game, there are in many cases reasons for having some kind of feedback conversation afterwards with the teacher. [...] Just playing the game is not enough.” (Oksanen)</p> <p>“[The discussions were] about the decisions that were made, about what it means, what some of the role play means, really opening up the underlying attitudes [...]. But it isn’t one that needs to be lead by the teacher because the students are all discussing between [themselves].” (Star)</p> <p>“They will be learning a lot more when they go on the internet and they read around the discussion forums or when they go on the cheat sites and look at alternative ways of doing it.” (Whitton)</p>

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Table 5: Learning elements of digital games – additional elements

Element	Description based on literature	Description based on expert interviews
<p><b>Active learning</b></p> <p>Learning ‘by doing’, ie actively engaging in the game-related task</p>	<p>“Games require the player to interact in order to progress [...], the skills and knowledge base is developed through participation in the game’s tasks” (Douch et al, 2010, p17)</p> <p>Games “encourage active and critical, not passive, learning” (Gee, 2003, p221)</p>	<p>“They say the learning is in their hands, [...] they work at their own pace.” (Hallybone)</p>
<p><b>Adaptivity/ Individualisation</b></p> <p>The difficulty of the game or task adjusts itself to suit the learner’s ability level</p>	<p>A “game continually adjusts itself to each player’s skills and abilities” (Prensky, 2006, p60)</p> <p>The ability “to tailor [...] challenges to each player’s ability, almost always without ever letting the player know it’s happening” (Prensky, 2006, p91)</p> <p>“The level of difficulty goes up or down automatically depending on what you do” (Prensky, 2001, p121)</p> <p>“Games are tailored to the individual through content and pre-set levels; [...] the game-play can adapt to the individual’s skills and knowledge by making tasks easier/ more difficult or by providing/ withdrawing support” (Douch et al, 2010, p17)</p>	<p>“When you’re a class teacher, children do have different abilities, [...] so you differentiate in terms of the level of task and demand that’s placed on the learner, depending on how you perceive their abilities and their needs. [Games] have it built in.” (Robertson)</p>
<p><b>Assessment</b></p> <p>Learners can review how well they are doing in the game and compare it with others</p>	<p>“Gamers can assess their progress within a game” and “compare their achievements with other players” (Douch et al, 2010, p17)</p>	<p>“We ask [the children] to keep a note of their scores [...], and we evaluate that at the end of every six week block.” (Hallybone)</p>

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Element	Description based on literature	Description based on expert interviews
<p><b>Authenticity/ Realism/ Fidelity</b></p> <p>Visual, sound and tactile effects and character behaviour that contribute to making the game more lifelike and convincing</p>	<p>“Rich 3D worlds, sound effects and dynamic action – even simple haptic (force and tactile) effects, such as ‘rumble’ forces in joysticks and gamepads, all contribute to today’s game players’ immersive experiences” (Stone, 2008, p14)</p> <p>“Task Fidelity - the design of appropriate sensory and behavioural features into the end user’s task that support the delivery of the desired learning effect</p> <p>Interactive Technology ‘Fidelity’ – [...] the degree to which input (control) and display technologies need to be representative of real life human-system interfaces [...]</p> <p>Context Fidelity - the design of appropriate ‘background’ sensory and behavioural detail (including avatar/agent styles and behaviours) to complement – and not interfere with – the task being performed and the learning outcomes” (Stone, 2008, p28)</p>	<p>“It’s not about some random world of aliens that have got nothing [to do] with reality or lots of cutesy, happy [characters] that are just jumping around. The reality is actually it’s a bit dirty, it’s a bit grimey and people say, ‘That’s a bit whack’.” (Star on Choices and Voices)</p> <p>“[The dog] rolls on its back, it reacts to wherever you touch it. So it’s such a beautifully engaging, tactile experience. You’re touching it, it’s almost as if it’s part of you, and so for the children, it’s almost as if they believe it’s a dog.” (Robertson on Nintendogs)</p>
<p><b>Competition</b></p> <p>Can be with others or with oneself, with the aim of outperforming others or self-improvement</p>	<p>“The goal is to achieve an outcome that is superior to others” (Whitton, 2010, p23)</p> <p>“Conflict, competition, challenge, and opposition are the problems in a game you are trying to solve. [...] It] does not necessarily have to be against another opponent, real or AI (artificial intelligence). It can be a puzzle to solve, or anything that stands in the way of your progress” (Prensky, 2001, p122)</p>	<p>“For the groups [of students] that were doing really well, competition was highly motivating, but for those that weren’t, it was demotivating.” (Whitton)</p> <p>“Kids aren’t really that bothered about having the highest score and beating people, [...] children are more concerned with self-improvement than they were with beating their peers [...]. The competition was with yourself.” (Robertson)</p>

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Element	Description based on literature	Description based on expert interviews
<p><b>Control</b></p> <p>The learner is able to manage and direct his/her own actions in the game</p>	<p>“Players should feel a sense of control over their actions in the game” (Sweetser and Wyeth, 2005, p5)</p> <p>“Active learner control” (Garris et al, 2002, p447)</p>	<p>“It really felt like [...] the learning had been given back to them. [...] The children actually said the learning is in our hands now, they’re in charge of the console, they’re in charge of the games.” (Hallybone)</p> <p>“This idea of ‘being good’, [...] that’s the perception of seeing yourself as an expert, so the pleasure you get from a feeling of being in control, of being good, of mastery.” (Whitton)</p>
<p><b>Creativity</b></p> <p>Using imagination to solve problems or produce (and share) artefacts in the game</p>	<p>“The opportunity for players to be creative, either through lateral thinking and creative problem-solving or through the creation of their own artefacts within the game (eg creating posters, video, or stories)” (Whitton, 2010, p146)</p> <p>“The ability to create, and to share (and even sell) one’s creations” (Prensky, 2006, p63)</p>	<p>Creativity and sharing: “It would be a sort of social networking, they could share backgrounds [and characters], so you could have a primary school working with a college.” (Burton-Wilcock)</p> <p>“Part of the ARG is going out and creating artefacts and using digital photography, video, etc.” (Whitton)</p>
<p><b>Mystery/ Curiosity</b></p> <p>Element of novelty, surprise and informational complexity within the game</p>	<p>“Mystery is enhanced by [...] complexity, novelty, surprise and violation of expectations [...] and information that is incomplete or inconsistent” (Garris et al, 2002, p450)</p> <p>“Cognitive curiosity: Does the program include surprises?” (Malone, 1984, p32)</p> <p>Games “stimulate and satisfy curiosity [...] by providing an optimal level of informational complexity [...], the environments should be neither too complicated nor too simple” (Malone, 1984, p34)</p>	<p>“It’s kind of the mystery, the curiosity angle, I want to find out what happened next.” (Whitton)</p> <p>“Then you saw the rest of [the games] with the question marks, ‘I wonder what they are?’, so that kind of intrinsic curiosity that’s in us all, inquisitiveness, it’s whetted.” (Robertson on Dr Kawashima’s Brain Training)</p>

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Element	Description based on literature	Description based on expert interviews
<b>Puzzle-solving</b> Mental puzzles, riddles or problems need to be solved to progress in the game	"Ongoing puzzles, riddles and problems that need to be solved [...]. These should start relatively easy [...], but can then get gradually more difficult" (Whitton, 2010, p146)	"It was very satisfying to be working on a puzzle for a long time and talking about it and thinking about lots of things, trial and error, thinking about possible solutions." (Whitton)
<b>Rapid decision-making</b> Having to make a series of choices fast and continuously to move forward in the game	"Complex computer and videogames [... are] all about making decisions [...]. When kids play complex games, they are making decisions rapidly and continuously [...], once every half-second" (Prensky, 2006, p61)	"You have to make a decision every 20 seconds or less, [...] it's continuously getting you to interact with it." (Star)
<b>Relevance/ Interest to the learner</b> Being able to relate to the game in a meaningful way	"Goals kids can relate to personally and emotionally", decisions "that are meaningful to the player" (Prensky, 2006, p60f)	"If you construct something for a specific group of people, and I mean really specific group of people, you have a very good chance of engaging them. [...] The feedback we got, 'I really like it, it's like round here, it's about me, [...] my people, my community, I recognize that'." (Star)  "[A] demotivating factor was just lack of interest in either the game [...] or [lack of] interest in subject matter." (Whitton)

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Element	Description based on literature	Description based on expert interviews
<p><b>Reward</b></p> <p>Prize or incentive given in return for what the learner has achieved, matching his/her increasing skills level</p>	<p>"For learners of all levels of skill there are intrinsic rewards from the beginning, customized to each learner's level, effort, and growing mastery and signaling the learner's ongoing achievements" (Gee, 2003, p223)</p>	<p>"The more adventure games you play, the more self-references you get from newer adventure games to older adventure games." (Whitton)</p> <p>"Easter eggs hidden in the game." (Robertson)</p>
<p><b>Role</b></p> <p>The learner takes on a specific part in the game and thus acquires skills and knowledge relevant in the real world</p>	<p>"A system in which students learn to work (and thus to think) as doctors, lawyers, architects, engineers, journalists, and other valued reflective practitioners—not in order to train for these pursuits in the traditional sense of vocational education, but rather because developing those epistemic frames provides students with an opportunity to see the world in a variety of ways that are fundamentally grounded in meaningful activity and well aligned with the core skills, habits, and understandings of a postindustrial society" (Shaffer, 2005, p2)</p>	<p>"The players were doing up an apartment, they were supposed to paint the walls, chose the paint colour – decorating. And the collaborative tasks were, for example, one player could see the prices for the paints and another player could see the size of the wall and maybe the third one had a calculator, so only he can calculate the area." (Oksanen)</p>
<p><b>Rules</b></p> <p>Conditions and restrictions that direct the actions the learner can take within the game</p>	<p>"The activity is bounded by artificial constraints" (Whitton, 2010, p23)</p> <p>"Game activity [...] occurs in a fixed space and time period with precise rules governing game play" (Garris et al, 2002, p448)</p> <p>"Rules impose limits – they force us to take specific paths to reach goals and ensure that all players take the same paths. They put us inside the game world by letting us know what is in and out of bounds" (Prensky, 2001, p119)</p>	<p>"They all had to learn together, so we went through the introduction together [...] and we talked through it and then [...] they have to do it as teams." (Hallybone)</p>

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Element	Description based on literature	Description based on expert interviews
<p><b>Safety</b></p> <p>Consequences of risk-taking in the game have no impact on the real world</p>	<p>“The activity has no consequence in the real world” (Whitton, 2010, p23)</p> <p>“Learners can take risks in a space where real-world consequences are lowered” (Gee, 2003, p222)</p>	<p>“[In real life] the cost of failure is high. So if you make a mistake, you might kill somebody [... or] you lose a lot of money [... or] you might lose your credibility [...], so if the consequence of that is a loss in some way, then the game becomes serious.” (Star)</p>
<p><b>Scaffolding and sense of improvement</b></p> <p>Gradually increasing level of difficulty and seeing oneself make progress in the game</p>	<p>“Scaffolding”: Games get “gradually more challenging as the learner progresses [...]. [They] include a number of levels through which a player moves as their knowledge and skills improve” (Douch et al, 2010, p18)</p> <p>“Learning situations are ordered in the early stages so that earlier cases lead to generalizations that are fruitful for later cases” (Gee, 2003, p225)</p> <p>“Leveling-up means feeling yourself getting better at the game, and achieving mastery over something difficult and complex” (Prensky, 2006, p59)</p>	<p>“Swift and steady improvement – for instance, being able to complete the first few levels really, really quickly or playing a role playing game and being able to [...] join a new guild very quickly.” (Whitton)</p> <p>“They don’t necessarily want to have the highest score. They’d like it, but they just want to get better.” (Robertson)</p>
<p><b>Transfer</b></p> <p>Learning from the game can be applied in other games or in a real world context</p>	<p>“Gamers use knowledge and skills learnt through playing a game in other games and in real world contexts” (Douch et al, 2010, p18)</p> <p>“Learners are given ample opportunity to practice, and support for, transferring what they have learned earlier to later problems” (Gee, 2003, p226)</p>	<p>“When they as a real child rather than their avatar get to the curb, that they then automatically do what they’ve been trained to do as an avatar in the game.” (Seymour on road safety behaviour and Code of Everand)</p>

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## Design principles for digital games-based learning experiences

Based on the literature review and the expert interviews, this report offers recommendations for the design of effective digital games-based learning experiences.

They are aimed at classroom teachers, teacher trainers and other educators. Together with the 'methods to enact the learning elements' generated in the teacher workshops (see Kirkland 2010), the design principles can be applied in formal education settings and used as the basis for games-based learning experiences that can, but don't have to, include digital games.

The following design principles relate to the learning elements of games as listed in the taxonomy in Tables 4 and 5. Digital games-based learning experiences should:

- use fantasy and narrative to create an engaging context for the learning experience
- relate to prior interests of the learner
- be visually stimulating, eg through the use of multimedia features
- be challenging with adaptable and increasing levels of difficulty
- have clear and meaningful goals
- provide immediate feedback to give the learner a sense of control
- provide opportunities for learners to make decisions that influence the learning experience

- encourage social interaction between learners by providing opportunities for collaboration and discussion – as part of the game, in the classroom and/or online
- focus on progression and self-improvement rather than competition between learners.

Further recommendations for the design of games-based learning experiences can be found, for example, in Mitchell and Savill-Smith (2004), Oxland (2004) or Prensky (2001).

The report concludes that there is a whole range of motivational elements in digital games that encourage learning. The publications reviewed and the experts interviewed consider different elements to be important although there is some degree of commonality. Common elements identified include challenge, fantasy/ narrative, feedback, goals, sensori stimuli and social aspects/ community.

In order to create an engaging games-based learning experience, it need not necessarily accommodate all of the above elements. Instead it should include a mix and a balance of elements in order to engage different types of learners. Finally, it is important that games-based learning experiences are mediated by a teacher to facilitate learning and are supported by other digital tools and teaching methods.

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## About Futurelab

Futurelab is an independent not-for-profit organisation that is dedicated to transforming teaching and learning, making it more relevant and engaging to 21<sup>st</sup> century learners through the use of innovative practice and technology.

We have a long track record of researching and demonstrating innovative uses of technology and aim to support systemic change in education – and we are uniquely placed to bring together those with an interest in improving education from the policy, industry, research and practice communities to do this. Futurelab cannot do this work on its own.

We rely on funding and partners from across the education community – policy, practice, local government, research and industry – to realise the full potential of our ideas, and so continue to create systemic change in education to benefit all learners.

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## Key to Themes

Futurelab understands that you may have specific areas of interest and so, in order to help you to determine the relevance of each project or publication to you, we have developed a series of themes (illustrated by icons). These themes are not intended to cover every aspect of innovation and education and, as such, you should not base your decision on whether or not to read this publication on the themes alone. The themes that relate to this publication appear on the front cover, but a key to all of the current themes that we are using can be found below:



Digital Inclusion – How the design and use of digital technologies can promote educational equality



Teachers and Innovations – Innovative practices and resources that enhance learning and teaching



Learning Spaces – Creating transformed physical and virtual environments



Mobile Learning – Learning on the move, with or without handheld technology



Learner Voice – Listening and acting upon the voices of learners



Games and Learning – Using games for learning, with or without gaming technology



Informal Learning – Learning that occurs when, how and where the learner chooses, supported by digital technologies



Learning in Families – Children, parents and the extended family learning with and from one another