STUDENT PARTICIPATION IN SERIOUS GAMES DESIGN

MATTHEW IAN BATES

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Abstract

Serious games can be defined simply as games with an educational intent. These games are regularly positioned within a curriculum as simple teaching agents and often lack meaningful participation from learners in their development. In 1992, Roger Hart proposed a model for the roles children play in participatory projects with adults. 'Hart's Ladder' presents eight levels of children's participation moving from tokenistic manipulation of children at the base of this ladder to 'citizenship' at the top where children can initiate and share activities with adults.

This research contributes to knowledge on methods of integrating serious games into formal educational settings by investigating how children, as participants, can work with their educators, as facilitators, to create serious games for use by their peers. Exploratory field studies have worked with secondary school children (11-16 years) to evaluate the hypothesis that higher levels of participation of children in making serious games will produce more effective educational artefacts. Educational artefacts are context specific to each study but encompass the product and accreditation of the process by participants, facilitators and all stakeholders involved.

Experimental work has investigated methods of facilitating a participatory serious games design project led by children with adults in a supportive role at level eight of Hart's Ladder. Results are compared with a design project led by adults who inform and assign specific roles to children (level four) and finally a revised design project led by adults who share decisions with children (level six). The participatory design approach is also applied to a serious games design project with adult offenders (considered students of an educational probation programme) to evaluate its scalability to a wider demographic of learner.

The research concludes that simply increasing the participation of students in making serious games does not consistently produce more effective educational artefacts. Rather, the positioning of learners and adults as 'design partners' at level six of Hart's Ladder produces a more engaging and productive design process together with a more functional and client-sensitive serious game product.

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List of Acronyms

BBFC	British Board of Film Classification
BME	Black Minority Ethnic
CAL	Computer-Assisted Learning
COD	Call Of Duty
COTS	Commercial Off-The-Shelf Software
CYD	Community Youth Development
ETE	Employment, Training and Education
FPS	First Person Shooter
GBL	Games-Based Learning
GCSE	General Certificate of Secondary Education
HCI	Human Computer Interaction
IT	Information Technology
MMO	Massively Multiplayer Online Game
MUD	Multi-User Dungeon
NPC	Non-Playable Character
NWN	Never-Winter Nights
OCR	Oxford Cambridge and RSA Examinations
PEGI	Pan-European Game Information
RQ	Research Question
SWF	Small-Web Format
VLE	Virtual Learning Environment
WOW	World Of Warcraft

Chapter 1: Introduction

> '*Where the field of games, learning and society is pushing us forward is in identifying and studying how games cultures themselves work, and then designing learning systems based on these properties.*'
>
> Squire, 2007

Serious games can be defined simply as games with an educational intent (Ulicsak & Wright, 2010). These games act as tools or agents to satisfy learning objectives (Gee, 2005) which can contribute to distributed knowledge within a community structure (Yusoff, 2010). Egenfeldt-Nielsen (2010) presents three models for using serious games in formal education; (1) learning *through* games (games typically developed for educational purposes to teach specific elements of a curriculum), (2) learning *with* games (games not specifically developed for educational purposes but used to teach concepts and methods) and (3) learning *by making* games (use of game-authoring tools to learn thorough exploration in order to teach your peers).

In 1992, Roger Hart proposed a model for the roles children play in community projects with adults which he called 'The Ladder of Children's Participation' (Hart, 1992). The model formalised eight discrete levels of participation from children as ascending rungs of a ladder. These levels range from simple manipulation of children at the base of this ladder to the freedom of children to initiate their own activities and share decision making with adults at the top. Coined simply as *Hart's Ladder*, the model is used today by youth activist groups as a conceptual framework to educate others about how children can form effective members of community projects (Driskel, 2002; Zimmerman, 2004). Despite this interest, there is little documented evidence of applications of Hart's Ladder to games-based learning activities, and in particular, to serious games design projects, which is the subject of the research presented here. Figure 1 presents a summary of the eight levels of Hart's Ladder which are discussed further in Chapter 2.

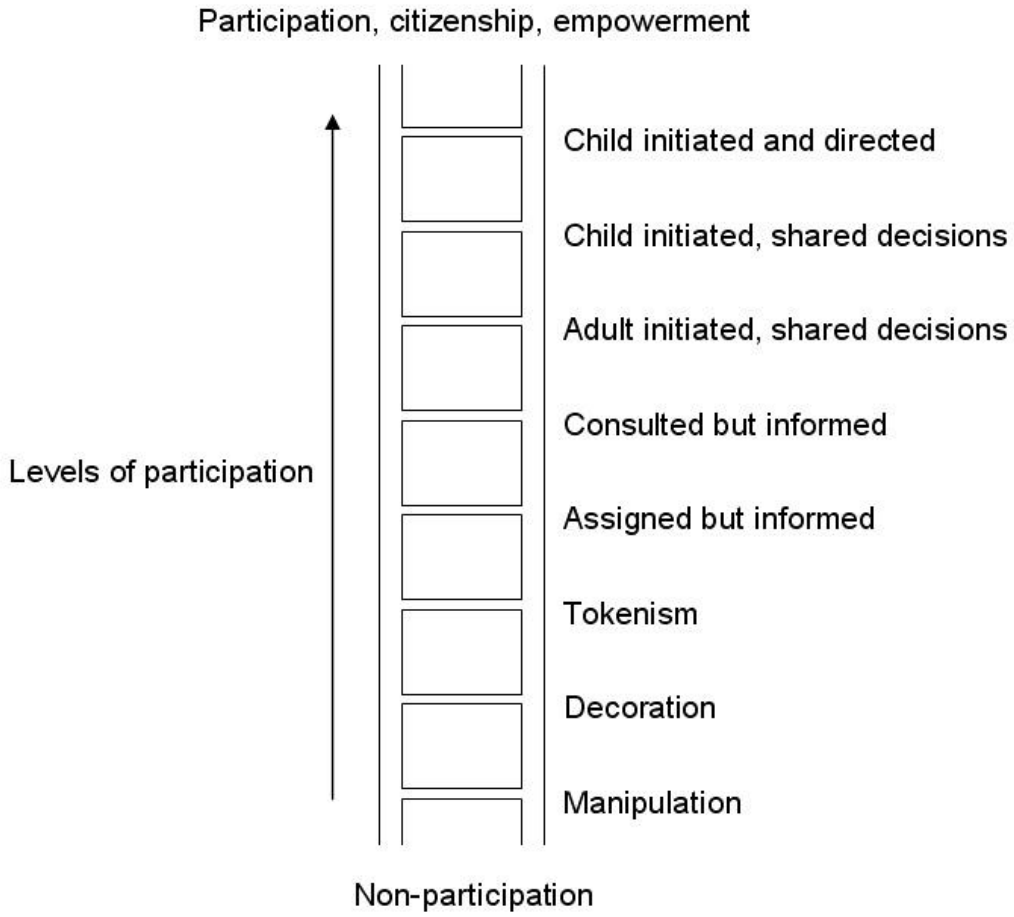

Figure 1: Hart's Ladder as adapted by Reddy and Ratna (2002)

This research seeks to contribute to knowledge of methods of integrating serious games into formal educational settings by investigating how secondary school children (aged 11-16 years) as participants can work with their educators as facilitators to create serious games for use by their peers. The limitations of the learning 'through' games model are presented and it is proposed that contemporary classrooms should move toward a more participatory model of learning 'by making' serious games. Research has evaluated four exploratory studies which have experimented with the roles children and adults play in participatory serious games design projects, using Hart's Ladder as a measure of participation. The results of studies have been compared based on their 'educational artefacts'. Educational artefacts are context specific to each project but encompass the creation of functional and client-sensitive serious game products, and accreditation of the design process by participants, educators and collaborators.

1.1 Research hypothesis

This research seeks to evaluate the hypothesis that higher levels of participation of children in making serious games will produce more effective educational artefacts.

1.2 Research questions

Evaluation of the research hypothesis presented above requires proving that projects offering increased power and responsibility to participants at the higher 'citizenship' levels of the Hart's Ladder model can indeed produce more effective educational artefacts than those positioning participants in a more tokenistic role lower in the model. This task necessitates the development of three important research questions to address the methods and tools employed at increasing levels of Hart's Ladder, and their ability to realise a suitable end product that satisfies project collaborators. Thus, the following three research questions (RQ) are defined here:-

RQ1: Can children design serious games?
RQ2: How do children build and share knowledge during a design process?
RQ3: What software is suitable to facilitate a serious games design process?

1.3 Research variables

The four studies presented as part of this research have worked with different numbers of facilitators from different educational disciplines including teachers, librarians, consultants, probation managers and the research candidate. To answer the above research questions, studies have been devised to interact with both students and their educators to collect data to address the variables outlined in Table 1.

Table 1*: Summary of research variables defined for each research question*

RQ	Research variables
RQ1	- range and suitability of ideas communicated by participants - ability of participants to convert designs into functional media
RQ2	- the amount and type of assistance both required and offered by participants - extent participants use physical and digital design tools to communicate ideas
RQ3	- opinions of participants and educators about software - ability to operate software within a learning environment

1.4 Research design

The research has involved experimentation with methods of structuring this multidisciplinary participatory design approach to short-term serious games design projects of less than 10 weeks. Four exploratory studies have investigated the roles both children and adults play in these projects using Hart's Ladder as an objective measure of children's participation. Discrete levels of participation were selected for each study and compared based on their educational artefacts. Each study has experimented with methods of facilitating participatory design projects by contrasting digital prototyping tools (such as internet blogs and accessible game-authoring software) with physical tools (such as LEGO^{TM}, playing cards and simple pen and paper worksheets). Studies have also attempted to refine methods of data collection combining video-footage and audio-recordings with observer field notes.

1.5 Thesis structure

The thesis is presented as nine chapters. Chapter 1 is the introduction which presents the context of the research, the research hypothesis and research questions used to evaluate the hypothesis. Chapter 2 presents a review of the serious games literature which outlines the limitations of the learning 'through' serious games model and discusses potential applications of a learning 'by making' serious games approach. Chapter 3 presents the setting of the research hypothesis as a case study of the limitations of the learning 'through' serious games model. Chapter 4 documents the setting and methodology of the design workshop approach to participatory design with children, and presents the results of a pilot study using these methods.

Chapter 5 presents the methods and results from a participatory design project led by children with adults in a supportive role positioned at level eight of Hart's Ladder via an extracurricular activity using self-selecting secondary school children. Chapter 6 presents the methods and results from a participatory design project led by adults who inform and assign specific roles to children (level four) via a curricular activity using a sample class of secondary school children. Chapter 7 presents the methods and results from a participatory design project led by adults who share decisions with children (level six) via a revised extracurricular design activity. Chapter 8 documents the scalability of the participatory design approach to learners from a radically different demographic by presenting the methods and results from a participatory design project with adult offenders in collaboration with a local probation service.

Finally, Chapter 9 presents a discussion of important observations across the four exploratory studies including design preferences based on age and gender, autonomy versus productivity, and the issue of separating learner and educator input within a participatory project. The chapter concludes the research and articulates the contribution of work, limitations of the studies presented, and recommendations for future work.

Chapter 2: Literature Review

Chapter 2 presents a review of the literature on serious games synthesised as part of this research. The review discusses the types of learning and limitations which occur when using serious games. Serious games are then considered as constructionist learning environments and observations of contemporary online learning practices are presented. A process of changing roles towards a more learner-centred paradigm is then considered by introducing methods of participation in gaming projects. Finally, the review discusses potential applications of learning 'by making' serious games.

2.1 Learning in serious games

> '*The object of knowledge is practical in the sense that it depends upon a specific kind of practice for its existence.*'
>
> Dewey, 1916

Games-based learning (GBL) is based on two premises; firstly that interactivity offers significant advantages over the standard, hypertext-style, Computer Assisted Learning (CAL) presentation of information, and secondly that the technologies and development methodologies perfected by the computer games industry for entertainment purposes can also be used for training and educational purposes (Corti, 2001).

Games by definition, aim to engage us in an activity for amusement or diversion. Computer games have become the new form of digital literacy, employing powerful principles of learning, such as modelled experiences, immersive environments and constructivism (Squire at al., 2005). The field of *serious games* represents new markets for non-entertainment uses of gaming technology where the learner has the ability to experience the world in new ways and form affiliations with other learners via community structures (Gee, 2003). However, researchers have also questioned the educational potential of serious games, as learners often fail to display any learning gains from their use at a critical level (Azevedo, 2005).

Critical learning as defined by Gee (2003) requires that a learner additionally think at a 'meta' level about the learning taking place and be able to innovate within an environment. Such environments are considered to be 'meta-cognitive' and can include hypermedia, multimedia, simulation and collaborative learning. Reviewing Azevedo's

(2005) characteristics of meta-cognitive environments reveals three key requirements for critical learning environments; such environments must: (1) allow learners to set their own goals, (2) allow learners to consider the context in which learning is taking place, and (3) allow both peers and tutors to support learning as regulating agents.

Critical learning environments can be found in unusual places. Contemporary *sandbox* games are defined by Olson (2010) as '*open-ended games with multiple solutions and play options.*' Delwiche (2006) believes that learning with sandbox games, such as the controversial *Grand Theft Auto* series, can also contribute to 'high level thinking' by inspiring players to modify environmental variables, test strategies through situated experiences, and interact with other users. Players therefore learn within these games by interacting not only with the software but with other players. Delwiche comments that this is in contrast to modern pedagogical approaches where learning is viewed as an individualised activity and collaboration on classroom tasks is discouraged as cheating.

These critical learning environments also inspire peripheral learning, both internal and external to the game, which was not originally envisaged by the designers. Becker (2008) classifies unintended learning and gameplay as 'collateral learning'. Collateral learning may involve peripheral learning of players researching items of interest from the games they play or the formulation of new gameplay by combining current game elements or themes which the game's designers did not envisage.

2.2 Limitations of serious games

> '*Teachers need support in developing their confidence and understanding of what technology can offer and how to use it effectively.*'
>
> Hague & Williamson, 2009

Children are often labelled as the 'net-generation' (Annetta et al., 2006) due to their experience with networked technology from a young age. This technology immersion has resulted in this current generation solving problems in fundamentally different ways to previous generations. Educators often view this technology immersion as a 'mindless indulgence' (Foreman, 2003), or approach technology with caution based on their own ability (Cohen & Heppell, 2002; Sandford et al., 2006). As such, activities such as

blogging, file sharing and media production are more common outside of the classroom than within (Steinkuehler, 2008).

McFarlane, Sparrowhawk and Heald (2002) found a mismatch between games content and curriculum while investigating teacher attitudes to learning 'through' serious games with popular commercial 'edu-tainment' computer games. Edu-tainment games represent an amalgamation of education and entertainment which the authors describe as '*activities structured with a view of loosely supporting education*.' The authors found that teachers need to both recognise and map the relationships between gaming activities and curriculum content in order to correctly 'frame' gameplay in a classroom context. This framing exercise requires educators to build a basic familiarity with these games which is one area where educators are reluctant to invest.

Acceptance or 'diffusion' of an innovation is the process by which the innovation is communicated among members of a social system over time (Rogers, 2003). Further, if we view this communication as a process by which people create and share information to reach a mutual understanding, then we can consider this diffusion as a process of 'convergence'. Egenfeldt-Nielsen (2010) evaluated the convergence of serious games into modern school curricula based on ease of operation, trial, observation and how the innovation is perceived to match or better current strategies. Egenfeldt-Nielsen highlights the limited adaptability that traditional 'edu-tainment' style serious games exhibit. These serious games are often not compatible with existing teaching praxis or are perceived as being difficult to use. Further, it is often difficult to observe the results of such an innovation. The author concludes that researchers must focus on identifying clear advantages, increased compatibility and reduced complexity of serious games to enable their diffusion into modern education.

Serious games often rely upon fantasy to deliver the core mechanics of gameplay where players make meaningful choices to arrive at meaningful experiences (Habgood, Ainsworth & Benford, 2005b). Cordova and Lepper (1996) worked with school children in the USA (7-11 years) to investigate the motivational appeal of contextualisation or 'fantasy embellishments' within a simple learning game. Post test questionnaires were used to compare the attitudes of children interacting with a simple maths based serious game with those of children playing a fantasy version of the same

game based on a treasure hunt. Participants were asked to rate how useful the games were, and their perceived level of competence with the game. The authors found that the provision of contextualisation in serious games increased motivation and perceived competence with a subject amongst young learners. However, the authors highlight that these approaches are not scalable to secondary school children as the allure of fantasy decreases with age.

Educators approach the use of games and the internet in classroom activities as 'digital immigrants' and often return to traditional printed materials (Prensky, 2001). Cohen and Heppell (2002) conducted an exploratory study of teacher attitudes to usage of the internet in secondary school classrooms in England. Interviews were conducted with teachers of mixed ages from different types of school (academic, technological and religious) each with experience in internet communication. The authors found that educators fear a 'status reverse' when using digital resources (such as the internet) in the classroom which conflicts with the position of the teacher within the classroom context. Teachers commented that they lack the time required to fully explore digital technologies, unlike their students who they consider to be 'leaders of change'. Teachers expressed they feared a lack of control and an anxiety to adapt to the new technology as they may ultimately appear incompetent to their students.

A 2006 survey of 924 teachers in England regarding the impact of using Commercial-Off-The-Shelf (COTS) sandbox games (such as *Rollercoaster Tycoon* and *The Sims*) in school classrooms was conducted by research group Futurelab (Sandford et al., 2006). The study found that only 27% of teachers surveyed had used GBL activities in classrooms. Of the teachers who had used games in the classroom, their primary motivation was that children have a natural affinity and motivation toward computer games. The study found that 85% of children at a secondary school level of education (11-16 years) played computer games at least once a week while only 28% of teachers use games outside of school. Sandford et al., found that this generational divide between the gaming practices of teachers and children makes it difficult for teachers to plan and execute effective GBL activities in the classroom. The study revealed three limitations to how teachers can implement GBL in classroom activities; (1) the extent COTS can be integrated into a current pedagogy, (2) technical infrastructure such as available

facilities and personnel, and (3) attitudes and experience (both educator and learner) towards computer games.

Kirkland and Williamson (2010) reviewed the results of the 2006 Futurelab survey to summarise the assumptions which teachers share about the use of computer games in the classroom. These assumptions were divided into two types: cultural assumptions (how learners react to the use of games) and curriculum assumptions (how games benefit the curriculum). The authors used observations of COTS in the classroom from the same study to identify four key themes; (1) games are motivational, (2) children are naturally competent with games, (3) children naturally progress through games, and (4) all children enjoy games.

The authors found evidence from the case studies which challenge each of the above assumptions. Firstly, games are not inherently motivational but rather specific game elements act as motivators (such as the freedom to explore and progress with minimal tuition). Participants were found to have considerably less competence with games than teachers expected and game 'experts' were rarely observed by teachers. Children progress through games in a non-linear fashion and exhibit 'spikes' of expertise making it difficult for educators to design learning tasks around the medium. Finally, not all children enjoy computer games, as some participants considered the introduction of digital games into the classroom as de-motivating or questioned their relevance as learning materials. The authors conclude that not all assumptions held by teachers are consistent with research evidence. Selecting appropriate computer games for use in educational settings can be a difficult task.

Most games have little educational value not because of their nature as games but because they lack pedagogical design and GBL principles (Prensky, 2001). Simply identifying the genre of a game can be a difficult task as industry, developers and academics each use different taxonomies (Hong, 2009). Hong worked with a panel of game scholars and professional games designers to produce evaluation indices for commercial computer games in Taiwan to be considered as 'educational'. The panel proposed 74 indices to assess the educational nature of a game which were grouped into seven categories; (1) mentality change, (2) emotional fulfilment, (3) knowledge enhancement, (4) thinking skills, (5) interpersonal skills, (6) spatial ability, and (7)

bodily co-ordination. The prospect of an educator considering all of 74 indices when evaluating a product for use in the classroom is often unfeasible and so until this evaluation process can be streamlined, educators will inevitably continue to select games with little educational value as they are unable to conceptualise the educational value of computer games.

Liu and Lin (2009) analysed 196 educational computer games by consulting with independent game experts in Taiwan to reach a consensus for evaluative indicators for educational computer games. The authors obtained 43 indicators which were classified into five categories; (1) game information, (2) multimedia, (3) interface design, (4) game content, and (5) game feedback. Despite being an improvement on 74 indices, the authors conclude that this list is perhaps incomplete as more expert groups need to be consulted to provide 'a more complete idea' of evaluative indicators. This will inevitably lead to the inclusion of additional indicators making it more difficult for educators to select and justify the use of computer games in traditional educational settings.

The limitations of serious games for learners with intellectual disabilities are also apparent in the literature. Around 20 people in every thousand have mild learning disabilities (Standen et al., 2002). Serious games have been created to support these learners with skills leading to better inclusion in society such as grocery shopping, road safety and vocational training (Standen et al., 2005). Small-scale usability reviews of these virtual environments at schools for students with learning disabilities have revealed commonly occurring problems with the design, implementation and delivery of this technology (Standen et al., 2006). These include: (1) inflexible software which is costly to run and update with frequently obsolete authoring tool kits, (2) environments which lack learning support to help users learn how to play the game, and (3) poor implementation of design ideas which do not fully appreciate the requirements of the end user.

Serious games designers have failed to present truly engaging and effective learning products as the tasks within such games are poorly designed and do not support learning (Yusoff, 2010). Yusoff asserts that learner control and authentic tasks are important attributes of successful serious games design. The content and application issues of

serious games discussed in this section rarely meet these requirements and so serious games researchers now look to gaming contexts outside our current formal educational system to understand the potential of games for improving cognition through collaborative activities (Steinkuehler, 2008).

2.3 Constructionist learning environments

> '*Learning is a search for meaning. Therefore, learning must start with the issues around which students are actively trying to construct meaning.*'
>
> Funderstanding, 2001

The terms 'constructionist' and 'constructivist' are closely related and sometimes used interchangeably to emphasise the socially constructed nature of knowledge and reality through language and experience (Freeman & Mathison, 2009 p.12). The idea of children's educational software being test-oriented or content driven is changing as we begin to move away from the 'edu-tainment' software popular in schools during the 1990s (Bergeron, 2006). The 'instructionist' approach of framing school-like exercises in the form of digital media is being replaced by the 'constructionist' approach of allowing students to construct their own learning through design of new materials (Kafai, 2006). These 'ideal' learning environments have constructive and motivational qualities which are absent in traditional classrooms (Foreman, 2003).

In Smeet's (2005) survey of how school teachers try to adapt a curriculum to create a more powerful learning environment, high ranking methods include stimulating pupils to discuss learning content together and find out new things with fellow pupils. Serious games design projects satisfy these criteria as they create a 'constructionist learning environment' where the learner is actively engaged in creating something as part of a supportive community (Bruckman, 1998). Similar to the use of text-based online environments for knowledge dissemination amongst educators (Heppell & Ramondt, 1998), research into the roles that children play in this community context has uncovered 'peer experts' in the classroom (Bruckman & De Monte, 1997), in-game peer 'apprenticeship systems' (Steinkuehler, 2004), and 'peer reviewers' in games-design projects (Robertson & Howells, 2008).

Salen and Zimmerman (2004) discuss 'meaningful play' as '*discernable relationships between actions and outcomes within a game*' and consider this meaningful play to be the goal of successful games design. Meaningful play requires the result of a game action to be communicated to the player in a perceivable way where actions affect the play experience both in the present and future of the game. Whitton (2007) further summarises that constructivist learning environments must support both active learning and critical thinking. Learning activities should be collaborative and personally relevant so learners may be supported in developing ownership of their learning through discovery and reflection. The authors conclude that meaningful play must be realised in different ways as there is no single formula that can be applied to every game.

Meaningful play through learning via simulation requires serious games designers to create a system of experiences which constantly change as a learner's understanding of a topic is updated and factored back into gameplay (Raybourn, 2007). Adaptive Training Systems are GBL technologies whose goal is to create communication opportunities between players. Users of such technologies should be able to update and adapt their understanding of a topic by sharing diverse solutions and strategies for play during, between and after gameplay. Raybourn believes such adaptive serious games are well suited for use in the classroom as they augment classroom activities and allow players to become engaged with realistic scenarios and develop adaptive (critical and reflective) thinking.

Meaningful play through learning via teaching requires serious games designers to create environments which support conceptual change where learners can experiment and reflect on their learning (Ketamo & Killi, 2010). The authors used the game *AnimalClass* with over 800 primary school children in Finland where participants had to teach virtual pets (teachable agents) decimals, fractions and percentages. The authors found that the learning by teaching approach of AnimalClass allowed learners to structure their knowledge, reflect on their decisions and take responsibility for their learning. Learning by teaching is therefore motivating because the player is not only responsible for their own learning, but also that of their teachable agent. Reflection on this learning was encouraged via breaks in play as participants had time to discuss ideas with their peers. The authors conclude that guidance, structure and focussed goals are all important to facilitate critical and reflective thinking in serious games.

Successful observations of GBL in the classroom are not limited to digital media. Bendixen-Noe (2010) has studied how traditional board games can be used by school teachers to enhance the classroom learning environment. Journal entries and transcripts from meetings and post session interviews were analysed via 'ethnographic analytic strategies' or simply using whatever materials were available to the researcher. All teachers involved in the study reported that children were receptive to learning how to play the games. Co-operation fostered through use of the games was also observed by teachers during the rest of the school. All teachers involved in the study planned to continue using board games in future lessons to build a 'classroom community' where children can learn the rules of play from each other.

The Finnish board game *Konkkaronkka* has been used successfully with children with learning disabilities aged 4-7 years (Marjanen, 2010). Educators have used this game during studies in day care centres in Finland to allow children whose social and emotional skills are lower than others to converse and interact with their peers in a safe and constructive environment. This approach removes the cognitive barriers of learning how to use games observed in previous studies (Standen et al., 2006) as these games are simple in nature and rely on physical discussions. The major advantage of this type of GBL is in creating a social environment where children are motivated to interact with both their peers and educators to learn new skills.

Ang et al. (2007) define the mental processes required in understanding and accomplishing tasks as 'cognitive loads'. In their study of how gamers cope with cognitive loads, the authors observed both short-term social interactions (players 'thinking out loud') and long-term social interactions (players forming groups with more advanced players to accomplish tasks). The social interactions fostered through peer competition within online multiplayer gaming have the potential to provide greater support for educational achievement outside of formal contexts and to produce a more seamless learning experience between school and home (De Freitas, 2007). Oregon State University has developed a recognition model for analysing educational achievement as part of their 'Oregon 4H' university extension programme. The model identifies peer competition as a strong motivator for children, but as being inappropriate for use with children younger than eight years (OSU, 2007).

2.4 Multiplayer gaming and motivation

'*We need to engage with young people to think about these [gaming] worlds they inhabit as that might help us create more of a dialogue with them when they are running into difficulties.*'

Cellan-Jones, 2008

Social gaming has its roots in the coin-operated arcade machines of the 1980s where gamers would observe their peers investing large funds in pursuit of perfecting skills, building scores and climbing competitive leader boards (cf. King of Kong, 2007). This extrinsic motivator of competitive play has also built relationships and formed hierarchies in modern gaming (Steinkuehler, 2004; 2008). Worth US$10billion in 2002 (Foreman, 2003), the computer games industry has evolved to provide gamers with new ways to interact. Gee (2003) identifies social gaming today as that played in three main scenarios; face to face on home consoles, locally over small networks such as cyber cafes, and remotely over the internet.

Inal and Cagilty (2007) observed the local gaming practices of 33 participating primary school children aged 7-9 years, during weekly meetings, playing a selection of their favourite computer games such as *Super Mario* and *Sonic the Hedgehog* in a school computing lab. Children completed questionnaires about their gaming preferences and participated in post-session interviews. The authors found that the majority of participants preferred playing games with friends (55%). Six male participants chose not to play games in the meetings and instead used this time to help their friends play. Male participants were observed collaborating in small groups while female participants preferred to play on their own, rarely seeking assistance from their peers.

Massively Multiplayer Online games (MMO) are immersive environments in which graphical representations of a user (avatars) interact in '*real-time with other avatars, computer based agents, digital artefacts and virtual contexts in a visually rich simulated world'* (Annetta et al., 2006). Research into the behaviours of these remote, online gamers has been difficult due to the restriction of access to data held on commercial game servers (Williams et al., 2009). Contemporary ethnographic research seeks to uncover this 'mangle of play' (Steinkuehler, 2006b) by combining participant observation (both in and out of the game) with interviews and any game related

artefacts available (Delwiche, 2006). These methods view games both as designed objects and emergent cultures within politics, academia and contemporary culture (Steinkuehler, 2006a).

Bartle (1996) observed internet forum postings over a six month period in 1990 to investigate player motivations in Multi-User Dungeons (MUD). These MUDs are essentially the text-based precursors of modern fantasy MMOs. Bartle found player motivations to include achievement within the game context, exploration of the game mechanics, and using the game to both socialise and impose on other players. Interestingly, Bartle found that MUD players favoured imposition using tools within the game to distress other gamers rather than help them, similar to the 'player killer' motivations uncovered by Steinkuehler (2006b) in modern MMOs. Bartle classifies these players as 'achievers', 'explorers' and 'killers' respectively and identifies an intricate balance between the gaming world and the players who inhabit it.

Research into today's popular MMOs such as *Lineage* (Steinkuehler, 2004) and *World of Warcraft* (WOW) (Steinkuehler, 2007) has uncovered that these gamers express a 'collective intelligence' driven by a desire to learn the mechanics of play through exploration and competition with others (Steinkuehler, 2008). Here, gamers are motivated to produce unofficial user manuals which supersede their official counterparts and create social scaffolds for new players via digital discourses. Steinkuehler documents a two-year ethnographic study involving over 2000 internet forum posts across 85 threads on the official WOW community forum (us.battle.net/wow/en/forum/) and found that 86% of posts constitute 'social knowledge construction' while only 8% account for general 'social banter'. Of these social knowledge posts, 28% use data and evidence (including 7% from outside resources) to reason and support their ideas. Steinkuehler found that 58% of posts make use of system based reasoning to support ideas (interpreting game feedback), 11% use model based reasoning (spreadsheets to model game mechanics) and 4% use mathematical modelling to predict how the game will behave.

Researchers are increasingly interested in the motivations of gamers for participating in such practices. Olson (2010) used survey data from 1254 American school children aged 12-14 years to propose two themes of motivation for playing computer games:

social motivations and expressive motivations. Observations from this survey are summarised below to form a description of these themes:-

1. Social motivations: Children consider gaming to be a highly social experience which provides structure to spending time with friends. Boys in particular enjoy the opportunity to compete and win in computer games. Players gain satisfaction in teaching other players via exchanging 'cheat codes' and strategies to overcome gaming problems. Games create common ground where people can make friends based on similar game preferences or favourite game consoles. Games also allow children to learn leadership skills such as mediation, persuasion and motivation.

2. Expressive motivations: Challenge and mastery are popular motivations, especially amongst boys. Computer games allow learners to express their creativity via building new game elements (game 'modding') which represent 'badges of membership' of a gaming community (Steinkuehler, 2007). Experimentation with identities is provided via gamers building digital representations of themselves (game 'avatars'). Games satisfy the curiosity of children by allowing players to experiment with scenarios which are unfeasible in the real world. Games (not specifically serious games) also motivate children to learn from their experiences and practice acquired skills.

To capitalise on this growing trend of social gaming, game developers or 'item producers' are now transforming themselves into 'service providers' to cater for these highly motivated gamers, allowing 'consumers' of their digital products to become item producers themselves (Steinkuehler, 2005). This may involve creating a narrative of the game via fan fiction websites such as *Red vs. Blue* (www.redvsblue.com) for the popular First Person Shooter (FPS) game *Halo*, social material such as the *Allakhazam* (www.allakhazam.com) 'wiki' style knowledge base for WOW (Pierce, 2007), or simply experimentation with crafting new gameplay experiences in simple single player games (examples of this include player made challenges such as the infamous 'speed run' of *Super Metroid*). Each of these examples forms part of a community of gamers where members produce new meanings, contexts and semiotic resources which makes play outside of the game space almost as important as what occurs within it.

Not all social practices are beneficial to the overall gaming experience of the population of an MMO. Steinkuehler (2006b) describes how emergent game culture often intersects with game rules to create new game themes which the developers were unable to foresee. When investigating the fantasy MMO *Lineage II*, Steinkuehler observed more experienced players capitalising on the lack of experience of new players to improve their own game status. These 'player killers' use their own advanced avatar statistics (such as better weapons, armour and skills) to kill the avatars of new players who possess weak attributes when enrolling into the game. This form of cyber 'bullying' is discouraging to newcomers and threatens growth of the game's consumer base as new (or observing) players are reluctant to invest in the game. The problem of 'player killers' creates a tension between game rules and game practice. This is problematic for the game development company, and also for the online community as new members decrease and existing members leave.

Steinkuehler (2006b) also refers to an exploitation of game rules by emergent cultures known as 'farming'. Here, real world companies use MMOs to profit from collecting and retailing in-game currencies through websites such as *eBay*. Companies recruit large 'teams' of gamers as labourers to explore the virtual environment and collect its virtual currency during long gaming sessions (often in excess of 12 hours) in exchange for real-world payments (often as little as US$3). This 'gold farming' process is often in violation of the terms of the game's use laid out by the developers, and is facilitated rather than outlawed by governments as they continue to invest in improving digital infrastructures and literacy. The only power for terminating these activities is held by the game development companies, who hold the 'nuclear option' of ultimately closing game servers (Heeks, 2008). Thus, these negative practices are highly disruptive to play and difficult to prevent which is concerning for the future development of MMOs.

Pierce (2007) documents a case study of Becker's (2008) 'collateral learning' using WOW with his nine-year old son. Pierce highlights the potential of the game to create social scaffolds (his son was observed working with other players in 'parties' to complete quests), disguise learning via gameplay (playing the game helped his son understand the Cartesian co-ordinate system), and providing a safe environment to experiment (his son was observed learning the value of currency through earning, saving and trading in-game currency with other players). Pierce identifies both in-game

(non-playable characters acting as trainers) and peripheral (online fan media websites) tuition systems which promote wider educational strategies such as learning in communities and lifelong learning.

However, Pierce stresses the importance of monitoring his son's time online to avoid over exposure, and protecting his anonymity while playing and interacting with others. Delwiche (2006) advises that MMO approaches to GBL activities require a clear definition of learning objectives, sensible selection of accessible digital domains and strict ethics such as warning gamers of the potential of addiction to MMOs. Delwiche was contacted during a study of the MMO *Everquest* by several ex-players recovering from addiction to gaming who urged the author to pass on their experiences to students.

The BBC blog article 'Addicted to Warcraft' (Cellan-Jones, 2008) documents the anticipated release of a 2008 update to WOW (the world's most popular MMO at the time) (Woodcock, 2008). The article allows both gamers and non-gamers an opportunity to debate the emerging trend of 'social' gaming and its impact on players in an ever increasing digital world. The article highlights the addictive nature of MMO gaming practices and how they can become damaging to young gamers. Contributors explain that MMOs provide an 'escape' where young gamers experience '*a heightened sense of reality that is more stimulating than the drudgery of homework.*' The potential of MMOs to become an addiction for young gamers therefore requires further investigation into the gaming practices of these players.

Mahmassani (2010) gathered user data for the MMO *Everquest II* to examine the relationship between player experience, age, and registration period, with their play time or 'activity engagement'. Mahmassani found that players whose avatars had more experience points (hence more experience with the game) tend to play for longer durations of time. Also, players with older user accounts (the duration a player has registered to play the game) tend to play less frequently due to declining interest in the game. Williams et al., (2009) conducted a survey with over 7000 players of *Everquest II* to uncover the role of gender in the online community. The authors' findings agree with previous observations that male gamers were motivated to participate in MMOs by achievements, while females were motivated by the opportunity for social interaction. Further, male gamers were more likely to 'over report' their gaming sessions through

bragging rights or male bravado. However, the authors also uncovered that it was female gamers who represented the 'hardcore' gamers as females played for longer durations (in short gaming sessions) and were less likely to quit the game. The authors believe that females invest longer hours in MMOs to form and maintain relationships.

The objective of using MMOs in GBL should not be in shifting the classroom into the online domain, but combining the digital and physical domains to create a mixed reality approach to learning via games. Online games represent neutral 'third places' where gamers enter and leave without permission or invitation (Steinkuehler & Williams, 2006) and allow learners an opportunity to interact with professionals as equals, separated only by a fantasy context (Bruckman, 1998) or user created avatars (Steinkuehler, 2004). The question for serious games researchers is how we adapt serious games from simple teaching agents into facilitators of discourse between learners and their educators. Salen and Zimmerman (2004) propose that it is impossible to anticipate play in advance, and so a 'role reversal' should occur where the designer becomes the player and the act of play becomes an act of design. A change in perspective on user-centred design may provide an answer for bridging this generational gap by treating children not as game players or testers, but as equal partners in the design of new serious games.

2.5 Changing roles

> '*There is a critical difference between going through the empty ritual of participation and having the real power needed to affect the outcome of the process.*'
>
> Arnstein, 1969

Adultism is defined as the 'behaviours and attitudes' that flow from an assumption that adults are 'better' than children (Zimmerman, 2004). Adultism centres around the idea that young people are 'oppressed' by adults as a form of ageism. Examples include adults speaking to children in a condescending manner, asking children to play small or menial roles in a task, or simply adults assuming children do not understand certain topics a priori (Sazama & Young, 2001). Adultism generates low self esteem in young people which results in poor academic performance and so educators must work harder to promote, support and celebrate the power of youth (Creighton & Kivel, 1992).

Driskel (2002) notes that young people are generally ignored when designing new educational projects and so investments must be made to provide young people with a platform to participate both actively and genuinely in a decision making process. Driskel highlights that the term 'genuine' participation is often difficult to define being context sensitive, and so there exists no 'recipe' for 'meaningful participation'. Both adultism and meaningful participation are clear concerns for educators. Between 2007 and 2009, the internet search engine *Google* experienced an 800% increase in searches for the term 'adultism' (Pevec, 2009). This popularity has created several organisations for youth empowerment such as the *Free Child Project* (www.freechild.org). The Free Child Project works to re-envision the roles young people play in society throughout the USA and Canada, and refers to adults as 'allies' in the education of children.

How to promote 'citizenship' amongst young learners has been the goal of the Community Youth Development movement (CYD) since 1993 (Curnam & Hughes, 2002). CYD asserts that everything exists in relation to everything else and that these relationships are constantly changing. Thus, the movement seeks to harness the energy, creativity, and dedication of both youth and adults to create sustainable communities that fully engage young people in their own development.

Kimball-Baker (2004) describes the external structures, activities and relationships which create positive environments for children as 'developmental assets'. These assets comprise of: (1) empowerment where children feel both valued and valuable, (2) constructive use of time where children have opportunities outside of school to develop and learn new skills, (3) social competencies where children interact effectively with others, and (4) a positive identity where children control their own learning. Curnam and Hughes (2002) cite evidence of such assets in youth development; service learning; summer and after-school programmes; adventure experiences; and environmental action efforts. Reddy and Ratna (2002) describe such 'empowerment of children' to be the role of an educator, in allowing children to occupy and use decision making spaces and opportunities effectively. The authors believe educators must provide children with the knowledge and skills to organise themselves, access information, and better understand the structures of which they form part.

Sociologist Roger Hart presents a useful model for thinking about children's citizenship, how they learn, and how adults can intervene in their learning (Hart, 1992). Based on the eight level 'ladder' model of adult citizenship proposed by Arnstein (1969), Hart's Ladder attempts to model the roles children play in participatory projects with adults. The ladder represents an interesting method to map educational activities into authentic and meaningful participatory projects with children and can provide a means of evaluating the quality of engagement between partnerships of adults and children (Fletcher, 2008). Educators and the activities they employ often move between rungs on this ladder and so the model allows adults to map current activities and their potential growth towards authentic and meaningful activities with children. The following list brings together the descriptions of the eight levels (or rungs) of the ladder with their descriptive terms as coined by Hart (1992) and expanded upon by Reddy and Ratna (2002) and Fletcher (2008). The list starts at the lowest level (manipulation) and increases to the top of the ladder (shared decisions). Hart considers levels 1-3 to be models of non-participation and levels 4-8 to be models of genuine participation:-

1. Manipulation: Children have no understanding of the issues surrounding a project and so have no understanding of their involvement. Children thus do or say what educators suggest and are often used to simply further the agenda of adults. Manipulation can be subtle and so it is often difficult for participants to notice when they are being manipulated.

2. Decoration: Children are used to help or 'bolster' a cause in a relatively indirect way with little or no understanding of why they are being involved. Children are treated as 'decorative objects' and adults make little use of their presence.

3. Tokenism: Children are asked for their opinions and ideas but have little or no choice about the way they express these or the scope of the ideas they can express. Children are included for the sole reason that they are children and, although not manipulated, their presence serves a wider goal of political correctness for adults.

4. Assigned but informed: Adults decide what needs to be done in a project but keep children well informed. Roles which are important to the project both functionally and symbolically are created for children.

5. Consulted and informed: Adults attempt to give children a more active role in a project but under strict supervision. A project is designed and run by adults, but children are continually consulted and their views are taken seriously. Children understand the process and their role in the project. Children are informed about how their input will be used and the outcomes of the decisions made by adults.

6. Adult-initiated, shared decisions: Projects are initiated by adults but roles and responsibilities are shared with children. Adults may have the initial idea but are willing to share the decision making with children, viewing it as a collaborative interaction.

7. Child-initiated, shared decisions: Projects are initiated by children and decision-making is shared between children and adults. Children thus have the initial idea, setup the project and invite adults to join with them in making decisions. Adults are jointly involved in the project within roles that are defined by mutual consent.

8. Child-initiated and directed: Children have the initial idea and decide how a project is to be carried out. Adults play supportive roles as required by children. Children thus initiate and direct the project.

There is some debate over the ordering of levels seven and eight of the ladder known as the '7/8' debate (Fletcher, 2008). Some educators believe that shared decision making is beneficial to both children and adults and is hence more meaningful (Fletcher, 2008) and so should be placed at the highest level of participation. Others believe that children are most empowered when they are making decisions without the influence of adults (Reddy & Ratna, 2002) and so place children directed projects at the highest level of participation. Reddy and Ratna consider the ladder to represent the varying roles adults play in relation to children's participation and so adapted the upper levels of the ladder to represent decreasing levels of adult involvement within a project. This idea agrees with the original eight-level model of citizenship proposed by Arnstein (1969) who considered 'citizen control' to take precedent over 'delegated power'. The authors agree that the ladder is in no way prescriptive and '*should not be used as a simple measuring stick of the quality of any programme*' (Hart, 1992). The ordering of the upper levels of

Hart's Ladder presented and referred to in this thesis is therefore based on that proposed by Reddy and Ratna (2002).

Hart considers four prerequisites for a project to be labelled as being truly participatory; (1) participants understand the intentions of the project, (2) participants are aware of why they are being involved and who authorised this, (3) participants have a meaningful role, and finally (4) participants volunteer for the project after the project is advertised and made clear to them. Thus, projects which display increased levels of understanding, awareness, meaning and initiative from child participants can be considered more participatory or empowering. Hart comments that the higher levels of Hart's Ladder are only applicable to older children (often teenagers) who have the capacity to exhibit the above four characteristics, and so projects considered to be at level eight of the ladder are often rare due to a lack of adults or 'allies' who are attuned to the particular interests of older children.

Sacife and Rogers (1999) describe child participants in a design process as 'informants'. The authors document an 'informant design framework' where children use low tech prototyping materials such as pen and paper drawings to design user interfaces, and discuss these ideas in small groups with their educators. The authors place emphasis on eliciting design ideas from children while minimising input from educators. This design philosophy involves viewing participants from different disciplines such as teachers, psychologists, Human Computer Interaction (HCI) experts, graphic designers, software engineers and end users (children) as informants in a design team (at different stages of the design process) to discover new ideas rather than confirm pre-existing ones. Some members of this team (teachers, in particular) will have more experience working with children than others and so one consideration of this approach is how to effectively involve each team member in the design process.

Another consideration of this approach is how to balance and integrate the contributions of each team member (especially those of children) as it is unrealistic to incorporate all ideas and suggestions during a design process. The design team must decide how these ideas fit together and, most importantly, whether they satisfy a project's objectives. The authors comment that these ideas are often overlooked by designers following user centric design methodologies, which involve end users simply to demonstrate the

validity of designs. Druin (1999; 2002) has pioneered the concept of having children form an integral part of a design team. Druin has explored methods of 'co-operative enquiry' between multidisciplinary partnerships of teachers, researchers, games designers and children. In this process, children take on the role of 'design partners' where they are considered as equal stakeholders in the design process and participate in activities that are both suitable to the process and the age of the participant.

Educators often become 'facilitators' to a learning process, acting as 'motivational cheerleaders' (Squire et al., 2005). Hanghoj (2010) argues that teachers change roles constantly as they facilitate the use of serious games in the classroom and presents four pragmatic categories of teacher roles. These include 'instructors' attempting to link game objectives to learning objectives, 'playmakers' attempting to explain game scenarios from the player's perspective, 'guides' attempting to scaffold learning, and 'explorers' who must fully understand a game in order to communicate with the players.

Hanghoj explored teacher positioning whilst using the role-playing humanities game *Global Conflicts* in the classroom with children aged 13-17 years. Hanhoj found that teachers assume passive roles as 'instructors' during GBL sessions and were rarely observed intervening in gameplay. Further, Hanhoj found that teachers share a view that serious games act as motivators and should not stand as lone educators, but should be integrated with other resources such as film clips, internet texts and student assignments for effective use. Hanhoj suggests that more work is required to fully understand the roles teachers play in the use of serious games in the classroom. Cohen and Heppel (2002) identify educators who are 'young in spirit' as being most suitable to incorporate digital innovations into the classroom. Considered 'lifelong learners', these educators are willing to adapt and take risks with new technologies.

How children engage with adults during a design process can be better understood by observing how children engage adults during domestic gaming. A 2009 study of family gaming conducted by research charity Futurelab surveyed a sample of 558 parents or legal guardians and 737 children aged 5-15 years in Great Britain (Ulicsak, 2010). The survey focussed on the motivations and methods of family gaming, including the type of games played and why. Researchers found that 64% of children surveyed had played computer games with an adult in the last six months. When asked why they play games

with adults, 49% of children surveyed responded ‘it’s more fun with an adult.’ The survey found that games are rarely viewed as learning experiences in households as young people do not play games with adults for any formal (or informal) learning purpose. Few adults consider their role within gaming to be that of a teacher (32%) and even fewer consider children to have teacher roles (25%). Similarly, few children view adults as teachers when playing games (14%) and no children considered themselves to be teachers. Parents view serious games as useful for teaching young children simple arithmetic and spelling but are less useful with older children (11-16 years) who are only motivated by the entertainment attributes of games (McFarlane, Sparrowhawk & Heald, 2002).

Facilitated collaboration is the responsibility of an educator in a GBL activity. The question of whether the collaboration experience should be enforced depends on the task being performed (Druin et al., 2003). To demonstrate this, a study of how primary school children (7-11 years) collaborate to search databases of multimedia resources (images, sounds and video clips of animals, space ships etc) was undertaken in which two experimental collaborative interfaces were compared. Educators experimented with an ‘enforced collaboration’ interface requiring participants to agree on how to navigate the database before any search results were returned. This approach was compared with a ‘non-enforced collaboration’ interface allowing participants to navigate the database freely, but disrupt the navigation of their peers in the process. The enforced collaboration interface was more effective in generating focussed and accurate search results than the non-enforced interface. However, shared goal discussions using this interface were less frequent than when using the non-enforced method which required participants to justify their choices to their peers. It is therefore the job of an educator to assess the activity being performed and to apply a suitable level of facilitation to inspire collaboration to achieve learning outcomes.

The role of a teacher as a Non-Playable Character (NPC) has been studied with the serious game *GeoEmmision*, a supplementary teaching tool for use in secondary school classrooms (Che Pee, Blanchfield, & King, 2010). The study examined whether GBL can promote collaborative and co-operative behaviour amongst players in a classroom environment. Twenty participants aged 13-14 years were divided into single and mixed gender pairs and observed playing the game in 60 minute sessions. Group members

interacted almost continuously during these sessions driven by self-appointed 'group leaders' who allocated tasks to individuals. The teacher had three roles in the game: monitor and evaluate the game session, maintain control of participants, and facilitate the learning process. Game responses were not automatic and were instead triggered by the teacher acting as an NPC.

The teacher in GeoEmmision could manipulate the gaming experience of participants by controlling how other NPCs in the game would behave in response to decisions the group made. Interestingly, participants were not made aware of the teacher's role as an NPC and so were unaware that these responses were individual to each group. Groups were able to identify an external influence, as their inquisitive nature to observe and assist the learning of their peers revealed that the game behaved differently for each participant group. The authors concluded that this inter-learner support and co-operation was due to the design of the game rather than its novelty.

2.6 Current software and strategies

> '*As games mature as a medium, the question is becoming not will games be used for learning, but for whom and in what contexts.*'
>
> Squire, 2008

Mixed reality multimedia uses novel methods to transcend the interface between our physical and digital worlds. Researchers use emerging technologies to encapsulate users in ways not possible with conventional physical or digital tools, such as combining local online play with remote mobile gaming (Flintham et al., 2003). The key to this approach to learning is to establish relationships between learning in radically different contexts. The role of the learning tool in this mixed reality system is to provide suitable information, presented in an appropriate way for learners to be able to understand the different contexts that make up the learning system.

Delwiche (2006) used the online MMO *Everquest* to explore social and philosophical issues related to new media as part of an undergraduate degree course. The traditional textbook for the course was replaced with a synthesised booklet of articles on gaming communities and social science research methods. This booklet was used by students to engage with the online MMO as a form of 'ethnographic field research' into the ideas

discussed in the booklet. The MMO was also used as a meeting ground for students to discuss classroom activities as homework assignments. Delwiche found Everquest to act as a bridge between digital and physical communities and practices. The author concluded that learners should be encouraged to reflect on their participation in both the digital domain of the game world and the physical domain of the classroom.

Learning can be thought of as a process along a 'trajectory of participation' which occurs within a community of practice to allow a learner to develop an 'identity' (Greeno, 1997). *Situ-activity theory* focuses on interactive systems of activity of which the learner is only one part (Derry & Steinkuehler, 2003). Thus, cognition is viewed as the social relationships, symbolic and material resources, and historical change of the learner within the activity system in which they participate. Situ-activity theory views knowledge not as mental representation but as that which resides in communities and manifests through what members of that community do and create. Situ-activity theory allows designers and researchers to view learning environments in terms of their observable activity structures. These include interactions and discourses between learners and their educators, and the development and use of tools within the environments. As these activities are context specific (case studies) they are difficult to deconstruct for researchers. Therefore, researchers study activity structures ethnographically using qualitative methods in situ.

A major limitation with qualitative research is that studies are often not written so that methods can be understood and replicated (Onwuegbuzie & Leech, 2004). Anfara, Brown, and Mangione (2002) discuss methods to improve the reliability of ethnographic qualitative research. The authors highlight that 'credibility' of ethnographic qualitative techniques can be improved by prolonged engagement in the field being assessed, and debriefing of peers to uncover reflection of process, while 'transferability' can be improved by developing a 'thick description' of the process (Steinkuehler, 2008) and using purposive sampling techniques such as 'opportunistic' or 'convenience' sampling methods (Patton, 1990). Patton's 'inductive analysis' examines the patterns and themes that emerge from the data during data collection rather than those imposed via *a priori* goals (Mittman, 2001).

Qualitative data encompasses research questions, theoretical issues, imagination, intuition and previous knowledge (Dye et al., 2000). Dye et al. consider the classification and comparison of qualitative data to be like viewing data through a 'kaleidoscope'. This metaphor shows how data classification can change depending on how the researcher views the data. Thus qualitative analysis is complex, and metaphors like this can be used to make better sense of emerging data (Schmitt, 2005).

Steinkuehler (2005) discusses how 'clinical trials' of new technologies examining countable variables and categories a priori, risk obscuring our view of how learners use new technologies such as MMOs and social media within their own indigenous contexts. Steinkuehler advocates the use of 'participatory observations' across the contemporary digital spaces which researchers study. Contemporary methodologies such as *activity theory* can provide a conceptual framework for understanding how complex systems or goal orientated activities change over time (Engeström & Miettinen, 1999). Activity theory can contribute significantly to the multidisciplinary (education, psychology, games development) wave of interest in cultural practices and subsequent cognition within these domains. Activity theory can also be used as a broad approach to develop new perspectives and conceptual tools for understanding how these social (especially gaming) networks function.

According to Engeström and Miettinen (1999), activity theory requires researchers to consider both 'historical continuity' (what is happening outside of the activity) and 'situated contingency' (what is happening within the activity) as part of their analysis. Thus activity theory attempts to explain local practices by considering how they are placed in broader global practices. Steinkuehler (2005) highlights that our understanding of these practices is shaped by our understanding of the tools and technologies that structure them. Therefore, as these technologies evolve over time (as is the case with current digital tools), a researcher's technical literacy with these technologies tightly constrains what they can observe and theorise.

Mittman (2001) argues that qualitative research methods encompassing observation, interviews, surveys and collection of artefacts can contribute significantly to research in the social sciences. However, Mittman also highlights that qualitative methods are often informal and ad-hoc when applied to hypothesis testing deductive research. Researchers

must derive formal hypotheses and specify variables in advance of data collection and analysis, as failure to do this will result in unfocussed analysis where the researcher is unable to identify key variables, or to recognise and properly interpret key findings. A lack of such planning will result in limited data collection that is disjointed (recording everything regardless of relevance to the hypothesis), sporadic (reduced likelihood of recognising and recording significant events) and inconsistent (data cannot be used for comparisons across different samples).

Mittman also advocates use of systematic tables for specifying key variables and suitable measures which should be collected from at least two data sources. Pilot testing will assist in identifying appropriate data sources, yet provision should be made to allow for flexibility in collection methods. Data collection and management plans must be developed to minimise bias and observer interpretation. Data validity can be enhanced by recording, or immediately coding and reviewing, data that are time or memory sensitive such as interviews and observation. Finally, analysis and interpretation of qualitative data can be strengthened through use of formal tables in which key variables relevant to the hypothesis are listed and manipulated.

Laitinen (2006) documents software usability testing as a process of data collection containing three main parts; briefing the user, observing the user, and finally a discussion of the user's experience. Researchers in these usability tests assigned participants tasks within a commercial computer game and discussed the methods participants used to achieve these tasks. Discussions were videotaped for review and involved the 'think aloud' method of immediate communication of thoughts and suggestions. Laitinen concluded that this three part procedure was successful in gathering new data as around forty percent of problems uncovered were new to the game developers.

Qualitative data can also be collected during co-exploration of new software (Downey, 2007). Downey discovered that testing new software in a group environment allowed the process of briefing, exploration and discussion to be performed in a much shorter space of time. This testing strategy involved a group of participants exploring software simultaneously in close proximity while an observer asked questions of individuals.

Similar qualitative methods have been used by Squire et al. (2005) to study how the game *Civilisation III* can improve collaboration when learning political and economic aspects of geography in a participatory simulation. The study took place over five weeks with American middle-school participants (aged 11-14 years) meeting twice per week for two hours. Meetings were structured into three main components, briefing, gaming and reflecting. Two facilitators (considered experts at the game) and one researcher were present at each meeting. Facilitators observed interactions amongst participants and recorded field notes to uncover emergent themes. Sessions were also videotaped to capture the dialogue of participants and to review earlier sessions where ideas could have been missed. Participants were interviewed informally throughout the study to probe initial observations, asking participants to summarise their goals for the day and their opinions of the game environment.

The methods used by Squire et al. allowed the authors to develop a narrative of important events and themes which could be used to help researchers understand the 'phenomenon' of play. The study was dynamic as facilitators met regularly outside of sessions to discuss observations and emerging themes, and to tailor future sessions. Participants were periodically required to complete questionnaires to assess their knowledge of the game environment and their new knowledge about world geography. Squire et al. found that allowing participants to work in pairs led to increased engagement, as participants could discuss game strategies to reduce confusion and increase reflection on game tasks. The study found that collaborative computer games (games which force players into collaborative strategies where they and their peers are part of a larger system) encourage these players to deliver precise, articulate advice to each other, and to improve their literacy and reasoning skills.

Game 'modifications' allow learners to change the rules of play and examine the results (Salen & Zimmerman, 2004). These modifications create game *mods* defined by Steinkuehler (2007) as '*games derived from those released by games developers*.' Game mods include changing game mechanics (visual objects or subject matter) to create a radically different play experience for use by gaming peers. Hayes (2008) breaks game content creation into two areas; in-game content such as new levels and characters (game assets), and games related content such video-clips, fan-fiction, walkthroughs and fan-art more commonly known as 'machinima' (Lowood, 2005). In a

study with over 1000 children aged 10-14 years, Hayes found that 38% of participants had created in-game content while only 20% had created game related content.

The authoring software *Stagecast Creator* has been used with children aged 7-11 years to explore in-game content creation via games design workshops (Habgood et al., 2005a). Children program using Stagecast Creator by creating images that represent 'before and after' scenarios for events within a game. The study was run within the context of a weekly after-school design club and participants were recruited via advertisements around the school. Meetings involved software tuition prepared in collaboration with the class tutor, design using paper templates and implementation using the authoring software. The study allowed participants a total of 10 hours contact time to complete their game designs. Habgood et al. found that the games created by primary level children often lacked educational content, and instead focused on the creation of 'extrinsic fantasy' where a game's fantasy is related to the learning content but not vice-versa. An example of this concept is learning about the different hardware components which make up a typical computer by simply navigating an obstacle course to collect pieces of computer hardware.

Robertson and Good (2005) have explored more complex authoring tools with secondary level children aged 12-15 years. The authors observed participants using the in-game content creator for the commercial role-playing game *Neverwinter Nights* (NWN). The software allows non-expert players to edit the NWN game environment to build new (free) content including characters, settings and interactive plots for other players to use. This software is regarded as a 'valuable tool' allowing researchers to investigate the creative aspects of computer games design of which 'very little' is known to date. Workshops took place in the computing labs of a local secondary school during the school holidays. Activities included group discussion about games, an introduction to the NWN software and the design of game assets using low-tech prototyping materials such as stationery and modelling clay. Participants were observed voluntarily disseminating new programming knowledge about the software amongst their peers and acting as games testers for each other. The authors conclude that sophisticated game-authoring is well within the reach of secondary school children.

Carbonaro et al. (2007) used the *Aurora* authoring software with NWN to explore whether prior experience with games and authoring tools was a significant factor affecting children's ability to create interactive stories. Participants from two secondary school English classes aged 14-15 years, worked with their class teacher and researchers over a period of 10 hours to modify a pre-built environment using the software. Meetings took place in both university labs for software tuition and school classrooms to complete designs. Participants had to add props, characters and dialogue to the pre-built environment to construct a short story which their teacher then rated. The researchers found that neither programming nor gaming experience was a significant factor affecting participants' ability to learn and utilise the software to author new interactions and dialogue for use by their peers.

Williamson (2009) describes two 'learning by creating with games' studies combining both in-game and games related content described by Hayes (2008). The first study used the game *Guitar Hero* to allow secondary school children to work alongside primary school children on a common project to introduce them to secondary school life. The game inspired pupils to work together to form a musical band, and engage in practices from various secondary school subjects including art, maths and music. Participants used the authoring aspects of the Guitar Hero game to create a logo and poster for a band (art), plan and work out finances for a tour (maths), and write songs (music). Participating primary school children said the project was a 'great experience' and made them '*more comfortable with their move up to the high school*.'

The second study Williamson describes uses the game-authoring software *Mission-Maker* to teach English and literacy in a secondary school in the UK. The software allowed students to dramatise scenes from the play 'Romeo and Juliet' in order to think about the conflict and violent nature of scenes in the play. The game supported students' literacy skills by allowing them to think critically, and to be productive by exploring themes from the play in contemporary culture. The participating teacher used Mission-Maker to construct his own games to introduce students to the software, and was keen to develop an online knowledge base for the GBL approach where both he and other likeminded teachers could exchange ideas.

As game-authoring software now supports design as the basis of play, where software experiences are based on user customisable parameters (Salen, 2007), the selection of experimental software is now more important than ever. During their investigation into commercial sandbox games in secondary school classrooms, Sandford et al. (2006) found that familiarity and freedom of exploration are important factors when selecting suitable software for use with children:-

> '*Student motivation might be more likely to arise 1) when students were using games familiar from their home environment, and 2) when students were able to have some degree of autonomy in playing the game.*'

The authors advise that effective use of such software is more reliant upon the ability of educators to scaffold the gaming activity rather than their own gaming prowess:-

> '*Using games in a meaningful way within lessons depended far more on the effective use of existing teaching skills than it did on the development of any new, game related skills. Far from being sidelined, teachers were required to take a central role in scaffolding and supporting students' learning through games.*'

Thus the selection of suitable experimental software should take into account recommendations from research participants based on their gaming preferences outside of the classroom, as well as the ability of educators to operate software within a current pedagogy. This requires researchers to consider both free, contemporary software sourced from the internet together, with common, commercial or proprietary software when selecting game-authoring software for use in a serious games design project.

Game-Maker is an example of accessible game-authoring software which does not require extensive programming skills or a user subscription and is supported by a gaming community website including active forums, 'wiki' style knowledge articles and tutorials written by developers and players alike (Hayes & Games, 2008). The software uses an 'event driven approach' to creating games by mapping 'events' such as object collisions and keyboard presses to 'actions' such as movements (Habgood & Overmars, 2006). The software allows users to quickly create small games via object-orientated programming by creating game assets such as backgrounds, sprites and

sounds. Game-Maker has been used as a platform to explain basic concepts of games design to undergraduate students at university (Overmars, 2004), but little published research currently exists documenting the application of Game-Maker to a design process with children.

Adobe Flash is an example of proprietary media creation software developed by Adobe. Flash allows users to create a library of game assets as design objects and to add functionality to these objects by positioning them on a two-dimensional stage. Users also have a third dimension of control by changing how these objects behave over time. Commercial adoption of Flash as a platform to deliver rich media across web browsers including streaming of video, audio and greater user interactivity (De Freitas, 2007) has led to the term *Flash* being synonymous with internet commerce and advertising.

Examples of Flash based serious games include simple 'web-games' or propaganda material from companies such as McDonalds (Salen, 2006) presented as free, accessible material to change perceptions or sell a product. A simple search of the internet can reveal the extent to which Flash is now a common addition to modern web design. Flash has also been used as authoring software to help students develop interactive story narratives (Hayes & Games, 2008).

2.7 Summary

This chapter has summarised the limitations of the learning 'through' serious games model and has presented potential solutions to these limitations as constructionist learning environments in the form of participatory serious games design projects. These projects reject the notion that games are somehow intrinsically motivational as simple teaching agents, and instead present games as platforms for collaboration, competition and knowledge dissemination amongst multidisciplinary groups. The chapter concludes by discussing examples of current software used to facilitate serious games design projects with children. The following chapter draws on this literature review and presents a case study of the limitations of the learning 'through' serious games model as the setting for the research hypothesis.

Chapter 3: Case Study

The previous chapter presented a review of the serious games literature outlining the limitations of the learning 'through' serious games model. Chapter 3 presents the setting of the research hypothesis by documenting a case study of the learning 'through' serious games model. The chapter documents the design of serious games software for a local education initiative as part of a 2006 MSc project. The post MSc evaluation of this software with primary school children (Bates et al., 2007) is then discussed as a basis for research into higher participation of children within serious games design.

3.1 Setting

Southwell Minster is located in the quiet market town of Southwell to the north of the city of Nottingham. The Minster's 'Time Travelling' school outreach initiative has been involved in the education of several Nottinghamshire primary schools with children aged 8-10 years via the preparation of information packs and lesson plans as part of each school's religious education curriculum. These schools also participate in a school visit to the Minster involving around 600 school children and 50 volunteers.

By visiting the Minster, children can learn about the Southwell diocese and important lessons in the Christian faith whilst participating in small group activities with local volunteers. With education focussed on social inclusion, friendship and community, children of all faiths can attend and benefit from the event. The Minster houses a variety of 13th century sandstone carvings 'only matched at York' (Pevsner, 1999) which attract hundreds of tourists each year, who must adhere to strict rules of not touching the carvings due to their high levels of corrosion. With this in mind, volunteers try to describe the importance of the Minster building whilst balancing a requirement to preserve its natural heritage and maintain a level of control over the visiting children. For this reason, the Time Travelling initiative is interested in new ways of delivering the experience.

Presented with a goal of integrating digital interactivity into the annual school visits to the Minster, significant historical and religious areas of the building were required to be modelled in a digital environment. This would involve the software being used by a teacher as part of a lesson plan to supplement the educational materials provided by the Time Travelling initiative. The goal of the software was to build an appreciation of both

the historical and religious significance of the building. Thus, the historical stone carvings and religiously significant stained glass windows which depicted important stories from the Bible (such as the story of Adam and Eve) were selected for inclusion in the software. Players of such software should be able to interact with these objects to gain a greater understanding and appreciation of their purpose and significance in preparation for their school visit to the Minster. The software would also allow children who could not attend the school visit to access and discuss the materials with their teachers or parents.

3.2 Software description

Built in Adobe Flash, the software is presented as a collection of Flash web objects which can be run from a CD or over the internet if uploaded onto a website. The software represents a two-dimensional 'virtual environment' which approximates areas of special interest within the Minster building into suitable vector-graphics. The identified key areas of carvings and stained glass windows were modelled as a carving game and a selection of interactive stories respectively. Sections were designed with high levels of interactivity which has been the main 'push' of the computer games industry in recent years (Foreman, 2003). This interface was achieved via the utilisation of both the keyboard and mouse (often simultaneously) within sections of the software.

The carving game represents a basic linear approach to GBL via goal specification, exploration and achievement as described by Bergeron (2006). Players are required to destroy blocks of 'virtual stone' to uncover an image of an important carving within the building. In contrast, the virtual books allow for greater freedom for exploration within the software. Players can move forwards and backwards through virtual pages or simply skip whole sections thus generating a non-linear method of GBL. Appropriate graphics, animations and sounds accompany the virtual books. Players can also listen to narrations of the text to improve accessibility. Scaffolding within the software is delivered via animated mascot characters. A dragon character provides assistance with using the interactive books while a stonemason character assists with the controls and objectives of the carving game. Figure 2 compares the player interface of the carving game (left) with the virtual book (right).

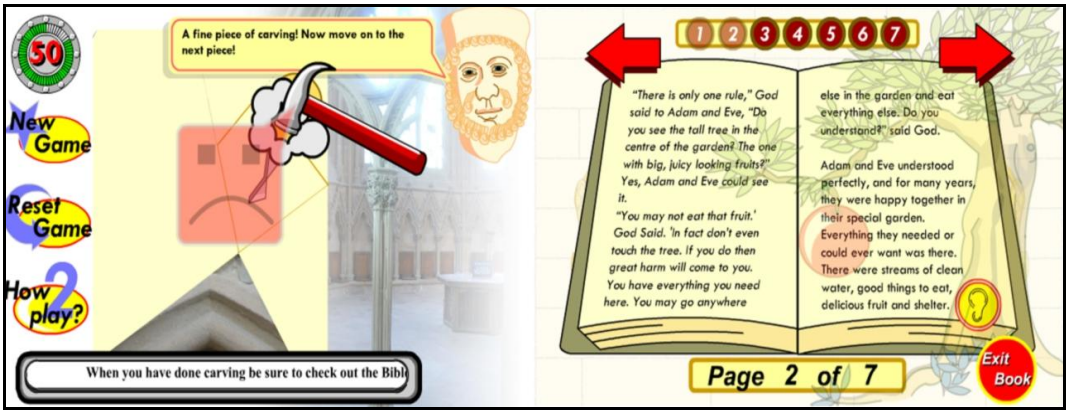

Figure 2: Screenshots of experimental software used in case study

3.3 Procedure

Testing of the software was focussed on its suitability for the target audience. This would focus on the ability of children to use the software with minimum input from educators. A testing strategy similar to the usability testing employed by Laitinen (2006) and Downey (2007) was identified as suitable for use in a classroom with primary school children. This strategy involves three main stages; initial briefing, group observation and post session group discussion. Participants are positioned in close proximity, exploring the software simultaneously while an observer asks questions of individuals and records notes. Evaluating software in this group environment allows the process to be completed in a primary school classroom.

A sample of target users from a local primary school who participate in the annual Minster visits, and who could accommodate the software being run simultaneously on multiple PCs, was required for testing. A local collaborating primary school who had previously worked with members of the Time Travelling initiative was selected for participation as they could provide a suitable computing suite to test the software. The school houses approximately 195 mixed gender pupils of ages 4-11 years. The school is non-denominational and caters for children with learning difficulties thereby providing a good sample of educational ability in the local area.

The PC suite at the testing school included five PCs arranged in a single row in the corner of one of the classrooms. Each PC was equipped with keyboard, mouse and 15-inch flat panel monitor with sound output enabled. A sample class of 30 children from Year 4 (aged 8-9 years) were selected by the school head as the class teacher had

expressed interest in using the software in the lesson. The testing was performed in three consecutive sessions, each consisting of a sub-group of 10 children further divided into single or mixed gender pairs. The software was copied from a CD onto the desktop of each PC allowing it to be restarted at the beginning of each session or if problems occurred.

The software was introduced to participants as a ‘game’ during an initial five minute briefing to spark an initial level of interest from the children. Each sub-group of participants were observed exploring the software for 20 minutes by the researcher, a member of the Time Travelling initiative and the class tutor. The remaining children worked on regular classroom activities. The software was assessed based on the level of observed intervention required for successful use. Consultation with the Time Travelling initiative revealed the following three participant abilities to be indicative of successful software usability:-

1. Navigate through the software with minimum effort or assistance
2. Interact with the software, being aware of and using the help facilities
3. Identify success and acknowledge group achievement

To assess abilities 1 and 2 above, no observer intervention was permitted unless prompted by a participant. Participants were instructed to raise hands to ask for assistance. If prompted, the issue was recorded and the participant was directed to the help information within the software. If further prompted for assistance, the participant was simply instructed on how to solve the problem and allowed to explore a new section. Software was downgraded based on the level of observer input required. To assess ability 3, the initial reaction of a participant when completing the carving game was noted, together with any observations of peer support. The level of peer support was also compared to the number of unsuccessful attempts at the game.

After an initial 20 minute period of monitored software exploration, each sub-group of participants was instructed to gather on the carpeted floor area within the classroom to engage in an informal group discussion regarding the software. This process lasted a further 5-10 minutes and involved asking participants questions such as ‘did you notice the dragon?’ to assess participant awareness of in-game help systems, and ‘if you could

add a new section, what would it be?' to explore participant ideas for improvements to the software. Children were encouraged to raise their hands to answer questions in order to maintain a structured discussion. An attempt to gather views from as many children as possible was made to improve the sample of responses. This involved issuing direct questions to individuals who were yet to contribute to the discussion, giving them an opportunity to voice their opinions if desired.

3.4 Results

The carving game was initially met with confusion as the in-game help was disregarded by participants despite being advertised as important by the mascot character. A lack of knowledge of the rules and controls of the game led to an overall expression of disappointment as the game-over screen was promptly displayed upon each first attempt. The level of motivation to master the controls was high with around half of all participant pairs opting to read the help information upon a second attempt at the game. However, the majority of these inquisitive pairs quickly lost interest in the help information as a desire to compete with their peers outweighed any desire to invest time learning how to play the game. These pairs either required observer support or moved on to a new section of the software through frustration. It was noted that no pair was able to master the carving game without some level of observer support.

Female participants initially chose to explore the interactive books. However, the initial popularity of this section was brief due to the male inclusive pairs now mastering the controls to the carving game, leading to an overall increase in noise and excitement from the testing group being observed. This newfound enthusiasm influenced the female inclusive pairs to follow suit into the section until all participants were observed to be interacting with the carving game. A similar convergence of initial section choices was observed during each of the three testing iterations.

Peer support was found to far outweigh peer competition whilst interacting with the software. The majority of children happily shared their knowledge regarding the rules and controls of the carving game. Participants would assist each other in understanding how to play the game, both within their pairs and via inter-pair communication. This included encouragement to succeed against the game's time constraint and acknowledgment of success via raising of hands, patting on backs and an expressive

‘yes’ sound when a game was completed. An overall feeling of ‘belonging’ to a class structure was exuded via inter-pair communication and congratulation on the completion of a task. Some group members were observed physically moving between pairs in order to help solve problems.

Post-session discussion revealed interesting observations of the level of enthusiasm exhibited by participants when asked how to improve the software. Suggestions were focussed on the inclusion of competitive elements such as points systems, league tables and skill level classifications. Participants were especially animated when presenting ideas for improving the game interface with some (especially males) observed standing up to voice their opinions before their peers.

3.5 Summary

This chapter documents a case study of the limitations of the learning ‘through’ serious games model. The results presented suggest that a lack of observer presence would have rendered the software ineffective as an educational tool as the software placed increased pressure on the class tutor to identify purpose, create structure and monitor progress throughout its use. However, the idea of a physical class tutor being the sole influence on the educational power of serious games software is naïve as the observations of high peer interaction and support in this study demonstrate.

If we view scaffolding as enabling a learner to function at a higher level by interacting with another who is considered more knowledgeable (Wiggins & Ruthmann, 2002) then the case study software presented here could be considered as scaffolding of a wider learning experience using games to create social platforms allowing learners to instruct, monitor and evaluate the learning of their peers. These unexpected observations generate interesting questions surrounding how serious games designers can capitalise on these discourses between learners and educators toward a more participatory process of learning ‘by making’ games. The following chapter documents the setting and methodology of the design workshop approach to participatory serious games design projects between children and their educators.

Chapter 4: Research Design

The previous chapter outlined a case for a change in perspective in the use of serious games in education by promoting children from simple users of serious games to participants in their design and creation. Chapter 4 outlines the research design by expanding upon the 'design workshop' methodology identified in the literature review of Chapter 2. A pilot study of a serious games design project with children is documented to determine the feasibility of the design workshop approach, and to select accessible and contemporary software which could be used to assist children in both communicating and implementing their design ideas into digital artefacts.

4.1 Setting

In January 2007, a collaborative research project was started with a local library service to create a new serious game which could be used to improve the image and usage of libraries amongst children. Aimed at secondary school learners, such a product would form part of the library service website and would be used on school visits by children's librarians to advertise the library service and help recruit new members. Based on their experience of hosting creative activities with children in the form of youth groups and design workshops to create new comic books, the service was keen to pursue a peer designed serious game as a new venture for engaging with the community and developing a useful end product for the service. The library service believe that a peer designed product can function as a more attractive and relevant product for children than one designed by librarians or academics.

4.2 Methodology

The research design is based on concepts from both activity theory (Engeström & Miettinen, 2010) and situ-activity theory (Derry & Steinkuehler, 2003) where researchers view learning environments in terms of their observable activity structures and study these structures on a case by case basis using qualitative methods in situ. Activity theory asserts that researchers must consider both what is happening outside of the activity and within the activity as part of the analysis in order to help explain local practices by considering how they are placed in broader global practices. This research is based on methods of 'co-operative inquiry' (Druin, 1999) using a multi-disciplinary design team of researchers and educators acting as 'facilitators' (Squire et al., 2005), meeting regularly with children positioned as equal members of that team. Co-operative

inquiry represents a methodology which adapts to the real-time observations and requirements of an investigation with children (Druin, 2002), and allows researchers to adapt methods to facilitate the individual needs of participants.

Co-operative inquiry represents an ethnographic or 'fieldwork' approach to research (Steinkuehler, 2004) involving researchers actively participating within a game world whilst recording digital video footage of gameplay and observation field notes through 'participatory observations' (Steinkuehler, 2005). Researchers are also advised to record game-related conversation via in-game instant messenger chat and internet discussion forums as these methods are readily available in the online domain (Mahmassani, 2010). Transcripts of these conversations are then produced to analyse discourse and examine how gamers enact activities and identities through their use of language (Steinkuehler, 2008).

As ethnographic research methods view games both as designed objects and emergent cultures (Steinkuehler, 2006a), this contemporary approach to research was adopted in an attempt to unravel the 'mangle of play' (Steinkuehler, 2006b) involved in a multidisciplinary design process between children and adults from different disciplines. Such an approach combines participant observation (both in the physical and digital domains) with interviews and any game related artefacts available (Delwiche, 2006).

Ideas uncovered during co-operative inquiry with participants then form a basis for further 'participatory design' (Druin, 1999), encouraging participants to explore these ideas by creating game prototypes using simple authoring tools considered 'low-tech prototyping' (Scaife & Rogers, 1998). Tools can range from simple pen and paper activities (Scaife & Rogers, 1998; Druin, 1999) to modelling clay (Robertson & Good, 2005) through to complex commercial software environments such as *Mission-Maker* (Williamson, 2009), *Stagecast Creator* (Habgood et al., 2005a) and NWN (Robertson & Good, 2005). As more gamers appear to participate in the creation of in-game content as opposed to peripheral game content (Hayes, 2008) careful selection of experimental game-authoring software is required, as this will ultimately shape what is achievable from a short-term design project. Further, as Steinkuehler (2005) highlights, our understanding of social practices is shaped by our understanding of the tools and technologies that structure them. This requires selecting both current and relevant

software suggested by participants themselves, and not by educators, so as not to constrain what could be theorized from the results of the research. Once selected, copies of sequential prototypes developed with game-authoring software should also be made available following each design workshop to create a development history of work during the investigation (Habgood et al., 2005a).

Meetings between facilitators and participants were presented as *design workshops* (Druin 2002; Overmars, 2004; Carbonaro et al., 2007; Robertson & Howells, 2008) and involved discussion and brainstorming exercises (Robertson & Good, 2005; Habgood et al., 2005b) while recording ideas and observer notes in the form of a diary of events. To avoid the qualitative methods applied in this research from resembling a subjective 'kaleidoscope' of data (Dye et al., 2000), measures to counteract the shortcomings of qualitative research were employed as identified by Mittman (2001). These included the derivation of a formal hypothesis and the specification of key variables in advance of data collection and analysis. Data was planned to be collected from at least two data sources and pilot tests were conducted to identify appropriate timeframes and data capture methods. Provisions were also made to allow for flexibility in methods to allow for different ages of participant as it is vital in co-operative enquiry that activities are both suitable to the process and the age of the participant (Druin, 2002).

A further limitation with qualitative research is the transferability of studies due to poor documentation (Onwuegbuzie & Leech, 2004). This research also sought to devise a clear method of documenting a design project by combining Hart's Ladder as an objective measure of participation, with novel methods of capturing participant ideas and interactions to develop the 'thick description' that ethnographic methods require (Steinkuehler, 2008). Thus Anfara, Brown, and Mangione's (2002) methods to improve the 'credibility' of qualitative ethnographic techniques were used by prolonging engagement in the field by repeating experiments with different participants in different environments across different age groups.

A target demographic of secondary school children was selected for this research based on observations in the current literature which suggest that sophisticated game-authoring is well within the reach of secondary school children although little evidence currently exists to fully assert this (Robertson & Good, 2005). It was also envisaged

that, although literature does exist on successful game-authoring amongst primary school children (Habgood et al., 2005a), this age group would be unable to operate at higher levels of Hart's Ladder in the initiation and direction of games design projects. Hart (1992) suggests that the upper levels of the ladder are only applicable to teenagers.

4.3 Pilot study

To evaluate the feasibility of working with a voluntary group of children over a long term project meeting monthly at a central regional library, a pilot study was run in summer 2008 (Bates et al., 2008). The purpose of this study was to determine the potential of recruiting participants for a serious games design project, methods of interacting with these participants during workshops, and methods of recording discourses and data collection. The pilot study would also seek to select a suitable game-authoring toolkit for use on computers with relatively low performance capabilities.

4.3.1 Procedure

Early meetings with the library service revealed that the library game should function as a package for 'active discovery' (Ulicsak & Wright, 2010) where players learn by doing rather than reading or listening. Such a library game should focus on *why* people use library facilities and not simply *how*. The serious game would form part of secondary school visits to advertise libraries as both educational and social resources where children can ask questions, complete homework assignments and borrow media resources such as music and computer games.

Library staff played the role of customer and wrote a shopping list of features they would like to see implemented in such a game. Following internal collection and synthesis of this data by the library service, four design objectives were devised for a library based serious game. Suitable games should allow children the following:-

1. To have a functional knowledge of how to access library services
2. To be aware they can find content that can enthuse and excite them
3. To explore why they would want to use a library and examine the alternatives
4. To have the opportunity to engage creatively with the library

The local library service and its staff therefore served as a client for the project and were viewed as stakeholders in its success. A local children's librarian with experience of organising youth group meetings for the library service, and with prior experience of working with children, was assigned to the project. A university student working part-time at the university library, with experience of creating short stories, was also recruited by the library service to help participants record their ideas for game narratives. In total three facilitators were used in the project; a local children's librarian (project co-ordinator), a university student (writer) and the research candidate (programmer) acting as project investigator.

The project began in May 2008 and was scheduled to run over the summer so that participants could travel both to and from the meetings safely in daylight. Monthly meetings were organised and advertised to participants via an internet blog. Meetings typically ran for one hour in the evening and were held at a major central library in the local area to capture participants from a broad area. Facilitators played a passive role of allowing participants to utilise the one hour meetings how they wanted to, with facilitators taking notes and offering assistance when required. Meetings took place in the children's section of the library which housed nine networked computers each with access to the internet and word processing software.

In order to gather as large a participant group from as broad an area as possible, opportunity sampling was conducted via a poster advertising campaign conducted around all libraries in the south Derbyshire area during May 2008. Participants were instructed to email the children's librarian (who was placed in charge of participant recruitment) with their intention to join the project and were subsequently invited (with parents) to an initial meeting in June 2008 at the central library. This convenience sampling was successful in recruiting 20 children aged 11-15 years, and four parents, to attend an initial briefing where the project was pitched to the group and names and email addresses were collected and protected by the children's librarian.

The restrictive nature of computers in the library meant that the installation of any third-party software, such as authoring software, was unfeasible. Access to the internet was heavily restricted by a third-party firewall which blocked access to sites with examples of serious games for demonstration purposes, and to potential game-authoring software.

The role of participants in the project was to create a goal, theme and control scheme for a single game idea, and to provide game assets such as characters, sounds and music. As facilitation was passive in nature, allowing children to take ownership of the project in alignment with the uppermost level of Hart's Ladder, the only facilitation tool used as part of the project was an electronic project blog. Created by the children's librarian using the free software *Blogger* (www.blogger.com), the primary function of the blog was to allow participants and facilitators to communicate outside of the scheduled monthly meetings. The project investigator did not contribute to this blog and instead used it as project diary to record events, methods and digital discourses throughout the project.

The project blog served as a landing page for anyone who had read the recruitment posters around the local libraries and was interested in the project. Therefore it was important that the blog should function to frame the goals and responsibilities of children during the project and to act as a recruitment tool itself. The following text is taken from an introductory post on this blog written by the participating children's librarian to advertise the project:-

> '*Welcome everyone to our exciting new project. If you've found this blog then you more than likely responded to a poster in one of our libraries, thank you for that. So what's the big idea? The big idea is very simply to allow you all to create a video game about the library and about why you should use the library. To help you do this we will be joined by a programmer and a writer and we may be joined later by other experts like musicians. But we need you to create the art, story, music, levels and gameplay. When it's finished the game will be available in all [local] Libraries, sent to [local] schools and available to the whole world through our website. And if you help us design it, your name will be on the credits.*'
>
> Blog post

The blog was therefore initiated in May 2008 exactly one month before the first scheduled meeting of participants in June. The children's librarian would insert blog entries as *posts* based on a particular topic with a description or question attached. Participants could then add their own opinions or suggestions to these posts as *comments*. Figure 3 shows how examples of serious games were embedded and shared

throughout the pilot study using the project blog. The following list summarises the four primary functions of the project blog during this pilot study:-

1. To collect digital discourses from participants
2. To advise participants on the dates of future meetings
3. To share examples of serious games and authoring software
4. To create a development history of work and ideas over a long-term project

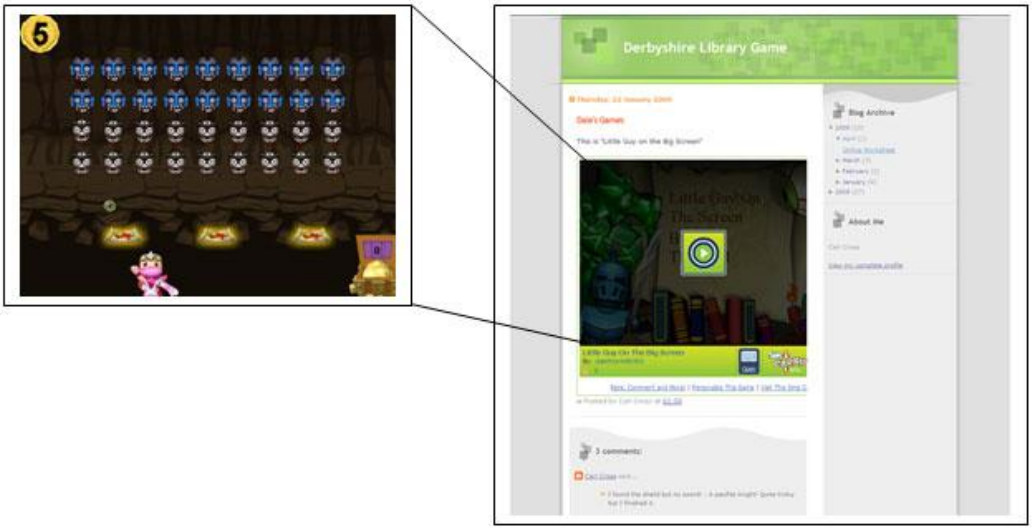

Figure 3: Example of embedding and sharing serious games using an internet blog

4.3.2 Results

Pimenidis (2007) identifies many concerns regarding working with children to create library based serious games. These include a lack of incentives for participation (both financial and academic) and the potential lack of experience of children with design-based projects. The pilot study attracted an initial participant group of 20 children which subsequently completely disbanded over a four month period. After an initial project brief in the June meeting, only four males aged 11-13 years from the initial participant workshop returned in July 2008. These participants were friends and travelled to workshops together. The same four participants returned again in August while three chose to attend in September. Despite being advertised on the project blog, no participants attended the design workshop in October. This, combined with a decline in contributions to the project blog, prompted facilitators to declare the project cancelled in November 2008 which was communicated to participants via the children's librarian.

The project blog attracted 21 comments in May 2008 which declined to just six comments in September. Facilitator posts to this blog had three important functions each month; to organise the current design workshop, to open a discussion on an interesting topic uncovered during the previous workshop, and finally to advertise the date of the next workshop. Therefore a minimum of three posts were made by the children's librarian to this blog each month. The number of entries was increased to four in July and again to seven in August. This was to accommodate posts to rearrange a cancelled workshop and to host simple mini-games games created by participants using the web-based *Sploder* (www.sploder.com) game-authoring software sourced by the children's librarian. The Sploder software allowed participants to create basic shapes and interactions but was too limited in scope to be considered as viable software for future use. Table 2 summarises the nature of facilitator posts and the number of participant comments generated during the pilot study.

Table 2: *Summary of blog contributions during pilot study*

Month	**Posts**	**Comments**	**Description**
May	3	21	Introduction to project
June	3	7	Discussion of favourite games
July	4	2	Participant software suggestions
Aug	7	15	Example games created by participants
Sept	4	6	Participant software suggestions
Oct	3	1	Summary of final design workshop
Nov	1	0	Notification of project cancellation

The highest frequency of contributions to the blog occurred in May where posts asked participants to introduce themselves and their favourite games, and also in August where posts asked participants to comment upon the design ideas of their peers. This demonstrates that children are enthusiastic to discuss their own gaming preferences and the gaming ideas of their peers. Other posts asking for examples of software to assist with game prototyping generated few contributions from participants. Figure 4 shows the distribution of facilitator posts and participant comments made to the project blog over the six month pilot study.

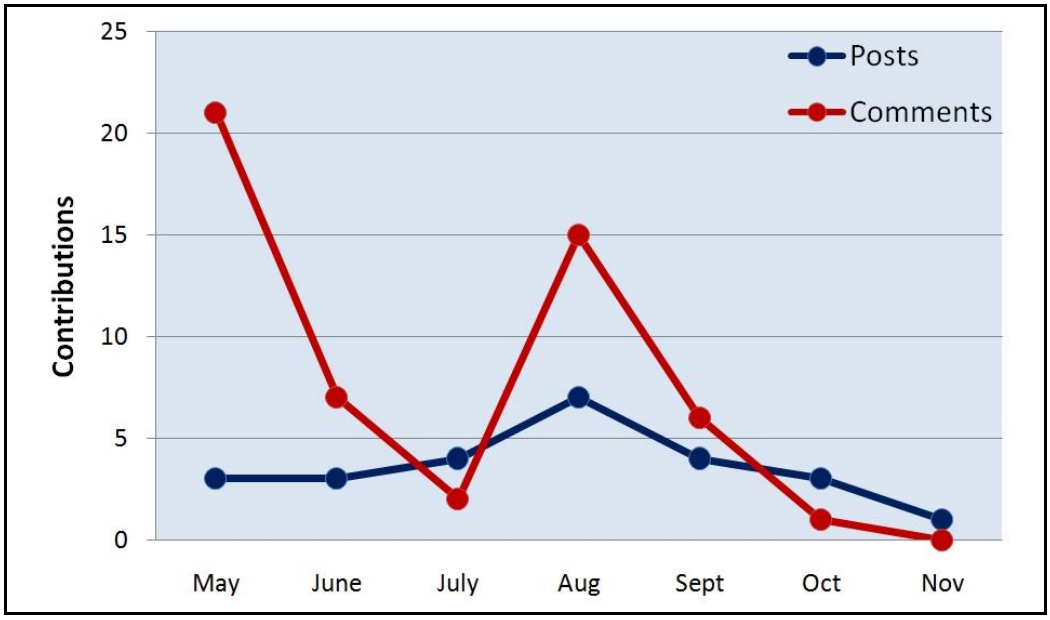

Figure 4: Distribution of blog contributions during pilot study

Reasons for this decline in participation are speculative as it was not possible to discuss potential attendance issues with participants as they were not available physically (did not attend meetings) or electronically (did not contribute to the blog). The children's librarian attempted to contact initial participants to enquire why they had chosen to leave the project using the email addresses he had acquired in May. The candidate is not privy to the contents of this email but is aware that no participants replied to this email request. As meetings were arranged monthly on an ad-hoc basis, the function of the project blog was also to provide scheduling information. If participants did not visit the blog then they would not be aware of when the next meeting would take place. This demonstrates that young gamers (11-16 years) are initially enthusiastic to discuss ideas for games design but are reluctant to invest in long term design projects of this nature. Therefore a major risk to this research is the longevity of a voluntary group of children participating in design.

4.4 Modifications

To address the issue of maintaining participant interest in an extracurricular design project, it was decided that workshops should instead take place using the facilities of a local secondary school. The children's librarian was able to use links established through previous projects to identify a suitable school which could facilitate such a project. Provisions were made for convenience sampling, again consisting of a poster advertising campaign around the school, plus school assembly presentations by the children's librarian. Design workshops would instead take the form of weekly meetings between educators, researchers and participants over a reduced timeframe of 10 weeks (Squire et al., 2005; Carbonaro et al., 2007). This timeframe allows such a project to operate within the tight schedules of a typical 12 week school term, and to minimise disruption from Christmas and Easter school holidays (of up to two weeks) where access to facilities (and staff time) would be minimal if not entirely restricted.

Meetings had to be accessible to improve attendance and longevity and so workshops could either be run within the school day or immediately after school. Workshops would also operate using the same facilities available to participants as part of their current learning environments (school libraries, classrooms), allowing participants some familiarity with these facilities prior to each investigation. Further, positioning workshops within these environments would hopefully allow participants easy access to any material required to create game assets or game content.

Based on the work of Squire et al. (2005) and Carbonaro et al. (2007), workshop activities would be broken down into three main sections; briefing, activity and reflecting. The initial goal of the research was to observe a project at the highest level of Hart's Ladder (child initiated with adults in a supportive role), using this breakdown of workshop activities. Workshops were designed to have a minimum of three facilitators present who would regularly meet outside of workshops to swap notes, discuss interesting observations and to tailor methods for subsequent weeks subject to current observations, in line with the dynamic nature of Druin's (2002) co-operative enquiry methods. Participants would be required to work in small groups to improve engagement, allowing them to discuss ideas and reduce confusion when asked to interact with new software (Squire et al., 2005).

Participants would be videotaped to capture their ideas and to uncover themes which may have been missed via observer notes (Squire et al., 2005). Video footage would not only provide a transcript of conversation but also visual evidence of physical exchanges between participants during workshops when conversing with peers. As a classroom based investigation into serious games design would necessitate physical conversation between both participants and educators as part of the design process, the use of video footage in this research was planned to mimic the fieldwork studies of Steinkuehler (2004) in an MMO centred digital environment, whilst allowing the ethnographic methods of participation and data collection to be performed in a physical environment such as a classroom. Participants would also be required to periodically complete questionnaires which had four main roles:-

1. Formally record participant design ideas to answer RQ1
2. Collect participant social gaming preferences to answer RQ2
3. Record participant opinions of authoring software to answer RQ3
4. Ascertain value of questionnaires as an ethnographic tool for use in future studies.

A debriefing process of participants was undertaken in the form of a post-investigation presentation to uncover reflection on both product and process, from both participants and educators, without the requirement for lengthy interview sessions and post-investigation questionnaires which were deemed unsuitable in extracurricular activities due to time constraints. This presentation was videotaped for transcription and acted as a reflective summary of the project from participants, facilitators and attending members of staff. Table 3 summarises the limitations encountered during the pilot study and proposed modifications to the research methods.

Table 3: *Limitations of pilot study and modifications to research methods*

Limitation	**Modifications**
Children are reluctant to attend a design project during the school holidays	Meetings to take place immediately after the school day using school facilities
Children are reluctant to invest in long-term design projects	Weekly meetings to reduce the duration of an investigation to 10 weeks
Library computers use third-party firewall software and are unsuitable to run game-related software and websites	Example media and game-authoring software must be suitable for operation on limited computer hardware
Children are reluctant to answer questions from facilitators in a workshop environment	Data collection methods to encompass questionnaires and a post-project presentation of work

As outlined in Chapter 1, research criteria were broken down into three key questions each with two variables. As much of the data for this research would be sourced from observations of participants during fieldwork and anecdotal evidence of behaviours, an observation schedule was developed for each of the six variables to assess how participants interacted during the design process. These observations would be recorded in note form and shared amongst facilitators. Synthesised notes would then be combined with collected questionnaire responses and game resources to form Steinkuehler's (2008) 'thick description' of the design process. Table 4 outlines this observation schedule for each research variable being evaluated.

Table 4: *Observation schedule for research variables*

Research variable	Observation schedule
Range and suitability of ideas communicated by participants	- how do participants communicate ideas with facilitators? - are game ideas achievable within the project timeframe? - are game ideas achievable using authoring software?
Ability of participants to convert designs into functional media	- do participants create their own game resources? - amount of facilitator input to meet objectives? - type of facilitator input to meet objectives?
Amount and type of assistance required by participants	- do participants choose to work alone or as a team? - do participants ask tutors / investigators for help? - do participants offer peer support to others?
Amount and type of assistance offered by participants	- do participants move around the room to provide help? - can participants provide the help required? - do peer experts / leaders emerge within the group?
The extent participants use design tools to communicate ideas	- do participants use pen and paper to record ideas? - do participants bring their own equipment to workshops? - do participants work on designs at home?
Opinions of participants and educators on software	- do collaborators comment upon software? - do their opinions change over the course of the project? - can technicians integrate software within current setup?
Ability to operate software within a learning environment	- availability of local computers and technology? - impact of local firewall software on project? - problems with software and workarounds used?

4.5 Summary

This chapter has discussed an ethnographic research methodology of co-operative enquiry into a serious games design project. The feasibility of the qualitative fieldwork methods of this approach were assessed for use with secondary school children via an extra-curricular activity by deploying a six month pilot study. This pilot study assessed the suitability of monthly meetings at a central library, using an internet blog to allow participants to continue work and discussions outside of meetings. The low adoption of the project blog, and issues with cancellations and rearrangements of monthly meetings, failed to maintain the initial interest of participants in a serious games design project. Thus, modifications to the research procedure were made including changing the long-

term nature of the project to a short-term project taking place in the school term. The learning environment was changed to make use of local school facilities. Data capture methods were also revised to include paper questionnaires and video capture of design decisions to improve the documentation of the design process. These revisions were applied to a short term participatory design project utilising the pupils and facilities of a local secondary school which is documented in the next chapter.

Chapter 5: Study 1 Library Investigation

The results of the pilot study documented in the previous chapter demonstrate that children are initially enthusiastic to discuss their ideas for computer games design, but are reluctant to invest in the long term design processes required by serious games. Therefore a major risk to ethnographic research into serious games design is the longevity of the voluntary participation of children. A potential solution to this longevity issue is to utilise the facilities of local secondary schools to deliver design workshops via an extracurricular after-school activity similar to the methods of Habgood et al. (2005a), Steinkuehler (2006) and Robertson and Howells (2008). Chapter 5 documents the methods and results from a participatory serious games design project led by children with adults in a supportive role (level eight of Hart's Ladder) via an extracurricular activity using self-selecting participants.

5.1 Setting

Using the library facilities of a local secondary school, Study 1 observed a voluntary self-selecting group of children from the school attending a 10 week after-school design project (Bates et al., 2009a). Meetings were organised as design workshops lasting one hour immediately following the close of the school day at 3pm. Staff at the participating school were consulted on a suitable time to run a 10 week project and the Spring term (January to April) was agreed upon as students would already be settled into new classes (occurring in the autumn term) and would not be distracted by important exam periods (occurring in the summer term). School holidays for half-term were accounted for in this planning and so a one week break would occur in February. The project blog would be monitored over this break to determine if, and how, participants communicated during school holidays.

5.2 Procedure

5.2.1 Participants

Participants were recruited using convenience sampling of applications to poster and school assembly advertisements of the project during December 2008. An example recruitment poster created by the library service for use in this campaign is provided in Figure 5. A preliminary planning meeting was advertised and was attended by facilitators and 10 participants to discuss the project and to distribute consent forms in

line with the ethical practice of all stakeholders. These forms were also counter-signed by parents.

Figure 5: Example recruitment poster used for opportunity sampling in Study 1

An initial group of 10 participants returned to attend the first design workshop consisting of nine males and one female of ages 13-15 years. Participants were set a project goal to create a serious mini-game for use by a local library service to advertise libraries as educational resources to secondary school children. The library facilities provided facilitators with a large workspace for group discussions and one networked computer for each participant. Project facilitators included the school librarian, the returning children's librarian and the research candidate acting as project investigator.

The library facilities of the school provided a learning environment with both workspace for discussions and access to 30 high specification PCs running the Microsoft Vista operating system equipped with CD drives, USB connections, Microsoft Office, Adobe Flash, mouse, keyboard and 15-inch flat panel monitors. PCs were connected to the school network for file storage and internet access was controlled via a third-party firewall. Images of the computing suite and workspace facilities of the secondary school library are provided in Figure 6.

Figure 6: Images of computing suite and workspace of secondary school library

5.2.2 Method

Weekly workshops lasted for one hour allowing for a total contact time of 10 hours between facilitators and participants. Workshop activities involved facilitators applying a passive facilitation approach by simply initiating and then observing participant activities. The project was broken down into five main stages; (1) an introduction to the project, (2) exploration of serious game examples, (3) low-tech prototyping using paper drawings and LEGO^{TM}, (4) an introduction to game-authoring software, and (5) preparation and presentation of a project summary to school staff. Questionnaires were distributed at each stage to record participant gaming preferences, design ideas and opinions on selected serious-game examples and game-authoring software. Examples of the questionnaires used in this study can be found in Appendix A.

The ethnographic research approach required investigators to participate within a gaming process whilst recording gameplay interactions, observation field notes, and game-related conversations for analysis (Steinkuehler, 2004). The selection of suitable software was therefore important to allow the candidate to address both RQ2 and RQ3. The online serious game example *Poptropica* (www.poptropica.com) was selected as a popular contemporary serious game to investigate how children build and share new knowledge during the investigation (RQ2). Poptropica is an educational 'web-game' which does not require complex software or a user subscription to play. Launched in 2007 by Pearson Education for ages 6-15 years, the role-playing tasks found in Poptropica have motivated players to exchange their gaming knowledge by distributing instructional material in both textual and video form on popular internet forums and media distribution websites, similar to the peripheral learning resources observed in

large scale MMOs by Steinkuehler (2008). Poptropica was selected as an example of accessible software that can run on limited hardware in a school library that participants were allowed to explore, discuss and evaluate during workshops. Further, the following two examples of contemporary game-authoring software were selected for evaluation during the investigation to find suitable software to facilitate a serious games design process with children (RQ3):-

1. Game-Maker (www.yoyogames.com/make):
   Sourced from the research literature and recommended by a participant in week one of the project, Game-Maker represents subscription free game-authoring software which is available via the internet. Game-Maker allows users to create game resources via a drag-and-drop interface (see Figure 7). Users can then customise these resources via an integrated graphics editor allowing for easy modification of existing games. Users can also publish their games as executable files allowing them to be freely distributed for testing and evaluation. Game-Maker can be installed either on a local computer or a network server for access.

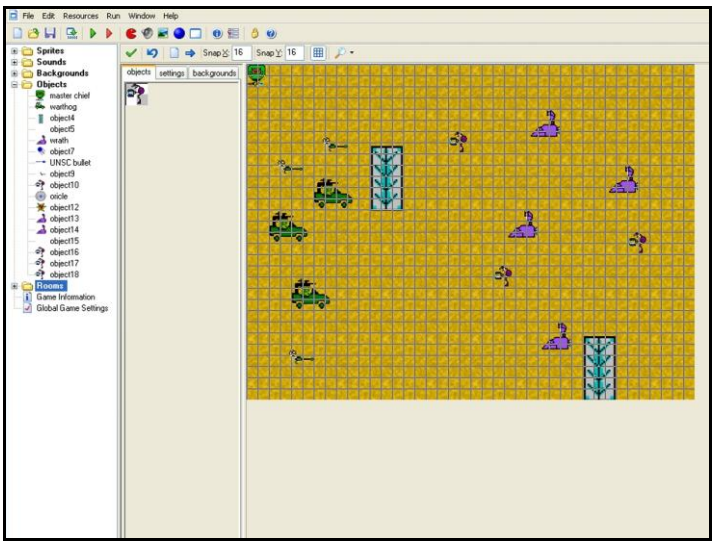

Figure 7: Screenshot of Game-Maker authoring environment

2. Sims Carnival (www.simscarnival.com/games):
   Sourced by the children's librarian and absent from the research literature as a contemporary tool, Sims Carnival represents commercial game-authoring software which is available via the internet for beta testing. Sims Carnival allows users to combine objects with programming logic via a drag-and-drop interface (see Figure 8).

Games can also be published to a central web-server for distribution via the Sims Carnival website. Sims Carnival must be installed on a local computer for access.

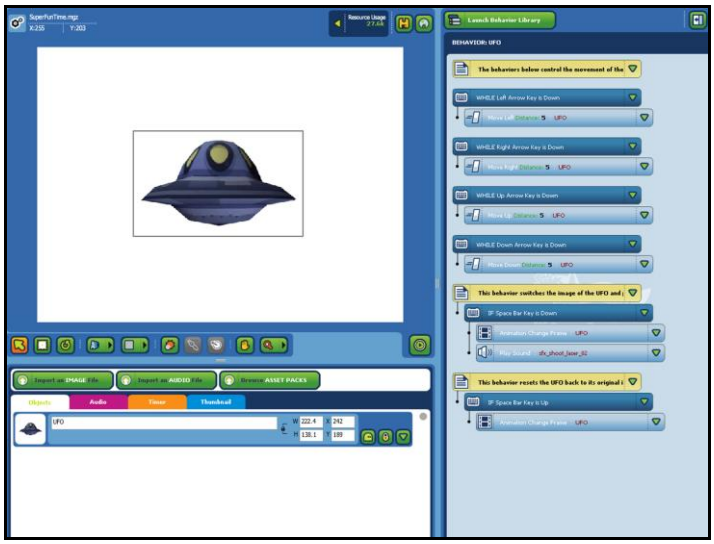

Figure 8: Screenshot of Sims Carnival authoring environment

Workshops consisted of a 10 minute initiation brief by facilitators and 45 minutes of activity, followed by a five minute debrief. Facilitators only provided input into the activity during the briefing and when requested by participants. Participants explored the selected authoring software at their own pace with facilitators available to answer individual questions when required (Robertson & Good, 2005). Facilitators adopted a passive approach to timeframes and deadlines as activities were extended into the following week for completion if the group requested. The project blog from the pilot study was introduced to participants in week one and was updated after each workshop by the children's librarian in line with the methods applied in the pilot study. Table 5 provides a breakdown of workshop activities over the 10 week investigation.

Table 5: *Weekly breakdown of workshop objectives and activities from Study 1*

Wk	Objective	Activities
1-2	Introduction and concept	- opportunity to create a game concept - introduce library learning objectives - introduce project blog - distribute Questionnaire 1
3-4	Explore software	- opportunity to explore and discuss software as a group - introduce Poptropica as serious game example - distribute Questionnaire 2 - workshops videotaped for analysis
5-6	Physical prototyping	- opportunity to expand concept into game design - distribute Questionnaire 3 - work in small groups using physical design tools - including LEGO™, pen, paper, glue, felt shapes, glitter - present game designs to peers using design tools - workshops videotaped for analysis
7-8	Digital prototyping	- opportunity to prototype game design using software - introduce game-authoring software via tutorials - distribute Questionnaire 4 - workshops videotaped for analysis
9-10	Prepare presentation	- complete games using selected authoring software - distribute game prototypes via the blog for comments - prepare presentation

5.2.3 Data collection

Paper worksheets were prepared and distributed by facilitators each week. These sheets acted as both questionnaires for participants regarding their gaming preferences, and design aids allowing participants to plan and describe their designs in written form. To compare participant design ideas with their home gaming preferences, paper worksheets asked participants to list their favourite computer games each week and these were used to determine whether commercial video games influenced the design decisions of participants. Participants were videotaped during selected workshops (Druin, 2002; Squire et al, 2005) including discussion of their low-tech LEGO™ prototypes, learning how to use Game-Maker, and the post-project presentation. These video recordings

were transcribed to uncover discourses facilitators may have missed, and to provide a narrative of contributions from all participants during these activities.

The project blog was monitored on a weekly basis with facilitators initiating discussions and inviting participants to post comments. Access to the project blog was restricted to registered users in line with the school's ethical approval, and participants were encouraged to log in using their Google web accounts. A register was maintained by the school librarian to monitor attendance, and all design artefacts including paper drawings and completed worksheets were collected from participants to form a physical developer's diary of worksheet responses and any other physical artefacts developed. Table 6 summarises the primary functions of the four data collection methods employed in this investigation and how these relate to specific research questions from Chapter 1.

Table 6: *Data collection methods and primary functions from Study 1*

Method	**Function**
Internet blog	Collect design ideas for comment by participants (RQ1) Record digital discourses between participants (RQ2) Record participant opinions of authoring software (RQ3) Create a development history of work Allow participants to communicate outside of workshops
Observer notes	Record design ideas from brainstorming exercises (RQ1) Observe participant interactions in workshops (RQ2) Record comments about authoring software (RQ3)
Paper questionnaires	Formally record participant design ideas (RQ1) Collect participant social gaming preferences (RQ2) Record participant opinions of authoring software (RQ3) Ascertain value of questionnaires as an ethnographic tool
Video-footage	Record physical discourses for transcription (RQ2) Record physical interactions within workshops (RQ2) Ascertain value of video-footage as an ethnographic tool

5.3 Results

5.3.1 Design products

The passive approach to facilitation meant that the design choices of participants were unregulated by facilitators. Of the six game designs presented in weeks five and six, four were influenced by the violent commercial FPS and Action Games participants said they played at home. Questionnaire responses revealed that these games included British Board of Film Classification (BBFC) rated franchises typically played on the Microsoft Xbox games console including, but not limited to, Halo, Gears-of-War, Call-of-Duty (COD), Dead-Space, and Aliens-versus-Predator.

European computer games are labelled with a minimum-age rating governed by the Pan-European Game Information (PEGI) system. If a game is deemed to be of major concern by PEGI then it is referred to the BBFC for approval in the UK. The genre and minimum-age rating of each game listed by participants using paper worksheets was collected using the search facilities of both the PEGI and BBFC websites. Action and shooting games accounted for 63% of participants' favourite games. Of these games, 62% had a minimum-age rating of 15 years classified by the BBFC for concerning content. Games designed by children are evidently influenced by the violent games they prefer to play which is a potential problem when designing serious games. A summary of participant gaming preferences based on genre and minimum-age rating can be found in Figure 9 and Figure 10 respectively.

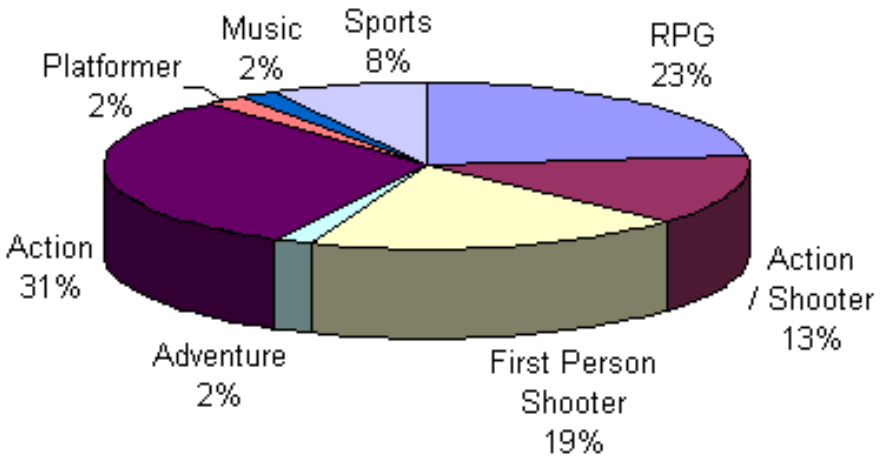

Figure 9: Children's favourite games based on genre

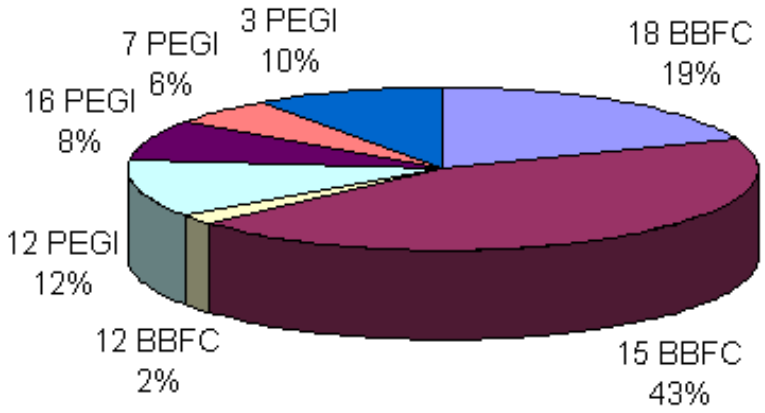

Figure 10: Children's favourite games based on minimum-age rating

To typify the influence of the Microsoft Xbox, its online multiplayer provision 'Xbox Live', the social motivator of gamer 'achievements', and the dominance of FPS and Action Games on modern games consoles, the following quote is taken from a questionnaire response in week one, asking participants to describe their idea for a library based serious game:-

> '*My game would be a[n] action and strategy game. It would contain violence, shooting, a bit of gore and a mystery / storyline. The city of Afghanistan is at stake. The U.S air force [has] been sent in with highly dangerous nuclear bombs. Your soldiers are still in Afghanistan fighting the war. You [have] only a week to get out of the country with your remaining squad. Otherwise the U.S Air force will fire the nuclear bomb at Afghanistan whether or not you're in the country. Play multiplayer online or system link. Play with up to 16 players from around the world. Plus, 3 day trial of gold Xbox Live membership inside.*'
>
> Participant K

It is worth noting that the library learning objectives compiled by library staff were written on this questionnaire immediately preceding this question (see Appendix A). The above game concept is clearly inspired by the violent commercial FPS games which Participant K included in his list of favourite games on the questionnaire. Participant K has clearly misunderstood the serious game nature of the question here, but the answer provided does give a useful insight into his game design choices and

how these are influenced by his gaming preferences. It is fair to say that a lack of facilitator input into the formulation of these concepts for a library-based serious game rendered these concepts as unfeasible within the constraints of a short-term design project and also unsuitable for use by a target audience of children.

One example of facilitator input advising upon the design ideas of participants was encountered during the low-tech prototyping stage of the project. The design for the game ‘Stick-Man’ sought to dissuade children from taking drugs by navigating a computer character through a *Pac-Man* style maze while collecting drugs to increase the character's speed. When pointed out to the male designer that this idea was in fact promoting the use of drugs rather than dissuading it, he quickly changed the design to offer users a choice of drugs to take.

Only two functional games were available for post-project presentation, neither of which included any library-based content. The shooting game ‘Collateral Damage’ required players to shoot soldiers and planes to reach the end of a level and was deemed unsuitable by the 13 year old designer to be presented to the school Head of IT (Information Technology) during the post-project presentation due to its violent nature. Similarly, the game ‘Halo Wars’ simulated a war environment between soldiers and aliens similar to that of the commercial game *Halo Wars*, which the designer said was one of his favourite computer games. Images of these games are presented in Figure 11.

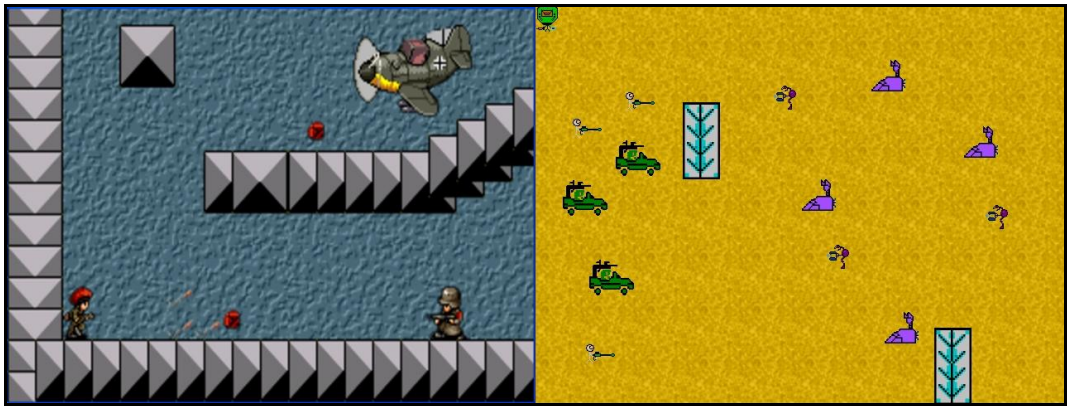

Figure 11: Screenshots of games ‘Collateral Damage’ and ‘Halo Wars’

The lack of learning material or library-based content in these games can be traced back to the physical prototyping stage of the project, where participants were asked to expand

their game concepts into designs by specifying the goal and features of their game idea together with any items or obstacles a player was required to collect or avoid using Questionnaire 3 (see Appendix A). Participants then used LEGO™ and stationery to prototype and discuss these ideas with each other. Participant responses as they appeared on this questionnaire are tabulated in Table 7.

Table 7: *Summary of children's game concept ideas as presented in Study 1*

Title	Stick-Man	Lego Force	Halo Wars	Collateral Damage
Goal	Get to the end of the board	Destroy / kill other opponents and enemies	Destroy enemy units and base	Blow up end console
Obstacles	Electric gates	Other people, enemies e.g. giant squids. Once an enemy is killed the player can have the enemy's advantages e.g. medi-packs	Infantry and units of the opposition must be destroyed	Enemy soldiers and maze like terrain
Items	Drug needles to make you go faster	Players can pick up weapons to defend themselves or attack other players	Outposts / air-strikes / special upgrades can be found	Medi-packs
Features	Because it's a new game that shows you what drugs do to you	The setting of our game is in the future. It is a strategy game	Must destroy enemy base and destroy infantry, enemies etc	Arrow keys to move, space key to shoot

Again, the goals and features of the games presented in Table 7 have no relevance to libraries or the required game learning outcomes presented to participants in week one. One important observation of these initial game ideas is the design for 'Lego Force' which was presented by Participant K. Participant K also wrote a brief synopsis for his game on the back of the questionnaire, such was his enthusiasm for the idea:-

'*The objective of the game is to destroy your opponents. To do this you roll a dice and then move the amount of number rolled, you then encounter someone landing next to them. You then roll the dice again and so does your opponent. Whoever rolls the highest number wins. To help you there are different features situated around the board e.g. you could equip a gun or a spear. You can also find medi-packs to restore your health if you lose an encounter and you can find shields to help you defined against other players or enemies on the board. The name of our game is Lego Force.*'

Participant K

This game idea is notably different to the violent FPS-inspired concept presented by Participant K in week one. The modified idea is clearly influenced by the participant's use of the LEGO™ design tool (hence the addition of the tool in the title of the game). The game resembles a typical card trading game such as 'Top Trumps' or POKEMON™, where players compare attributes of items and swap them. The focus of these trading games is still a combat mechanic, but the relevance of this combat is nowhere near as profound as in the initial concept presented by the participant. The marked change in approach to the game idea was attributed to the experimental or 'sandbox' nature of the toy LEGO™ as a design tool, and its ability to allow participants to explore ideas by building assets and sharing them with their peers.

5.3.2 Design process

The use of LEGO™ as a physical design tool motivated participants to convert basic paper design concepts into functional models to assist them presenting their work to their peers. An example LEGO™ model used to demonstrate the game idea 'Lego Force' is shown in Figure 12. However, the use of this tool was also a distraction for the male participants, which was commented upon by the female participant as being 'unacceptable' for taking '*twenty five minutes just to go through two LEGO games!*'

Figure 12: LEGO™ models created during co-operative enquiry with children

Conversely, electronic discussion via the digital domain of the project blog was disregarded by participants as only three participants requested their games to be embedded in the blog. Further, only one of these games attracted user comments. In response to this, investigators suggested participants write a game review using the blog, with the best review receiving a discount voucher from a local game shop purchased by the school librarian. This incentive attracted a further six posts over two weeks which included four game reviews. The remaining two posts concerned an argument about one participant allegedly plagiarising the work of another. This new competitive stimulus generated a further three posts, creating eleven posts in total during the investigation. These observations suggest that children do not naturally use blogging software to share ideas and knowledge during a game design process.

A positive result of the investigation is the high level of participant attendance at the weekly workshops. An initial group of 10 participants was reduced to a core group of seven over the 10 week investigation including six males and one female of average age 14 years. The dips in attendance as highlighted in Figure 13 were due to illness, part-time jobs or school revision classes. However, many participants chose to attend the design workshops rather than other commitments thereby demonstrating their enthusiasm for the project.

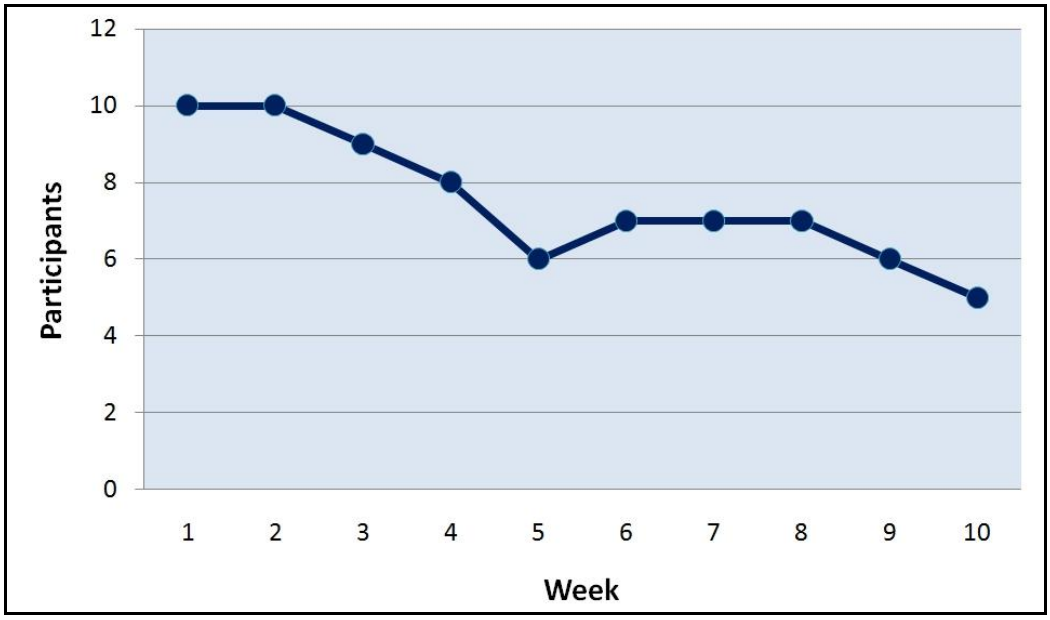

Figure 13: Distribution of participant attendance during Study 1

Questionnaire responses revealed that children prefer to 'keep trying' when presented with a computer game problem rather than ask for help. This was further observed during the exploration sessions with both Poptropica and Game-Maker as very rarely were participants observed asking for help when stuck. Participants were asked where they seek help when confronted with a gaming problem at home, with 'websites' and 'friends' being the most common responses. Participants agreed that the most important goal of a computer game was to 'have fun' as opposed to actually completing the game or generating a high score. This was contradicted by the actions of some participants however, as they continued to play Poptropica at home and presented their in-game achievements to their peers in the workshops.

5.3.3 Authoring software

Firewall restrictions at the school would not allow participants to install the Sims Carnival software or access the Sims Carnival website. However, the firewall software would allow the games developed in Sims Carnival to run when embedded in the project blog. Game-Maker allowed participants to publish prototypes as executable files allowing games to be run easily once installed on a library computer. However, distribution of these files was also restricted as the school firewall software prohibited access to the .exe file format in email attachments. This is an understandable precaution, and so investigators chose to distribute all Game-Maker prototypes using a computer memory stick. Questionnaire responses revealed that 80% of participants preferred

Game-Maker over Sims Carnival, commenting that it was ‘brilliant’ and ‘simple to use with great results.’ One participant did express concern that the software interface ‘looks a bit hard to use.’ Participants who preferred the Sims Carnival software commented on its streamlined user interface that ‘tells you what to do next.’

The post-project presentation was held in the school library allowing participants to summarise the design project for stakeholders at the school who had expressed interest in the methods and results of the project for use in the current curriculum. This presentation was videotaped and transcribed for analysis. Figure 14 provides a sample of the transcript from this presentation. This sample reveals that participants disregarded official tutorials when learning how to use Game-Maker and instead opted for peer-based tuition amongst the participant group. The transcript also reveals that this ability to facilitate communication amongst a student group meant that Game-Maker was regarded as a potential addition to the school’s IT curriculum by the Head of IT.

Figure 14: Transcript of presentation to school stakeholders from Study 1

5.4 Summary

Elevating learners to higher levels of Hart's Ladder and granting them more freedom to schedule, and ultimately control, their own learning can be a problematic strategy for educators as there is no guarantee that children will complete key learning objectives in an open-ended explorative gaming session. However, the importance of granting a learner the tools to facilitate their own construction of knowledge should not be underestimated when designing new educational software. A mixed reality approach promoting both physical and digital discourses has proven effective in allowing learners to express themselves using both physical and digital prototyping tools within a school learning environment.

This chapter has documented increasing the level of student participation in making serious games by elevating children to higher levels of Hart's Ladder allowing them to initiate and direct weekly design activities (level eight). To compare these outcomes with student participation at lower levels of Hart's Ladder involved increasing the participation of adults as facilitators to the design process. The following chapter presents the methods and results from a participatory design project led by adults who inform and assign specific roles to children (level four) via a curricular activity using a sample class of secondary school students.

Chapter 6: Study 2 Classroom Investigation

The previous chapter documented the methods and results from a participatory design project led by children with adults in a supportive role at level eight of Hart's Ladder, via an extracurricular activity using self-selecting participants. Chapter 6 presents the methods and results from a participatory design project led by adults who informed and assigned specific roles to children (level four of Hart's Ladder), via a curricular activity using a sample class of secondary school children (Bates et al., 2009b). The design workshop methods of the previous chapter were adapted for use in a classroom context and the number of facilitators was increased from three to six to deliver a more active approach to facilitation during the project.

6.1 Setting

In May 2009, a local education initiative sought to collaborate with local schools as part of a community outreach programme for the 2009 Nottinghamshire *GameCity* computer games festival. The objective of this collaboration was to allow secondary school children aged 14-15 years access to feedback from industry professionals as part of their GCSE (General Certificate of Secondary Education) Art & Design curriculum. The collaboration would involve members of the GameCity initiative working with children at a local secondary school during their timetabled school lessons on a short term serious games design project. The goal of this project was assigned by the teacher selected for participation by the school. This goal required participants to create serious games to impart important knowledge about secondary school life to prospective primary school applicants aged 9-11 years. The candidate was invited to participate and observe the project in exchange for assistance with the game-authoring software Game-Maker which had been pre selected for use during the project by GameCity.

The project represented a useful opportunity for the candidate to participate with a real world multidisciplinary project initiated and led by adults. As the project was curriculum rather than research led, the production of functional final products took precedence over exploration of innovative approaches to design partnerships. Educators from a variety of backgrounds drew on their own experiences and ideas of best practice to devise an active approach to facilitating a participatory project with children. Thus, the rudimentary roles of teachers and students in a classroom context were applied, with adults making decisions on weekly tasks and deliverables whilst devising specific roles

for participants which were important to the project both functionally (communication) and synthetically (motivation). This curricular activity was therefore positioned at level four of Hart's Ladder (assigned but informed).

6.2 Procedure

6.2.1 Participants

A sample class of 22 children from Year 10 (aged 14-15 years) containing 12 males and 10 females were selected by the school as participants. Selection of this class was made using convenience sampling by the school of the GCSE Art & Design class assigned to the participating teacher. The collaborating secondary school was selected for participation by the GameCity initiative due to its accreditation as a 'technology college' by school regulatory body Ofsted, and previous collaborations between the school and the initiative. Project facilitators of this classroom investigation included the class teacher, a classroom teaching assistant employed by the school, two design consultants from GameCity with experience of games design projects in industry, a university student recruited by GameCity with experience of Game-Maker and the research candidate acting as project investigator.

The investigation made use of the existing pedagogy employed by the school as far as possible to capture results from a typical contemporary school classroom. The investigation operated within participants' timetabled Art & Design lessons which took place weekly on Wednesday afternoons for two hours during the summer term. These classes ran immediately after lunch between 1-3pm after which students were free to go home. The learning environment used for the investigation was the timetabled Art & Design classroom and all facilities within. Typical of secondary school classrooms of this nature, this learning environment contained large, square desks which participants sat around facing each other.

The class teacher had access to an overhead projector and whiteboard, and participants had access to digital cameras and six computer laptops with wireless functionality and a connection to the internet through the school's Virtual Learning Environment (VLE) *Frog* (www.frogteacher.com). The Frog VLE is an example of commercial software which allows secondary school students to collaborate on projects via both local and remote access to school resources and chat facilities, via online workspaces known as

'learning rooms'. This VLE was advertised by the school during preliminary meetings and email conversations between the research candidate and school staff as a viable resource for use during the investigation. The use of this resource would necessitate liaison with the school's technical staff who had ultimate control over the VLE resource. Requests for the creation of new learning rooms and the provision for facilitators to access this material in a read-only manner were made in week one of the investigation. Technical staff assured facilitators that requests would be executed quickly and easily, such was the flexibility of the VLE.

6.2.2 Method

The investigation observed five, 2-hour school classes throughout the summer term. Combined with three preliminary classes of software tuition led by a GameCity representative, this generated a total of 16 hours of contact time between facilitators and participants. Facilitators applied a more active role in the project by assigning participants weekly deliverables, delegating tasks within participant groups, and discussing and advising on participant design choices each week.

The researcher's role as project investigator necessitated observing and recording the designs and discourses of participants, but also required assisting with the formulation of these design ideas and their subsequent implementation if requested by participants. This was in line with the nature of the candidate's invitation to participate within the project acting as an advisor. As such, the research candidate took on the role of *participant observer* (Squire et al., 2003) where, rather than being a removed observer of how participants worked with facilitators to realise their design ideas, the candidate offered suggestions, guidance and support where requested. Table 8 summarises the role of each facilitator in Study 2.

Table 8: *Summary of facilitator roles in Study 2*

Facilitator	**Roles**
Class teacher	- regulate workshop activities - remind participants of timeframe and deadlines
Classroom assistant	- regulate student behaviour
Design consultant 1	- compile and lead Game-Maker tutorial
Design consultant 2	- lead workshop discussions and assign roles - provide support on designs ideas
University student	- provide Game-Maker support as instructed by class teacher
Research candidate	- observe workshop activities - provide Game-Maker support as instructed by class teacher

The two-hour workshops allowed facilitators increased time to concentrate on initiation of activities, including framing them in the context of the project, so that participants could understand why they were being asked to pursue such activities that week. As such, 20 minutes were allocated to this weekly initiation discussion between facilitators and participants to encourage team work and reinforce the importance of meeting weekly deliverables. Participants were introduced to the project goal in week one before being led through an official Game-Maker tutorial sourced from the developer's website by a participating member of the GameCity initiative with previous experience of using the software. Participants worked on individual networked PCs in their school computing lab between weeks one and three to complete this tutorial, assisted by the class teacher, teaching assistant and a member of GameCity.

Participants were reminded of the project goal in week four by facilitators and divided into self-selected groups of 3-4 participants. These groups recorded design ideas on paper worksheets which were then discussed and critiqued by each facilitator while moving around the class at twenty minute intervals. Participants were allocated a wireless laptop connected to the school network and a digital camera between weeks five and seven. Participants used these digital tools to create and edit game assets and save their work using the school's networked storage.

In week eight participants presented their completed games to a class of primary school children who then discussed these designs with the class teacher. As the target audience

for the serious games developed as part of this study were prospective secondary school applicants from local primary schools, a visiting class of primary school children acted as a focus group for the serious games created by participants. The selection of this focus group was undertaken by the class teacher who used links with teachers from a local feeder primary school to recruit a focus group. A sample class of 20 pupils from Year 5 (aged 9-10 years) was selected by the school head, who also attended this design workshop to view the games and to supervise the focus group. These children represented prospective school applicants as they would be entering the final year of primary school (and thus applying to secondary schools) the following academic year. The role of the research candidate as participant observer meant that no input was made into the selection of this focus group. Table 9 provides a weekly breakdown of the workshop objectives and design activities used in Study 2.

Table 9: *Weekly breakdown of workshop objectives and activities from Study 2*

Wk	**Objective**	**Activities**
1-3	Project introduction	- introduce project goals and facilitators - introduce Game-Maker in computing lab - Game-Maker tutorial led by GameCity
4-5	Game design	- divide class into self-selecting groups - discuss game concept ideas with facilitators - assign roles to group members
6-7	Game creation	- use laptops to create game resources - use digital cameras to collect game resources - implement and experiment with game designs
8	Focus group testing	- complete games and prepare demonstration - demonstrate games to focus group - discussion with focus group led by class teacher

6.2.3 Data collection

Video-capture was abandoned due to the classroom context and so data collection primarily focussed on observer notes following the observation schedule outlined in Chapter 4. These notes focussed on participant activity, motivation, and level and type of facilitator input required for each participant group. Notes were also shared amongst facilitators post-session via discussions both in person and via email. Due to the limited

use and eventual rejection of the paper questionnaires from participants in Study 1, use of questionnaires or paper worksheets were also abandoned almost entirely in Study 2 in favour of observer notes during discussions with participants. Communication via an internet blog was rejected by the school due to ethical concerns over privacy, and instead restricted to the 'in-house' resource-sharing facilities of the school's VLE. Conversations with the school's technical staff to initiate and maintain the VLE during the project would also allow the views of staff not directly involved with the project to be collected as part of research.

A simple paper worksheet was prepared by the GameCity design consultant resembling a crude game design document. This worksheet was distributed in week four to assist participants to appreciate the serious nature of the game they were developing by asking them to consider what their game would teach. Also, this worksheet would assist participants to think about the game assets (sprites, mechanics, controls) such a game would require by listing the function and appearance of the major assets within their game. These worksheets provided a primary focus for discussions between participant groups and facilitators in week four of the project as facilitators moved around the classroom to speak with each participant group. Facilitators recorded the names and gender of group members, game title, learning content, game type and game description. Notes were synthesised via discussions post-session to produce a summary of game ideas for the class as a basis for discussion in subsequent weeks.

6.3 Results

6.3.1 Design products

The active approach of mixed-discipline facilitators in this study resulted in five of the initial six game concepts created in week four being converted into functional products for presentation in week eight of the project. These final products varied in both scope and functionality. Table 10 summarises the initial six game concepts as presented by participants in week four and synthesised by facilitators.

Table 10: *Summary of game concepts for each participant group in Study 2*

Group	Members	Game title	Content	Game type	Description
A	4 male	School Days	School curriculum	Role-playing	Play subject specific mini-games
B	4 male	Bursting Point	School rules	Maze navigation	Navigate a maze to reach school bathroom
C	3 male	Sproglet	School orientation	Point-and-click navigation	Locate key buildings on a school map
D	4 female	New Kid at School	School orientation	Point-and-click navigation	Navigate through school
E	4 female	Spot the Bully	Bullying advice	Quiz	Identify school bullies
F	2 female, 1 male	Splat the Teacher	Teacher names	Mouse-based shooter	Hit teachers with subject-related projectiles

The adventure-styled role-playing game 'School Days' far exceeded the scope of games expected by project investigators to be achievable in a short-term project. The four male members of Group A chose the variety of classes within a typical school timetable as the content for their game. The design presented by this group included a narrative to a typical school day delivered via crude in-game cut scenes and role-playing activities. Players could also move around isometric images of the school's courtyards to enter classrooms, speak with NPCs and enter subject-specific mini-games (see Figure 15). Consolidation of observer notes from the focus group testing revealed that the primary school children considered secondary schools large and difficult to navigate after playing this game. Group A were therefore considered successful by the class teacher in

achieving the project goal of imparting important aspects of secondary school life to prospective primary school applicants.

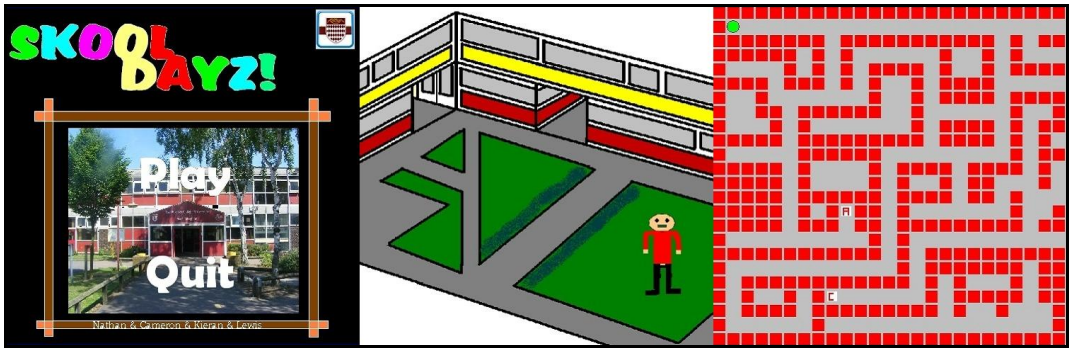

Figure 15: Interface design of role-playing adventure game 'School Days'

Conversely, the four female members of Group E were unsuccessful in implementing their game idea into a functional product. This group initially struggled to see the value of creating games in the classroom stating that games were 'boring'. The class teacher was required to speak individually with each member of this group to convince them of the merits of working with educators from outside of the school. Facilitators also had to work very hard with this work to elicit a game idea in the initial design phase of the project. The group chose to base their game on bullying advice as they believed this was important advice for new children at a secondary school. However, as the group was unmotivated they failed to develop a viable game format within which to present this information, resulting in little productivity during the project. The GameCity design consultant proposed that the group present their advice on school bullying as a simple quiz but the group were unwilling to experiment with these ideas within Game-Maker.

6.3.2 Design process

Facilitators chose not to work exclusively with a particular participant group, but to instead move around the class so that each group had access to all facilitators. The number of facilitators varied each week (see Figure 16) but no fewer than three facilitators were present at each design workshop. As availability of facilitators varied throughout the investigation, provisions were made by GameCity to recruit additional facilitators towards the end of the project.

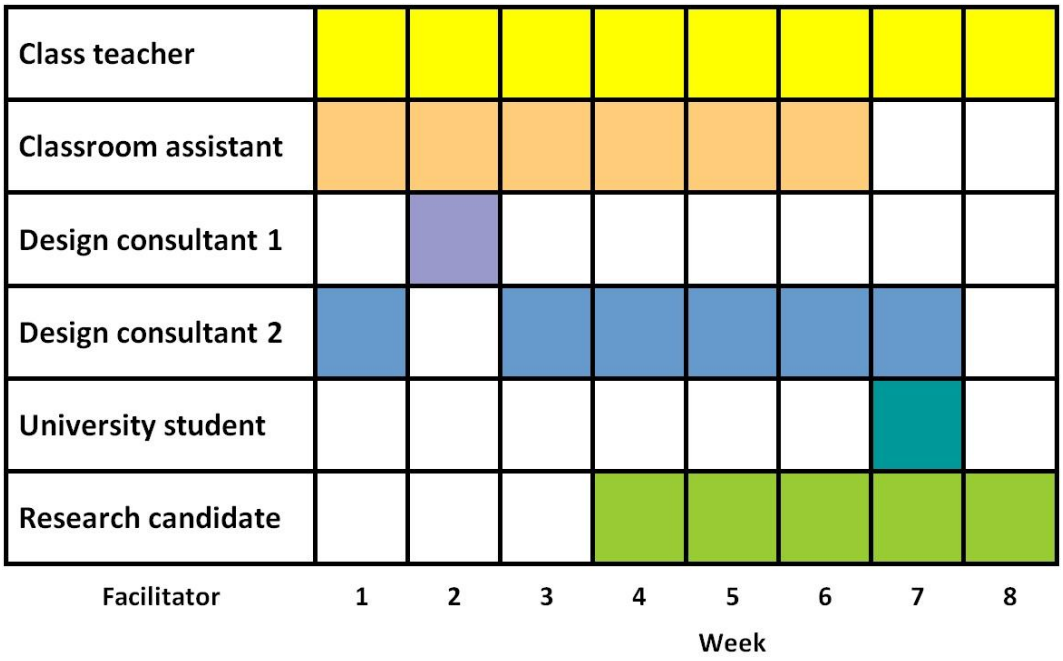

Figure 16: Summary of facilitator involvement in Study 2

Group F were the only mixed gender group and required the most input from facilitators. This group were reluctant to assign roles to members and to interact with Game-Maker. It was therefore the job of facilitators to discuss individual skill sets with members of this group in order to assign individual roles to participants. Discussions uncovered that one female member of the group was confident enough to use Game-Maker and so was assigned the role of 'programmer'. The second female member was interested in drawing and so was assigned the role of 'artist'. Finally, the male member of the group was highly critical of the work of his peers and would often argue with both participants and facilitators regarding the design of the game. The male member of the group was thus assigned the role of 'creative director' and tasked with overseeing the work of his group members. These roles were created ad-hoc within this group with titles that reflected the personalities of the group members which would hopefully motivate the group to work together on a common task. Specific roles allowed these participants to focus on the area of games design they enjoyed and so produced work of a high quality during the implementation phase of the project. Figure 17 presents an example of the effort invested by the female artist into creating game resources.

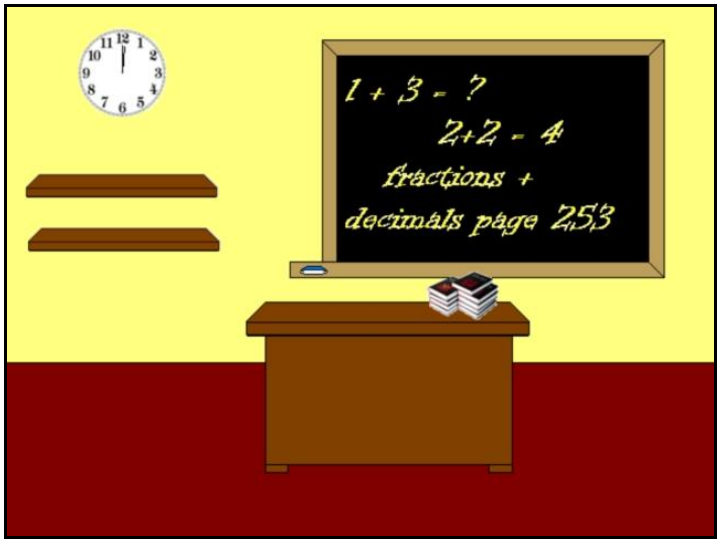

Figure 17: Example game resource created by participant using Game-Maker

Despite this resurgence of interest in the project from the female artist, the female programmer struggled to add functionality to these backgrounds. With help from facilitators, the programmer implemented mouse controls but continued to be hostile toward the male creative director as he contributed very little to the project yet was highly critical of the work of his peers. Despite discussions with each facilitator, Group F continued to be hostile and reluctant to work as a team. This necessitated much work from the GameCity design consultant, the university student and the research candidate, to implement the assets created by the female artist into a functional game.

A concerning observation from this classroom investigation was the level of input into the project from the school's technical staff. Upon request from the class teacher, Game-Maker was installed onto the six wireless laptops the teacher had access to. The school's VLE had the potential to allow participants to supplement their physical classroom work with access to an online workspace. The presence of such an online workspace during the investigation would have provided an important contrast to use of the internet blog during the Study 1.

Despite early assurances from the school's technical staff that provisions within the online workspace for participants to access their Game-Maker resources from home would be created, a learning room where participants could access and share resources was only initiated in week four of the investigation. Further, this learning room was terminated due to technical issues in week five without informing project facilitators.

Post-workshop discussions between facilitators and the class teacher revealed that participants had expressed concern regarding the sudden withdrawal of access to the project learning room within the VLE as they had found it useful. Further discussion with these participants during workshop activities revealed they had used the online workspace to create a project plan and allocate roles and deliverables to group members. They also reported that the ability to share resources such as game sprites outside of class allowed them to prototype ideas much faster which could then be shared with facilitators in workshops.

In light of these comments, repeated requests were made to the school's technical staff, both in person and via email, to reinstate access to the online workspace. Despite these requests, access was never restored during the investigation. A meeting between the candidate and technical staff in week six of the project revealed that technical issues had forced staff to remove participant access to the project learning room within the VLE as the software was new at the school. The short-term nature of the project meant that staff were unwilling to resolve the problem as they were busy with other requests relating to the curriculum. Technical staff were not hesitant in informing the candidate that serious games projects featured low in their list of priorities. Although this approach to the investigation from the school's technical staff is understandable and perhaps expected, these observations do underline the difficulty in integrating objectives peripheral to those of a curriculum, into a secondary school schedule.

6.3.3 Authoring software

The pre-selection of Game-Maker as suitable game-authoring software by GameCity offered an opportunity to further investigate its use in a curricular context. No participants said they had any experience with Game-Maker prior to the investigation yet 80% of initial design ideas were converted into functional games. However, the level of support required varied between participants. The all male participant groups required little assistance with Game-Maker while the all female groups regularly requested that facilitators take control of their game programming activities.

An example of this extensive facilitator input into Game-Maker implementation was observed during week six when the GameCity design consultant was required to dedicate the full 80 minutes of workshop time in assisting the all female Group D in

converting digital images, which they had captured using digital cameras, into game sprites. The object-orientated nature of Game-Maker programming made converting these images into design objects and applying interactions an easy process for the facilitator. In this scenario, the facilitator took on the role of 'developer' within the group, responsible for creating Game-Maker assets and attaching functionality, while participants collectively became 'creative directors', responsible for aesthetic decisions such as colours, fonts, and positioning of these assets. Figure 18 presents the navigation interface design of Group D's point-and-click adventure game 'New Kid at School'.

Figure 18: Interface design of point-and-click adventure game 'New Kid at School'

6.4 Summary

This chapter has described a curricular-based activity set within the context of a typical secondary school classroom. The non-self-selecting nature of the sample class meant that several children were unmotivated towards a serious games design project, and so required much guidance and the assignment of ad-hoc roles and tasks by their educators. Study 2 represents participation which is neither initiated nor controlled by children and so is positioned at level four of Hart's Ladder. The study was successful in creating a suite of serious games which were accredited by the teacher as potential additions to the school's open day resources.

The results of Study 2 confirm that short-term serious games design projects can be completed successfully by controlling the enthusiasm and ideas of learners through time management and specific roles assigned by educators. Study 2 also suggests that

positioning student participation at lower levels of Hart's Ladder creates more suitable educational artefacts than projects positioned at the highest levels. The next study was designed to determine whether maintaining this level of educator input, whilst sharing design decisions with children at higher levels of Hart's Ladder, could produce further benefits. The following chapter presents the methods and results from a participatory serious games design project led by adults who share decisions with children at level six of Hart's Ladder.

Chapter 7: Study 3 Library Investigation

The previous chapter presented the methods and results from a participatory design project led by adults who informed and assigned specific roles to children at level four of Hart's Ladder, via a curricular activity using a sample class of secondary school children. The study attempted to elevate both adults and teachers as educators to a higher level of participation by implementing strict deadlines and deliverables for work during the project, which necessitated increased input from educators into the design process. This active approach to facilitation yielded a high conversion of design concepts into functional serious games.

Active facilitation of an extracurricular activity must recruit and maintain children who participate voluntarily. This requires creating a balance between the creative freedom of children in Study 1, and the necessary restrictions imposed by educators to ensure project objectives and deliverables are achieved in Study 2. Chapter 7 presents the methods and results from a participatory serious games design project led by adults who share decisions with children at level six of Hart's Ladder, via a revised extracurricular design activity collaborating with a local library service (Bates et al., 2010a).

7.1 Setting

Study 1 allowed children to initiate and direct the activities of a serious games design project positioned at level eight of Hart's Ladder, but failed to produce the functional end product required by project stakeholders. Although Study 2 demonstrated the high productivity of curricular projects directed by adults who assigned roles to children at level four of Hart's Ladder, it was decided that applying such a rigid structure to the facilitation of an extracurricular participatory design activity might dissuade children from participating. Study 3 would therefore attempt to combine the ideas and enthusiasm of children as participants with the knowledge and experience of their educators as facilitators.

To provide a comparison with the initial library-based serious games design project positioned at level eight of Hart's Ladder, the project aim, context, facilitators and school library facilities from Study 1 were again used in Study 3. This new project again sought to work with children to create a library-based serious game for use by a local library service to change the perception of modern libraries amongst a target

audience of secondary school children. Using the same secondary school library facilities from Study 1, the revised library investigation observed a voluntary self-selecting group of children from the school attending a weekly after-school design project. Meetings were again organised as design workshops lasting one hour immediately following the close of the school day at 3pm. Both the children's librarian from the local library service, and the school librarian from the participating secondary school, chose to return as facilitators to the project with the research candidate. The library service again acted as client to the design process, and the school staff again as stakeholders in the extracurricular nature of the activities undertaken.

7.2 Procedure

Study 3 sought to position participants and facilitators as equal stakeholders in the design process. By positioning adults and children as 'design partners' (Druin, 2002), facilitators were now equally responsible for the fulfilment of the project goal in providing a serious game for the local library service. This required revisions of the methods, data collection and library learning objectives from Study 1.

7.2.1 Participants

Repeating the opportunity sampling methods of school poster advertisements and assembly presentations by the participating children's librarian used in Study 1, the revised library investigation was successful in recruiting five male participants aged 13-14 years. This group included only one returning male participant from the core group of seven participants who completed the original library investigation. When asked why they chose not to return to the revised project, other members of the original core group commented that they had increased work commitments from their school exams. This was expected as many of these original members had moved into Year 10 of the secondary school and were now undertaking their GCSE qualifications, and so chose to use the library facilities after school to complete their school work rather than participate in an extracurricular design activity.

7.2.2 Revisions to method

The requirement to operate the project within the constraints of a single school term was relaxed to incorporate the two-week school holidays at Christmas 2009 as a break from the project for both participants and facilitators. This decision allowed the project to

operate over two consecutive school terms. The first term concentrated on Druin's (1999) methods of co-operative enquiry to experiment and decide upon a game concept. The second term attempted to modify Druin's methods of participatory design to implement an iterative cycle of implementing and modifying new ideas to improve productivity. Strict timeframes and deadlines for deliverables were imposed capping the initial co-operative enquiry process at five weeks followed by a five week process of iterative participatory design. The project thus commenced in November 2009 for five weeks and resumed in January 2010 for a further five weeks concluding in March 2010.

Participants began with an enquiry process of deconstructing the rules of popular board games and constructing new ideas using a pack of playing cards as a low-tech prototyping tool. Board games have been used successfully in European classrooms to create discourses and co-operation between children (Bendixen-Noe, 2010; Marjanen, 2010) and so could provide a potential catalyst for the sharing of gaming knowledge amongst participants of a serious games design project. Study 3 made use of board games available to the school librarian including the strategy game *Jenga*, the construction game *Mouse Trap* and the money management game *Monopoly*. Participants played each game with facilitators and were tasked with compiling a list of rules for the games which were presented to the rest of the group.

Participants were presented with a deck of playing cards as a low-tech prototyping tool in week two, and worked in pairs with facilitators to develop a quick game idea within 30 minutes. The objective here was to devise a comprehensive set of game rules that could be easily communicated to other participant pairs allowing them to immediately understand and play the game. Playing cards were selected as a comparison to the use of LEGO^{TM} as a physical design tool in Study 1.

For the participatory design phase of the project, facilitators compiled five design criteria which would be discussed with participants; game setting, player objective, game narrative, characters and game aesthetics. These five design criteria were organised into weekly deliverables which would be achieved via round-table discussions between participants and facilitators using the workspace of the school library. These discussions created a dialogue between participants and facilitators which would be recorded, and combined with facilitator notes, to create a record of the

decisions agreed upon during these sessions. Further clarification of these decisions was made via the children's librarian synthesising these observer notes and presenting them as weekly posts on a new project blog, which participants could comment on between meetings if desired. Facilitators would also work to implement the design decisions into weekly digital prototypes using Adobe Flash programming software.

Weekly appraisal and revision of Adobe Flash prototypes created an iterative process of participatory design in the second phase of the project. As this process required weekly synthesis and implementation of design ideas by facilitators, participants were restricted to working together on a single game design to be presented to stakeholders. This early restriction meant that participants could not direct their own projects and so were forced to work together with facilitators and share design decisions as much as possible. Workshops optimised the one hour of contact time with participants by imposing further restrictions of 30 minutes for testing current prototypes, and a further 30 minutes for discussion of a new weekly design criteria. A summary of the iterative participatory design procedure is presented in Figure 19.

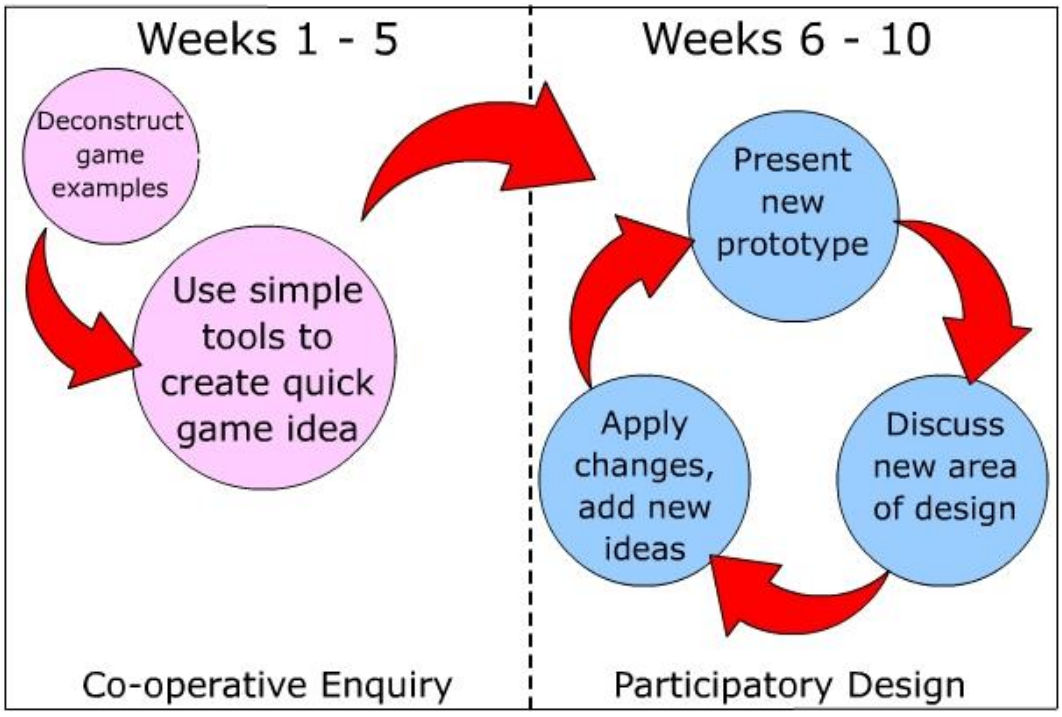

Figure 19: Summary of iterative participatory design procedure from Study 3

Adobe Flash was selected as experimental game-authoring software during the investigation as the software already formed part of the school's IT curriculum for

students in Year 10 (14-15 years) and so was pre-installed on the school library PCs. Facilitators also had experience with the authoring tool which meant it could be easily integrated into an iterative participatory design process. The difficulties encountered in distributing prototypes using the executable (.exe) Game-Maker file format in Study 1 could also be avoided by using the Small Web Format (SWF) Flash files for prototypes which could be easily distributed via the project blog. A weekly breakdown of the workshop objectives and activities from Study 3 is presented in Table 11.

Table 11: *Weekly breakdown of workshop objectives and activities from Study 3*

Wk	**Objective**	**Activities**
1	Introduction	- discuss important library features - revise library learning objectives
2	Experimentation	- dissect popular board games with facilitators - present summary of game rules to peers
3	Quick game idea	- low-tech prototyping using playing cards - present quick game idea to facilitators
4	Modify idea	- play digital versions of card games - modify games to satisfy learning objectives
5	Game setting	- round-table discussion of design objective - testing and modification of current game prototype
6	Player objective	- round-table discussion of design objective - testing and modification of current game prototype
7	Narrative	- round-table discussion of design objective - testing and modification of current game prototype
8	Characters	- round-table discussion of design objective - testing and modification of current game prototype
9	Aesthetics	- round-table discussion of design objective - testing and modification of current game prototype
10	Prepare presentation	- review blog and reflect on design process - test game and prepare presentation

7.2.3 Revisions to data collection

Study 1 made use of three data capture methods: paper worksheets, video-footage and a project blog. Although useful in recording participant gaming preferences, paper

worksheets were often disregarded by participants during Study 1 and so transcripts of video-footage and observer notes were the primary methods used to record design ideas. Further, the presence of a video camera was often distracting for participants, and electronic discourse via the project blog attracted an average of just one participant contribution per week. It was decided that Study 3 would instead use a mobile phone as a non-distractive audio recording device for use with a small participant group. The role of the project blog would also be revised to offer easy distribution of weekly prototypes, and to record facilitator workshop summaries thereby creating a development history of work. Table 12 presents a summary of the limitations to the data collection methods from Study 1 while Table 13 presents the revised methods used in Study 3.

Table 12: *Summary of limitations to data collection methods used in Study 1*

Method	**Primary function**	**Limitations**
Paper worksheets	- record gaming preferences - synthesise design ideas	- disregarded by participants - verbal discussion preferred
Video-camera	- record physical interactions - record physical discourse	- distracting for participants - audio only useful data
Internet blog	- share digital prototypes - record digital discourses	- disregarded by participants - required incentives

Table 13: *Data collection methods and primary functions from Study 3*

Method	**Primary function**
Internet blog	- distribute design prototypes and record comments - record development history of design project
Audio recording	- record range and suitability of participant design ideas - record facilitator input during design workshops
Observer notes	- record interesting observations during workshop activities - allows facilitators to synthesise information via project blog

7.2.4 Revisions to learning objectives

Participants of the classroom investigation in Study 2 were presented with a simple learning objective for their serious games; to educate prospective school applicants on important areas of secondary school life. This single, open ended learning objective allowed participants to select from a variety of potential learning content which they considered important. Participants were therefore successful in designing and implementing games to teach the names of school teachers, school orientation and an introduction to the school curriculum.

Conversely, the original library investigation of Study 1 presented a more ambitious set of learning objectives for a serious game compiled by library staff. These learning objectives were regularly questioned by participants during the investigation hence illustrating their ambiguity. This ambiguity also meant that participants were being asked to deliver material which they did not necessarily understand or consider important. Facilitators therefore updated the learning objectives from Study 1 to be more specific and manageable within the project timeframe. This involved consulting participants on what they considered important features of their school library in week one of the project, which resulted in the formulation of three revised learning objectives for the serious game. Table 14 compares the library learning objectives from Study 1 with the revised objectives used in Study 3.

Table 14: *Comparison of original and revised library learning objectives*

#	Original learning objective	Revised learning objective
1	Children should have a functional knowledge of how to access library services	You can ask for help at the library reference desk
2	Children should be aware they can find content that can enthuse and excite them	You can find non-fiction books arranged by subject areas in the library
3	Children should have explored why they would want to use a library and examined the alternatives	There are a variety of places you can find information in the library

7.3 Results

The revised methodology was able to retain all five participants throughout the 10 week investigation and all expressed regret that the project had to conclude. Comments by the school librarian during the post-project presentation included that participants had been attending 'regularly and enthusiastically' and had produced a functional game 'more successfully' than the previous year.

7.3.1 Design products

The initial phase of co-operative enquiry using board games and playing cards as low-tech prototyping tools allowed participants to present simple game ideas in week two of the project. The first game participants presented (Game A) was a variation of the popular card game *Happy Families* involving players taking turns to swap the positions of royal cards within a grid to correctly align cards of the same suit. Conversion required facilitators to create a drag-and-drop interface allowing a player to swap cards by overlapping card sprites using their computer mouse. To satisfy the learning objective that a player can find non-fiction books arranged by subject areas in the library, participants instructed facilitators to change the card sprites into books with non-fiction titles, and allow a player to arrange these titles according to their subject areas. A comparison of the original and modified player interfaces for Game A is presented in Figure 20.

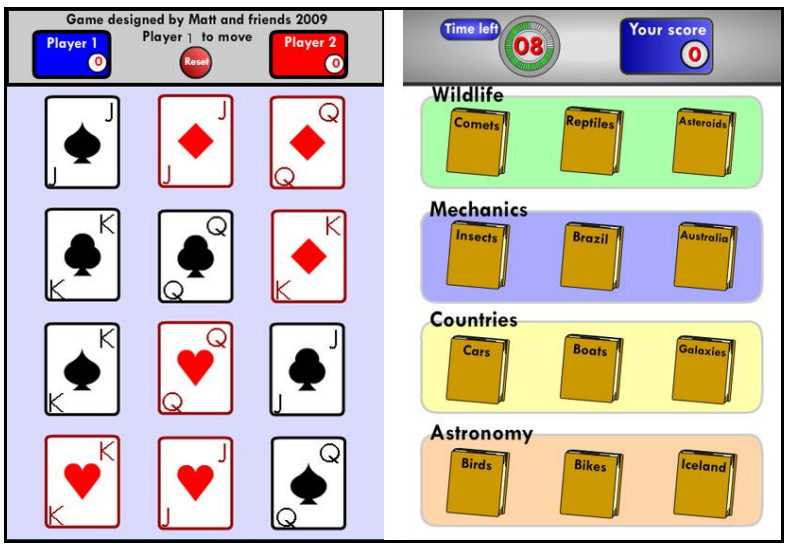

Figure 20: Original and modified interface design for Game A

The second game participants presented (Game B) was a variation of the popular arcade game *Space Invaders*, involving players taking turns to remove 'invader' cards from an array by comparing a card's value with that of a 'ship' card. Conversion required facilitators to arrange the invader card sprites as a grid, allowing a player to select a card for comparison by aligning a ship sprite with a column of this grid using their computer keyboard arrow keys. Facilitators suggested replacing the array of invader cards with ranges of the library Dewey Decimal System, requiring a player to correctly shelve a book according to its index value in the system which would again satisfy the learning objective that a player can find non-fiction books arranged by subject areas in the library. A comparison of the original and modified player interfaces for Game B is presented in Figure 21.

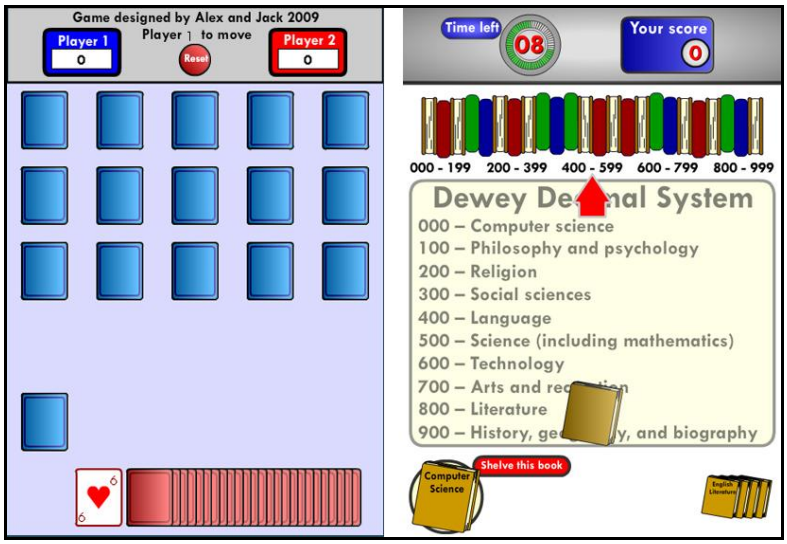

Figure 21: Original and modified interface design for Game B

7.3.2 Design process

The combination of deconstructing board games with constructing simple card games, enabled participants to present ideas for mini-games early in the design process. These ideas could be easily converted into digital prototypes by facilitators and modified by the design team to satisfy the library learning objectives. Post-session discussions revealed that facilitators considered the combination of board games and playing cards in Study 3 superior to the use of LEGO™ models in Study 1.

Deconstruction of the physical components of board games during the revised investigation allowed participants to explore the mechanics of gameplay by discussing

both the rules of the games and the strategies required to complete them. The simplistic nature of playing cards required participants to focus on game rules and strategies to distinguish their ideas from those of their peers. This concept of game strategy was considered overlooked by facilitators during the use of LEGO™ in Study 1 as participants focused more on the tool itself than the ideas behind its use, and were therefore limited by the variety of LEGO™ pieces provided.

Similarly to the results of Study 1, the project blog was again rarely utilised by participants during Study 3. The co-operative enquiry phase of the project produced eight comments over five weeks, while the participatory design phase produced eleven comments over five weeks. Although limited in its ability to inspire digital discourses amongst participants, the project blog was an invaluable tool for hosting the weekly game prototypes so they could be easily distributed amongst participants each week. Prototypes could be easily uploaded to a web server, linked to the project blog and distributed to participants, both inside workshops and remotely to absent participants, with minimum effort from facilitators. Figure 22 summarises the iterative participatory design method and the position of the blog within this method as applied in Study 3.

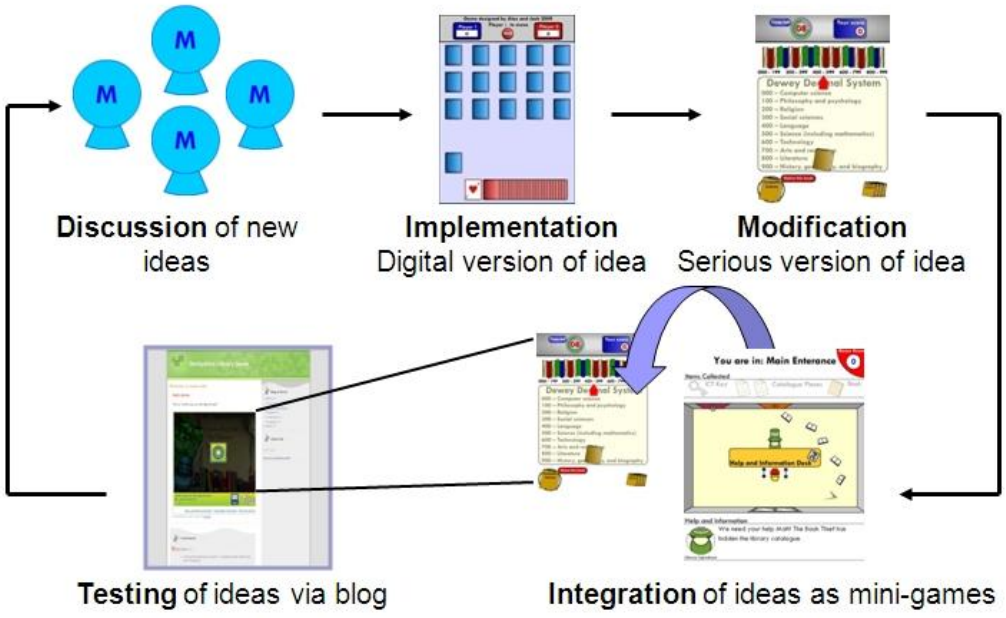

Figure 22: Summary of iterative participatory design methods as applied to Study 3

Participants decided in week five to frame access to their mini-games via a library themed adventure game. This adventure game was entirely designed and implemented

during the five week iterative participatory design process. This process was documented by participants during a post-project presentation advertised to school staff by the school librarian. Two of the school's IT staff agreed to attend this presentation, which motivated participants to articulately justify their design decisions to school staff using the project blog as a presentation plan. This procedure created a thorough documentation of the design process for use by investigators. The following summary of the participatory design process is presented using participant dialogue captured during the post-project presentation:-

> '*Mini-games were something we wanted to include. In order to get the final game design we went through several processes and basically shouting matches to see whether we would have mini-games or if it would be a single adventure. One idea was for it all to be like Pac-man and we could be chased by guards and would collect books but we eventually decided on the mini-games purely because we had already made some mini-games with the cards so it was a simple case of changing some sprites and we came up with some other ideas as well and then implemented the characters. The mini-games themselves we transposed from the original card games into books and then we also added educational elements.*'
>
> Participant A

This library-themed adventure game requires a player to assemble a library catalogue to locate information and defeat an antagonist. The game also requires that a player speak with NPCs by navigating a two-dimensional library environment derived from a pen and paper game-map created by participants:-

> '*We wanted to have a storyline so the map had to fit into the storyline. It was about a library and the storyline was a boy or a girl basically gets stuck in a library and there is this book thief and he is bringing all the books to life and you have to learn how to use the library so you can put the books back and save the day. So we had to make a map that suited that and we had separate parts of the map which you could go to and help different characters to get different parts of the storyline.*'
>
> Participant Z

To add a competitive element to the game, the group designed a score system which a player could compare with friends once the game was complete. To satisfy the requirement that the game be suitable for use during school visits by the library service, participants decided to supplement the score system with a time constraint to control how players progressed through the game:-

> '*Because this game was designed to be played by a class, we have not made it that you have to get a certain score to get to the next level because obviously in a class there may be some people who will struggle. We used a score system and a time system so everyone finishes at the same time if everyone starts at the same time so people can compare results as well so there won't be someone who is stuck on the same bit for an hour.*'
>
> Participant A

Table 15 summarises the three key player tasks within this library game which were presented to IT staff post-project, together with the library learning objectives which they relate to. Figure 23 presents the interface design of the library game at each of the three key player tasks.

Table 15: *Summary of player tasks and library learning objectives satisfied*

#	**Player task**	**Learning objective**
1	Use library facilities to locate computing suite and main library	You can ask for help at the library reference desk
2	Assemble library catalogue using computing suite	There are a variety of places you can find information in the library
3	Use library catalogue to locate information to defeat antagonist	You can find non-fiction books arranged by subject areas in the library

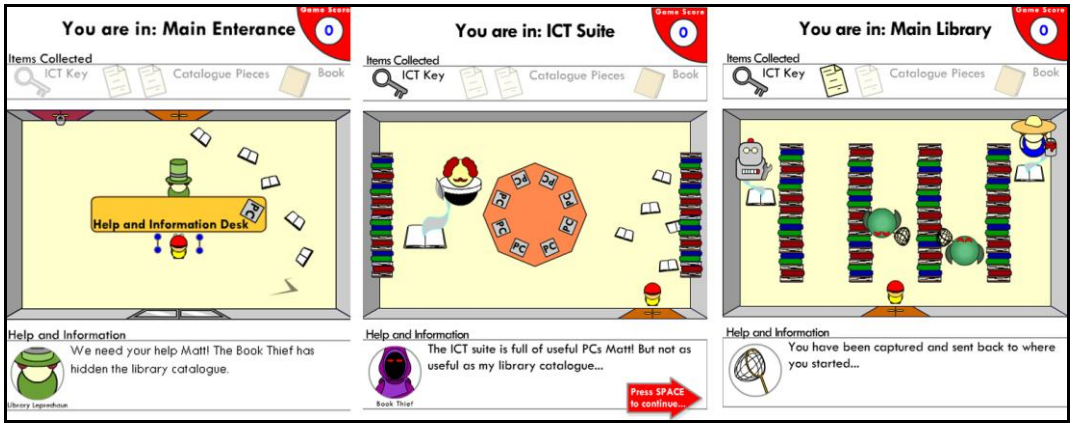

Figure 23: Screenshots of library serious game at key player tasks

7.3.3 Authoring software

Only one participant made use of the Adobe Flash authoring software, which was pre-installed on the library computers, during the project. This participant had prior experience with Flash and was motivated by the digital card games in week three, to commence work on his own Flash mini-game. However, facilitators were only made aware of this process via a blog contribution by the participant in week seven:-

> '*I have come up with a mini game for the robot but need sprite ideas. I have so far a character at the bottom of the screen, that has to catch squares falling from the roof, and avoid falling circles.*'
>
> Participant A

The participant informed facilitators during workshops that he lacked sufficient knowledge of the Adobe Flash programming language *Actionscript* to fully implement his idea, yet had been motivated to source Adobe Flash tutorials using the internet. Figure 24 presents a transcript of dialogue captured during the post-project presentation between participants A, O and Z and the attending IT staff. The transcript reveals that use of Adobe Flash as game-authoring software during the project had inspired participants to pursue games design courses within the school's curriculum.

A:	Just out of interest, what programming do you do in IT?
Staff:	We use Actionscript.
O*:*	Do you make games, or animations, or both?
Staff:	We make games and animations… You can teach the lessons!
A:	I hadn't done Flash in ages since before I started this project and I have learned new things but mainly it has helped me get back into Flash.
O:	So what sort of programming do you learn?
Staff:	It is similar to this, we start off with setting up interactive quizzes and creating movie clips and interactive buttons.

Figure 24: Transcript of presentation to school stakeholders from Study 3

7.4 Summary

The idea of allowing children to instruct, monitor and evaluate the learning of their peers via an extracurricular activity has the potential to create new powerful learning environments. Although Study 3 recruited a smaller participant group (n=5) than that of Study 1 (n=10), the active facilitation methods of Study 3 were more successful in maintaining the attendance of these participants. The importance of facilitation within this voluntary environment should not be underestimated as educators must maintain schedules and discipline amongst learners whilst encouraging the shared vocabulary, skills and tasks which make these multidisciplinary activities effective.

Additionally, the facilities provided to both learners and educators may also play a crucial role in this participatory design process. Study 3 made extensive use of Adobe Flash authoring software, internet access and a media-rich learning environment (school library) to facilitate the construction and dissemination of new knowledge amongst participants. Not all educators have access to such facilities and so the scalability of the participatory design approach is questionable unless observed with participants from a radically different demographic to those documented thus far. The following chapter documents the scalability of the participatory design approach to learners from a radically different demographic by presenting the methods and results from a participatory serious games design project working with adult offenders in collaboration with a local probation service.

Chapter 8: Study 4 Probation Investigation

The previous chapter documented the methods and results from a participatory design project led by adults who shared decisions as ‘design partners’ with children at level six of Hart’s Ladder, via a revised extracurricular design activity collaborating with a local library service. As the project relied upon a technology-rich learning environment to build and share new game resources, it was necessary to repeat the participatory design approach with learners from a radically different demographic. Chapter 8 documents the scalability of the shared decision participatory design approach by working with adult offenders in collaboration with a local probation service (Bates et al., 2010b).

8.1 Setting

The Probation Trust is a criminal justice agency which manages offenders who are on license from prison or community orders. This service works alongside the police, prison and prosecution services to both protect the public and reduce re-offending. The service works alongside voluntary organisations to rehabilitate offenders through education schemes and referrals into employment, training and education (ETE). The service also works directly with these offenders to identify barriers to ETE including common problems such as lack of social skills and qualifications. The service also works with offenders to improve their lifestyle choices, confidence and self esteem.

An opportunity to work with participants from a different demographic was presented to the research candidate in January 2010 by working with adult offenders at risk of social exclusion, via collaboration with a local probation service as part of the Probation Trust. Probation managers from this local service sought assistance with their current diversity objective to address the under-representation of black minority ethnic (BME) offenders referred to ETE upon completion of their community orders. The BME demographic covers British adults (above 18 years) of non-white background whose main language is English. These adults often have poor reading and writing ability and IT skills. Further, the facilities offered by local probation centres often lack access to current technology and computing facilities. The Probation Trust was keen to work with researchers to determine whether a participatory serious games design project could benefit BME offenders in terms of their employment prospects and referrals into further education and skills training initiatives.

Working with a local probation service provided this research with a suitable demographic and learning environment to evaluate the scalability of the shared design decision approach to participatory serious games design projects. Probation managers set a primary project goal of creating serious games for use by offenders to impart information considered important by participants of the study from their own experiences of using the probation service. Probation managers would therefore act as clients to the design project, requiring participants to prepare a presentation of their serious game to an audience of probation managers and tutors post-project.

8.2 Procedure

Working with adult offenders to assess the scalability of the design partner approach to serious games projects also required adjusting the wording of the research questions to encompass a wider demographic of participant. The term 'children' used was therefore updated to the broader category of 'students' in this study to reflect learners (regardless of age) engaging in a formal learning scheme such as that of the probation service.

8.2.1 Participants

Participants in the probation investigation were recruited via the same opportunity sampling method used in Studies 1 and 3, using applications to internal poster advertisements around local probation centres, supplemented with recommendations of participation from probation tutors. Probation managers from a local probation centre reviewed applicant suitability for participation in a voluntary project as 'low-risk' offenders on community orders and licenses from minor offences. This sampling method was successful in recruiting an initial participant group of six male BME offenders aged between 21 and 35 years.

Student participation was positioned at level six of Hart's Ladder (adult initiated, shared decisions) and so the probation investigation followed the same iterative participatory design methodology developed in Study 3, positioning offenders as participants and probation tutors and researchers as facilitators to the participatory design process. Due to the small size of the adult participant group and the limited available resources of the local probation centre, weekly workshops were attended by only two facilitators; a probation tutor with previous experience working with the selected participants and the research candidate again working as participant observer.

8.2.2 Method

Facilitators encouraged participants to reflect on their own experiences of using the service to create a serious game for use by other offenders. Game-Maker was selected by facilitators as accessible game-authoring software for use during the investigation to explore its scalability to adults with poor IT skills. Workshops made allowances for periods of Game-Maker tuition, co-operative enquiry into gaming preferences and design ideas, iterative participatory design to create, test and modify game resources, and a post-project presentation of these resources to probation managers.

Probation managers were keen that participants should have an opportunity to present their work in order to improve their presentation skills. This presentation would take place at a central probation centre to an audience of facilitators, probation tutors, and probation managers as clients for the serious games design project. Probation managers were concerned however, that participants would be either unable or unwilling to contribute to this task through a lack of experience and/or confidence in speaking to large groups. Thus a post-project presentation was considered both as a project deliverable, and as a summary of participant and educator opinions to be captured as research data. Table 16 presents a weekly summary of design workshop objectives and activities as applied in Study 4.

Table 16: *Weekly breakdown of workshop objectives and activities from Study 4*

Wk	Objective	Activities
1	Game-Maker tutorial	- introduce Game-Maker software - complete Questionnaire 1
2	Game concept design	- discuss ideas for game concept - prepare list of required game resources
3	Design resources	- discuss game resources with facilitators - create game resources in computing lab
4	Complete resources	- discuss current resources with facilitators - work with facilitators to complete resources
5	Complete and test game	- modify resources to meet design objectives - complete Questionnaire 2
6	Post project presentation	- discuss project with probation tutors - complete Questionnaires 3 and 4

Working with the Probation Trust meant that interactions, and the provision for interactions, between participants and facilitators had to be carefully managed as part of the ethical practice of the service, and the nature of working with offenders. Probation managers did not support the use of an internet blog to record a development history of work during the project, as they felt they could not control participant use of this external resource which conflicted with their professional responsibilities. The service was unable to offer an accredited alternative to the internet blog and so communication between participants was restricted to physical discourses during design workshops.

Further technology restraints imposed by the probation centre learning environment, meant that the computing resources at the local probation centre were deemed unsuitable by probation managers, both in scale and performance, to run a games design project. The investigation instead took place using the resources of a computing classroom at Nottingham Trent University. This classroom was selected as it conformed to restrictions imposed by probation managers that technology provisions should not include internet access, in order to control offender activities using these resources. Thus a computing classroom was selected containing 10 PCs, each equipped with the university's standard specification of Windows XP, CD drive, USB connectivity,

mouse, keyboard, and 15-inch flat panel monitor, which were isolated from the university network and so lacked access to the internet or shared resources for storage.

Finally, as participants were recruited on a voluntary basis with no monetary incentive for participation, probation managers envisaged that hourly workshops over 10 weeks might result in low attendance as participants would quickly lose focus on the project. The 10 hours of participant contact time used in Studies 1 and 3 was maintained, but instead delivered via weekly two-hour workshops over a five week project, similar to the timeframe applied in Study 2. Table 17 summarises the issues with implementing the experimental methods of Study 3 with the probation service.

Table 17: *Summary of issues and restrictions to methods used in Study 4*

Issues	**Restrictions**
Concern re: external communication	- resource sharing via internet blog removed from project - contact between participants limited to design workshops
Concern re: internet access	- digital design tools limited to network-isolated computers - digital resources limited to bundled Game-Maker sprites
Limited technology of probation facilities	- non authentic learning environment of university used - workshops less accessible than previous investigations

8.2.3 Data collection

As probation managers were against the use of an external internet blog to allow participants to communicate outside of workshops, the data collection methods of the probation investigation consisted of observer notes, paper worksheets, and video-footage of presentations. As probation managers considered the reading and writing ability of adult offenders to be similar to that of a 13-14 year old secondary school student, the paper worksheets from Study 1 were considered suitable for use in the probation investigation, but would require a probation tutor to assist participants.

To contrast the design decisions of adult offenders with those of children, it was necessary to repeat the gaming preferences data collection of Study 1 during the probation investigation. This involved modifying the questionnaires from Study 1 for use with a new demographic of participant. To account for the limited reading and writing abilities of adult offenders, these questionnaires were prepared with closed-

ended questions as far as possible. The selection of suitable categories for these questions was made after reviewing gaming questionnaires currently in use.

International Hobo is an internet-based game design consultancy whose members have worked with major games publishers such as Sony Computer Entertainment to target core audiences for their leading game franchises (International Hobo, 2010). The consultancy has operated the 'BrainHex' online questionnaire since 2009 which expands on Bartle's (1996) classification of four player types within traditional MUDs to devise an updated classification of seven player types within today's MMOs. The questionnaire is composed of 28 multiple choice questions ranging from frequency of gaming activities to rating gaming experiences such as co-operating with strangers and solving gaming problems. Questions targeting frequency, mode (single or multiplayer) and style of gameplay for adult gamers were extracted from the BrainHex questionnaire and presented in the probation investigation as Questionnaire 1. Examples of the questionnaires used in Study 4 can be found in Appendix B.

Questionnaire 2 recycled questions from Study 1 targeting participant use of Game-Maker, and was distributed in week five of the probation investigation to collect participants' opinions of Game-Maker to address RQ3. Questionnaire 3 asked participants to synthesise the goal of their game, special items which could assist a player's progress, and game obstacles which would hinder that progress in preparation for their post-project presentation. The questionnaire would not only allow participants to discuss their design ideas, but would also ascertain if these ideas had been successfully communicated amongst the participant group during the project as part of their knowledge building and dissemination activities. Thus, as was the case in Study 1, the questionnaire was treated as both a physical design tool and a data collection method, used here to address RQ2.

Finally, Questionnaire 4 asked participants to review the serious games design project and their reflections on the process and product they had created. The questionnaire was used as a supplemental data collection method to video-footage of the post-project presentation, in order to capture the opinions of any participant who chose not to participate in this verbal discussion. Table 18 summarises the functions of the data collection methods used during the probation investigation.

Table 18: *Data collection methods and primary functions from Study 4*

Method	**Functions**
Observer notes	Record design ideas from brainstorming exercises (RQ1) Observe participant interaction in workshops (RQ2) Record comments on authoring software (RQ3)
Paper questionnaires	Formally record participant design ideas (RQ1) Collect participant social gaming preferences (RQ2) Record participant opinion of authoring software (RQ3)
Video-footage	Record discourses during the post-project presentation (RQ1, RQ2 and RQ3)

8.3 Results

Of the initial six participants recruited, a core group of four participants was established over the five-week project. These participants are denoted here as D, K, P and R.

8.3.1 Design products

Table 19 summarises the data collected on participant gaming preferences in week one of the project.

Table 19: *Summary of adult gaming preferences as presented in Study 4*

Participant	D	K	P	R
Age	31	28	35	21
I typically play computer or video-games	Occasionally	Every day	Every day	Occasionally
I would consider myself	Casual gamer	Casual gamer	Between casual and hardcore	I have no idea
I prefer the following way of playing games	Single player alone	Single player alone, Multiplayer in the same room	Single player alone, Single player with other people helping	Single player with other people helping, Multiplayer in the same room
Name your three favourite games	Shooting games, Football games	COD, Gears-of-War, Wheel-Man	COD, FIFA, Grand-Theft-Auto	COD, Pro-Evolution-Soccer
Playing in a group	Dislike	Like	Like	Like
Talking with other players	Dislike	Like	Okay	Okay
Working out what to do on your own	Love	Dislike	Like	Okay
Co-operating with strangers	Okay	Okay	Okay	Okay

The first interesting observation from Table 19 is that the probation investigation was successful in recruiting offenders with similar gaming preferences and experiences. All four participants who made up the core group regarded themselves as ‘occasional’ or

'casual' gamers with only 50% of this group declaring that they played games 'every day'. All participants preferred playing games either alone or with friends helping in the same room. Participants also shared the same gaming preferences as the children in Study 1, favouring violent commercial computer games such as COD and Gears-of-War. However, unlike observations with secondary school children, football simulator games such as *FIFA* and *Pro Evolution Soccer* were also prevalent among participants' favourite games.

Participants K, P and R mainly agreed on their favourite gaming experiences, enjoying playing in a group and talking with others. Participant D disagreed with these responses and instead preferred working alone on a gaming task. All four participants agreed that co-operating with strangers on a gaming task was 'okay'. Despite this observation, the Probation investigation was successful in facilitating 'strangers', who reportedly had only met briefly prior to the start of the investigation, in working together to complete a task set by their probation tutors. Participants agreed to work as a four-person team on a single game design which alleviated pressure from the early departure of two participants in week two. Despite efforts from probation tutors to consult these participants on why they had chosen to leave the project, no information was provided.

This core participant group were successful in designing a serious game which aimed to assist offenders in making lifestyle choices relating to areas such as drugs, education and employment upon leaving the probation service. Interestingly, the game design of these adults did not include elements of violence, guns, aliens or war which were prevalent in the game designs of secondary school children, despite both demographics displaying a preference for violent FPS games at home. Further, participants showed a disciplined approach to the project timeframe by working on weekly deliverables outside of workshops, often without prompting by facilitators, in order to complete a functional product for demonstration to their probation managers. Participants even requested the five week project be extended to six weeks to facilitate the completion of their ambitious serious games design.

The project required little, if any, co-operative enquiry to elicit a game concept for further expansion. Participant P presented a crude pen and paper concept document for his game idea 'Pathways to Life' in week two of the project, stating that he '*wanted to*

make something that would help people on probation in the future and this game could be useful to people of all ages.' The single page summary prepared by Participant P (see Figure 25) included basic interface schematics, a breakdown of important game parameters such as start and end conditions, and an extensive list of potential learning material including information on crime, college, sports and work.

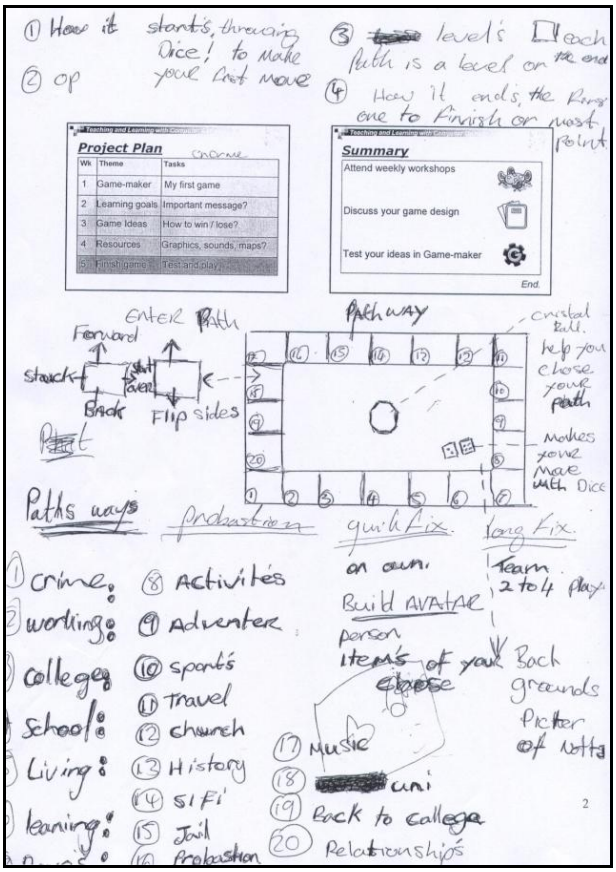

Figure 25: Concept for probation serious game as presented by participant

The game 'Pathways to Life' allows players to make choices relating to areas such as drugs, education and employment. Players move around a digital board similar to that used in the game *Monopoly*, which contains triggers for mini-game levels where players undertake challenges such as maths and spelling tests. The probation service is represented in the game via a simple teaching agent in the form of a crystal ball which offers advice on suitable lifestyle choices. Participant P demonstrated that he had invested several hours of time working on this design outside of workshops, during which he had prepared and presented his ideas to his probation tutor.

The persistence of Participant P in successfully completing and presenting his design concept helped him to convince his peers of the viability of his concept as an achievable task within the five week project timeframe. This required Participant P to motivate other participants to work as a team on one core game idea rather than each participant working on a separate game. Participants agreed the game should make use of keyboard inputs as they already had knowledge of this programming mechanic from the Game-Maker tutorial which was delivered in week one.

Important design decisions such as how players progressed and completed the game required facilitator input, as the importance of design parameters such as start and end conditions for the game were not immediately obvious to all participants. Facilitators advised on the addition of a simple score mechanic for which points could be earned for successful completion of challenges within levels for the game. Participant P decided that the aim of the game should be to accrue 10 points through successful completion of player tasks, while scores could also decrease with any wrong decisions taken, for example refusing to attend work or college, which would increase the game's difficulty.

Time constraints meant that each participant could only concentrate on one level of the game and so 'attending a college course', 'joining a sports team' and 'visiting probation' were selected by participants as suitable pathways (proposed by Participant P in week two) to be developed as game levels. Participant P worked on a gaming hub containing the crystal ball teaching agent which would link these levels together. Participant P also took on the role of design consultant for the game when participants required more information, such as the design of the game sprite representing the player. Of the levels selected, only 'visiting probation' was not used in the final game presented to probation managers, as Participant R who was responsible for this level was absent for weeks four and five of the project. Screenshots of the interface design for the game hub, college and sports levels of the probation game is provided in Figure 26.

Figure 26: Screenshots of probation serious game at key player tasks

Using Liu and Lin's (2009) evaluative indicators for effective educational games, allows the final product of the probation investigation presented to probation managers to be regarded as an effective serious game. When assessing the design of this product based on content and feedback, the game context matches the learning context and the storyline is directly related to the learning content. Feedback in the probation game is provided in a timely manner with easy to understand hints, while the speed of the game is controlled by the player with an assessment of the player's skills provided at intervals within the game. To improve the serious game according to Liu and Lin's criteria, this assessment of skills should be accessible to the player at any point throughout the game and potentially saved for review by an educator.

8.3.2 Design process

Responses to Questionnaire 2 reveal that adult offenders play computer games to have fun and prefer to 'keep trying' when presented with a gaming problem rather than ask for help. Participants preferred to ask facilitators for help rather than their peers as they rated this peer assistance as 'average'. Reponses to Questionnaire 3 reveal that participants agreed upon the design parameters for their game including game title, educational aim, player objective, items, obstacles, and rules:-

> '*The game gives you a sense of achievement, also a point system should give you an idea to make the right choice in life.*'
>
> Participant P

Participant D agreed with this educational aim by stating '*the game teaches you how to make the right decisions in life*' while Participant K did not answer this question. Participant P who attended five of the six design workshops and was responsible for the

initial game idea, was able to answer all 10 questions presented on Questionnaire 3 regarding the parameters of the game's design. Participant D who was also present for five of the six workshops could answer eight questions while Participant K who attended four design workshops could answer just five questions. Participant R who attended only half of the design workshops chose not to complete the questionnaire. This demonstrates that many of the knowledge-building and dissemination activities surrounding the design and justification of the game 'Pathways to Life' took place during the scheduled design workshops, as participants with lower workshop attendance were less able to recount the major design parameters of their game.

Participants struggled with the official Game-Maker tutorial in week one due to its extensive use of text-based instructions. Facilitators decided to move through the tutorial as a group using computer projection equipment to instruct participants on how to create basic Game-Maker resources such as game sprites and control mechanics. Facilitators assigned participants challenges to seek new knowledge by modifying these game sprites. Despite these challenges, few participants chose to converse with and assist each other in the early stages of the project. Participant R, the youngest of the group, quickly grasped the basics of Game-Maker but was reluctant to share his knowledge with other participants, instead opting to experiment with the software on his own. After invitation from facilitators to assist in helping other participants, Participant R was observed initially shouting instructions across the classroom, but eventually began moving around the room offering visual instructions by guiding participants around the Game-Maker interface via physical gestures and hand signals.

Participant P was regarded by facilitators as a potential 'peer expert' (Bruckman & De Monte, 1997) enthusiastic to master the controls of Game-Maker in order to implement and demonstrate his ideas. Participant P supplemented his pen and paper concept idea in week two by using his own laptop in week three to demonstrate a prototype for the game 'hub' which he had created using Game-Maker at home. The initiative to download and experiment with Game-Maker meant Participant P had made use of both physical and digital design tools to communicate ideas without prompting of any kind from facilitators. No other participant engaged in this practice or chose to work from home. The use of Participant P as a peer expert assisted facilitators in managing the project and completing a functional product within the extended six week project.

8.3.3 Authoring software

Each of the three participants who completed Questionnaire 2 said they had encountered problems with the Game-Maker tutorial including 'resizing a player' and 'making a link to the next level' of a game. Two of these participants said they would use Game-Maker again in the future noting that '*it's really good to know how basic games are made, you can really put an idea into practice.*' Participant D found Game-Maker 'difficult to use' for someone unfamiliar with game authoring and noted that he would not use Game-Maker in the future. Participants requested that 'more objects' such as 'backgrounds' and 'sprites' be added as improvements to the supplied Game-Maker tutorial resources.

Participants were successful in completing the game 'Pathways to Life' after extensive assistance from facilitators. Once participants had elected to work as a team and had delegated tasks, facilitators then assisted participants to complete these tasks and combine their created resources into a single functional game product. Facilitators were required to both advise and assist participants on their design choices at regular intervals. This involved the probation tutor asking participants how their design choices would satisfy the project goal, and the research candidate assisting participants with their Game-Maker questions. For example, Participant D had an objective to build the 'attending a college course' level for the game. Participant D was comfortable using his knowledge of Game-Maker to modify the sample level he had created during the week one software tutorial into a level that resembled a school. He accomplished this task by converting game sprites of walls into classroom tables.

The probation tutor then worked with Participant D to consider how to add educational content into his level design and agreed on the idea of a spelling quiz. Assistance with the implementation of this quiz was then provided by the research candidate to allow Participant D to extend his knowledge of Game-Maker in order to complete this task. The probation tutor then tasked Participant D with adding appropriate user feedback to this quiz and so the process continued. This iterative process was repeated with each participant and so was time consuming for facilitators. Despite initial proposals that the probation game would include sound effects by importing into Game-Maker audio samples which participants had produced at home, these resources never materialised in workshops and so the final product lacked sound output.

The two responses received to Questionnaire 4 revealed that participants were happy with their game design. Responses to this questionnaire revealed that participants had learned 'how to use Game-Maker' and had gained a 'sense of achievement' during the project which had improved their skills in 'computing' and 'team-work' respectively. Participant P commented that the project had helped in his employment training as he had 'gained experience with game making' as a result of participation. Both participants who completed this questionnaire said they would recommend the project to a friend who is 'interested in a gaming project', and who could 'find something they would like' within it. Participant P requested 'more time' as an improvement to the project.

8.4 Summary

Elevating learners to the position of design partners within serious games design projects requires facilitation regardless of the age and experience of participants. Working with children presents investigators with enthusiastic learners driven by a desire to personalise the computer games medium, yet demands rigorous facilitation in maintaining schedules to meet project objectives. Working with adults requires little facilitation to convince participants of the serious nature of deadlines and deliverables, yet the low recruitment and retention of participants in this investigation suggests a difficulty in motivating learners to engage with a GBL initiative in the first instance.

Accreditation of the process from probation managers as project stakeholders, including opportunities to present work at a national level, participate in radio interviews and appear in internal publications within the probation service, demonstrates the value of participatory serious games design projects in improving key skills and employment prospects amongst adults at risk of social exclusion. Further opportunities to accredit the informal, participatory, design processes of serious games by groups at risk of social exclusion should be investigated that could potentially provide pathways to further study or work experience. Potential accreditation bodies could include OCR (Oxford Cambridge and RSA Examinations) providing qualifications to learners of all ages, abilities and in a variety of settings.

Chapter 9: Conclusions

The previous chapter documented the scalability of the design partner approach to participatory serious games design projects by working with adults at risk of social exclusion as a final study in this research project. The probation investigation was successful in facilitating adult offenders making a serious game for use by the probation service during an adult-initiated, shared decisions participatory design project. Chapter 9 presents an overview and discussion of important observations across the four exploratory studies conducted as part of this research including design preferences based on age and gender, autonomy versus productivity, and the issue of separating learner and educator input into a participatory project. The chapter concludes by articulating the contribution of work to the serious games research field, limitations of the studies presented and recommendations for future work.

9.1 Conclusion

This research has shown that simply increasing the participation of children in making serious games does not consistently produce more effective educational artefacts. Rather, it is the balance of learner input with educator experience by positioning children and educators as design partners in making serious games, that produces a more engaging and productive design process, together with a more functional and client-sensitive serious game product. This balanced approach to participation in making serious games has been demonstrated as both applicable and scalable to a wider range of students through successful application with adults at risk of social exclusion.

9.2 Overview of experimental work

The use of serious games in mainstream education requires extensive justification and a fine balance must be found between learning through play and instruction. In a design project with children, the level of facilitation in a multidisciplinary design team of learners and educators has to be carefully managed. Passive facilitation allowing children to initiate and direct their own learning through play with their peers can be a problematic strategy for educators as there is no guarantee that children will complete key learning objectives, such as fulfilling the serious game design objectives expected by collaborators. Conversely, active facilitation allows educators to fulfil these objectives within short timeframes, but introduces the need to elevate the participation of learners to retain a user-sensitive approach to design, and in separating learner and

educator input from the products of these processes. The following sections summarise the results of the four exploratory fieldwork studies and pilot study conducted as part of this research, to evaluate the hypothesis and research questions outlined in Chapter 1 and denoted here as RQ1, RQ2 and RQ3.

9.2.1 Pilot study

The pilot study demonstrates that children are initially enthusiastic to discuss ideas for games design, but are reluctant to invest in long-term serious games design projects. The designs created by children lacked educational content and were restricted by the simple nature of the web-based authoring software imposed by library computers. Children rarely engaged in electronic discourse and were reluctant to converse with facilitators during physical meetings hence limiting the available data to answer the research questions.

9.2.2 Study 1: Child initiated and directed participation

In relation to RQ1, this study demonstrates that there are problems with children designing serious games in isolation as the design ideas of children are heavily influenced by the violent commercial games which they play at home. Only two functional games were produced as part of this study, neither of which satisfied the design objectives of collaborators. In relation to RQ2, the study found that children prefer using physical tools such as LEGO^{TM} to build and share gaming knowledge, to electronic discourse via an internet blog. Children also prefer peer-based tuition to electronic resources when interacting with new software. In relation to RQ3, the study presents Game-Maker as suitable software to facilitate a serious games design process as it was praised by both children and educators as a viable addition to a school curriculum. The retention of voluntary participants during an extracurricular school activity during Study 1 suggests that higher levels of participation of children in making serious games creates a more stimulating learning environment for children, but fails to create the approved final product required by collaborators. The research hypothesis is neither accepted nor rejected at Study 1 as this requires comparison with lower levels of participation from children in making serious games achieved in Study 2.

9.2.3 Study 2: Assigned but informed participation

In relation to RQ1, this study demonstrates that children can create serious games when facilitated by their educators as the study was successful in creating a suite of serious games which were approved by collaborators. In relation to RQ2, the study found that children often require assignment of ad-hoc roles by adults to improve productivity. The design process also benefited from the imposed timeframes, deliverables and homework requirements of the classroom context in which the study was run. In relation to RQ3, the study again made successful use of Game-Maker to facilitate the design process, as the software was easily integrated into a school computing setup, and was accessible to both children and adults from different backgrounds. Study 2 rejects the research hypothesis by demonstrating that restricting the participation of children using methods at level four of Hart's Ladder produced both a more productive design process, and more suitable final products as educational artefacts, than projects which elevate the participation of children in making serious games and restrict adults to a supportive role such as that observed in Study 1.

9.2.4 Study 3: Adult initiated, shared decisions with children

In relation to RQ1, this study demonstrates that children can design serious games as part of a design 'partnership' with their educators. In relation to RQ2, the study found that physical tools can be combined with digital tools to allow children to conceptualise, design and modify serious game ideas within short project timeframes. Physical tools such as board games and playing cards can be used with children to facilitate co-operative enquiry into design ideas, while digital tools such as internet blogs can be used to create an iterative process of participatory design. In relation to RQ3, Adobe Flash was demonstrated as suitable software to facilitate this iterative design process for use by educators, but not as an accessible tool for use by children. Study 3 refines the research hypothesis that elevating children to higher levels of participation is optimised when learners and educators are positioned as 'design partners' and have equal stakes in the serious games design process. This can be achieved by applying the methods at level six of Hart's Ladder where adults initiate tasks and share decisions with children.

9.2.5 Study 4: Adult initiated, shared decisions with adults

In relation to RQ1, adult offenders (considered students of an educational probation programme) can design serious games as they demonstrate ambition and motivation to

fulfil the design objectives of collaborators within short project timeframes. In relation to RQ2, elevating learners to a position of design partners within serious games design projects requires facilitation regardless of the age and background of participants. Study 4 found that adult offenders respect the serious nature of deadlines and deliverables within serious games design projects and are enthusiastic to make use of any physical and digital tools available to present their ideas to educators. In relation to RQ3, the study presents Game-Maker as suitable software to facilitate a serious games design process with adults at risk of social exclusion, as the software is accessible to learners with limited access to technology resources. Study 4 presents evidence that the participatory 'design partner' approach to making serious games achieved at level six of Hart's Ladder is scalable to students from a wide demographic through successful application of these methods with adult offenders. Study 4 supplements the results of Study 3 to accept the refined research hypothesis that an optimal 'design partner' level of student participation in serious games design produces both a more productive design process and relevant final product (as educational artefacts) than the higher and lower levels of student participation evaluated in Studies 1 and 2 respectively.

9.3 Discussion

The following sections discuss interesting observations across the four exploratory fieldwork studies conducted as part of this research.

9.3.1 Design preferences based on age of participant

An important contrast between adult and child participants in the studies presented is their design influences when asked to brainstorm game ideas early in a design process. Study 1 observed that the design ideas of secondary school children are heavily influenced by violent FPS games which they play at home, such as the BBFC rated Halo and COD franchises. Despite this FPS genre often carrying minimum-age ratings of 18 years for concerning content, it is apparent that children as young as 13 years old regularly play these games and are evidently influenced by their violent characteristics in terms of their belief of what constitutes good games design. Conversely, Study 4 revealed that adults rarely made reference to these same violent FPS games in their design ideas despite identifying these games as their favourites. There is no evidence from the design workshop discussions, or the final product presented to stakeholders in

Study 4, that the violent characteristics of these FPS games influenced the design choices of the adult offenders who participated in the study.

The reluctance of adult learners to ask their peers for assistance when designing and presenting with new software is interesting. Despite questionnaire responses that participants of Study 4 ask friends for help when presented with gaming problems outside of workshops, these same participants rarely approached their peers within workshops for assistance with game-authoring software, and instead favoured the assistance provided by facilitators. Participants in this study required invitations from facilitators to both assist other team members and to experiment with the software. This initial reluctance to communicate might be related to the previous educational and social experiences of participants. Conversely, the child participants of Study 1 required little encouragement to disseminate new knowledge amongst their participant group and were keen to further explore serious games software in order to demonstrate their achievements to both their peers and facilitators in workshops.

The most encouraging observation from Study 4 was the motivation of participants to complete their serious games within the project timeframe for presentation to their educators. The initiative this small group of adults displayed to work as a team and delegate the creation of specific resources to individual team members, demonstrates the importance adults place on meeting deliverables within short-term projects. This is a positive outcome for the collaborating probation service as it creates a productive GBL activity where learners can benefit from the design process while producing games which are of potential benefit to their peers. This outcome meant the probation investigation received positive feedback from both participants and probation managers as a valuable addition to their offender rehabilitation curriculum:-

> '*Working on this project together with the support I've had from probation has given me so much confidence, and the incentive to get into education.*'
>
> Participant, Study 4

9.3.2 Design preferences based on gender of participant

The curricular project of Study 2 worked with a larger number of female participants (n=10) than the extracurricular project of Study 1 (n=1). As the proportion of female

participants in Study 2 accounted for approximately 45% of the total participant group, differences between design choices and facilitator input based on gender could be observed. The level of facilitator input into this project varied between the male and female working groups. The male groups demonstrated an enthusiastic approach to the design project requiring little assistance from facilitators. These groups were able to delegate tasks to individual members without prompting from facilitators. Conversely, the female groups were slow to begin work during workshops and required motivation from facilitators to identify and assign tasks to the skill sets of individual group members. The mixed gender group proved the most difficult to facilitate as its members consistently argued over design choices, which required facilitators to act more as mediators in the design process.

Study 2 also observed differences in design choices between genders. Male participants created complex player interfaces of keyboard commands but opted to include crude game sprites created using simple graphics editors. Conversely, female participants created simple player interfaces of point-and-click navigation, but opted to create complex game sprites using images they had captured with digital cameras. These design choices agree with the work of Hayes (2008) who found that males preferred creating new mechanical content (control mechanisms) while females preferred creating aesthetic content when asked to make their own gaming materials.

9.3.3 Autonomy versus productivity

The powerful learning environments proposed by Smeets (2005) call for active and independent learning to be stimulated. The extracurricular nature of Study 1 attempted to create an autonomous learning environment where participants could learn from each other with little input from facilitators, yet this approach created little productivity within the 10 week timeframe and failed to satisfy the design objectives of collaborators. Conversely, the classroom setting of Study 2 was successful in converting 80% of initial game ideas into functional products approved for use with a target audience of primary school children by the class teacher.

Framing tasks as school homework activities inspired participants to continue work on their games outside of workshops to fulfil the project objectives within the eight week timeframe. This motivation was lacking in Study 1 as facilitators considered that

imposing homework activities would de-motivate participants from continuing with a voluntary extracurricular activity. Thus, time reserved in Study 1 for experimenting with game-authoring software was often abused by participants who instead used this time to complete their school homework assignments. As participants from both studies appear to place greater importance on their curricular based activities, it is therefore the responsibility of facilitators in extracurricular activities to scaffold an effective learning environment. Facilitators must balance the freedom of participants to direct tasks and schedules within such an environment with the required productivity of participatory design projects.

9.3.4 Learner versus educator input

Both Study 3 and Study 4 attempted to apply an active approach to facilitation by positioning learners and educators as 'design partners' at level six of Hart's Ladder. This involved facilitators devising weekly objectives, activities and deliverables for the project which participants could inform. Should these deliverables not have been achieved then facilitators had the responsibility to complete tasks, as they had equal stake in the deliverables of the project. Typical facilitator input observed across both studies included the implementation of design ideas using game-authoring software.

Increased facilitation in these projects necessitated increased facilitator direction and input into participant tasks, which blurred the boundaries between learner and educator input into the design process. However, the main goal in multidisciplinary participatory projects is for children and adults to simply work together towards a common goal Druin (2002). Druin's design partner methods call for 'idea elaboration' where ideas are simply expanded upon by the multidisciplinary members of the design team, regardless of where those ideas originated. Therefore careful observations of workshop discussion transcripts, and use of observation schedules to compile observer notes, can reveal how learners have developed both their own design ideas, and those proposed by their educators, in the final game design.

The issue of separating learner and educator input during the design process can also be addressed via the inclusion of a post-project presentation of work by participants. Such a presentation encourages learners to consider both the final product and the design process in order to reflect upon and justify their design decisions to their educators. This

strategy proved useful in Studies 3 and 4 as participants were able to identify their own input into the project, and distinguish this from the input of both their peers and educators by either reviewing the project blog or working through paper questionnaires in preparation for this presentation. Encouraging participants to consider their roles within a design team via a reflective task such as this reinforces the meta-cognitive benefits of these activities.

9.4 Contribution of the work

This research reports on the limitations of the learning 'through' serious games model. The literature review and case study presented in Chapters 2 and 3 respectively have highlighted the limitations of this model as these serious games often result in peripheral learning (such as inter-peer discussions of how to play the game) which raises questions regarding the accessibility of these products. Squire (2007) identifies that gaming is now participatory, with digital authoring tools and distribution networks changing the ways in which we interact today, and suggests a change of direction for serious games research including exploration of how computer games and their associated spaces (message boards, multiplayer groups) function. This research has worked to contribute to the literature in this area by attempting to augment the digital discourses of the online domain with the physical exchanges of classroom activities to create a 'mixed reality' (Flintham et al., 2003) approach to serious games design.

The research presented in Chapters 4 through 8 advocates the potential of the learning 'by making' serious games approach by demonstrating the ability of design-based projects to both recruit and maintain participants within extracurricular activities, whilst satisfying the design objectives of collaborating services. The research also proposes new methods to frame classroom activities using computer games as a platform for children to engage in group activities, peer review and reflection on work. Further, this research has established a suitable level of facilitation for a serious games design project which allows both children, and adults as learners, to engage with a multidisciplinary group of educators to share the serious games creation process and thus benefit from its successful completion.

This research advocates the positioning of learners and educators as equal stakeholders in a serious games design project at level six of Hart's Ladder. As the role of 'design

partners' seeks to combine the ideas and enthusiasm of children with the knowledge and experience of facilitators (Druin, 2002), this research presents a method of iterative participatory design to facilitate this level of participation which will help to improve the productivity of future research projects between learners and their educators. The participatory method concerns the development of key design criteria by educators early in a design process, with decisions on these criteria organised into weekly discussions with learners. Subsequent synthesis and development of these ideas can be achieved by educators implementing ideas into digital prototypes using accessible game-authoring software such as Game-Maker or Adobe Flash. Weekly delivery, appraisal and revision of these prototypes by learners then creates an iterative design method that is successful in fulfilling project objectives and deliverables in short projects typically of less than 10 weeks. Table 20 summarises the five main objectives and their associated activities proposed for this iterative participatory design process.

Table 20: *Breakdown of proposed objectives for iterative participatory design*

#	**Objective**	**Activities**
1	Familiarisation	- introduce digital design tools - discuss project design objectives
2	Conceptualisation	- conduct co-operative enquiry into game concept - use low-tech prototyping tools
3	Creation	- use discussions to agree upon new resources - implement ideas into digital resources
4	Modification	- present digital resources using tools available - discuss modifications and improvements
5	Presentation	- reflect on design process and discuss roles - prepare and deliver presentation of product

The ethnographic nature of this research has required experimentation with methods of facilitating design-based projects with both children and adults. This has involved contrasting physical design tools such as paper worksheets, playing cards, board games and LEGO™ with contemporary digital tools such as internet blogs and school virtual learning environments. This research also contributes to existing knowledge of non-commercial game-authoring software, and presents evidence of the successful application of Game-Maker as subscription-free and accessible authoring software

available from the internet. The collection and presentation of positive opinions towards Game-Maker from both learners and educators as part of this research, allows Game-Maker to be considered as a viable authoring tool in future research.

This research also presents application of the participatory design model to learners of a radically different demographic than the typical application to secondary school children available in the current literature. The literature review presented in Chapter 2 demonstrates evidence from several studies into making serious games which are specifically targeted at children. These studies include typical classroom activities (Scaife & Rogers, 1998) conducted using technology-rich school computing facilities (Robertson & Good, 2005). These studies do not experiment with the scalability of proposed methods to learners from a different demographic or learning environment. The probation investigation presented in Study 4 of this research addresses this problem by working to scale the participatory design model to an unconventional participant group with limited access to technology resources and strict restrictions on facilitation methods. The positive results of Study 4 represent an important addition to the literature on the design of serious games allowing the participatory design model to be considered for use by educators outside of conventional contexts, such as the Probation Trust.

Finally, this research contributes to the current debate within the literature on the effects of violent computer games on children. This research demonstrates that BBFC rated content is prevalent amongst the gaming preferences of children as young as 13 years. Further, this research demonstrates that, while not observably affecting the behaviour of these children, these computer games do influence children's perception of what makes games fun. This research has revealed that children find conventional serious games boring and so transplant learning activities with shooting mechanics, blood and copyright infringing homages to their favourite computer game franchises when asked to create their own serious games. Therefore, this research presents evidence that exposure to this genre of games creates potential problems for elevating children to higher levels of participation in making serious games. Non-facilitated serious games design projects with children fail to create suitable or relevant products for use by collaborators. This creates the concerning scenario where serious games created by children are rejected by collaborators, which in turn discourages collaborators from investing in serious games design projects in the future.

9.5 Limitations

An important potential criticism of this research is the use of small sample sizes of participants in each study. Although the methods applied in this research were successful in retaining participants throughout each study, the low number of initial recruitments meant that observations of the core participant groups which developed could be considered statistically insignificant and discounted as simple case studies rather than representative samples. The low number of applicants to attend the extracurricular design project in both Study 1 (n=10) and Study 3 (n=5) meant that the gaming preferences, design ideas and ability to function as part of a participatory design team, documented in this research are limited to observations amongst these small participant groups. A lack of incentives for participation, combined with competition for use of participant time from homework assignments and other participant commitments such as part time jobs, can all contribute to the low recruitment of participants for this research. Potential methods to address this include monetary incentives for participation, or some form of accreditation of the design process from collaborating schools or other awarding bodies. These accreditation routes could have a potentially valuable impact on the further education and employment opportunities of participants in serious games design projects.

A further important limitation of the research is the nature of working with a self-selecting group of computer game enthusiasts to advocate the potential of serious games design methods. Participants of Studies 1 and 3 were recruited via applications to participate with a serious games design project and thus had an initial level of gaming experience, preferences and motivation towards computer games prior to the investigations. Whether the positive observations of participatory serious games design projects can be extended to secondary school children in general requires further investigation with non-voluntary samples of school children, by integrating design projects into secondary school lesson plans. This limitation was addressed in Study 2 which assessed the active facilitation methods of the lower levels of Hart's Ladder by positioning the investigation within a secondary school classroom context. The sample class of secondary school children used in Study 2 was selected from school rated as average by school regulators. Further, these participants displayed a variety of enthusiasm, experience and opinions towards computer games, and so provided a more

representative sample of children with which to evaluate the participatory design approach to serious games.

Studies 1, 2 and 3 were conducted using facilities and participants from secondary schools with average to high ratings by school regulators. Studies 1 and 3 worked with students from a secondary school rated ‘outstanding’ by school regulators and Study 2 with students from a secondary school rated as ‘average’. Participants of these studies worked in technology-rich learning environments with access to networked computing facilities and media creation tools such as image manipulation software. Further, school staff who participated in these studies were often enthusiastic toward the use of contemporary tools such as blogs and game-authoring software as part of this research. Subsequently, these studies observed an enthusiastic approach to the design process by a young demographic of digital natives working within a familiar learning environment. Further investigation into the potential of the participatory serious games design approach requires working with a radically different demographic of participants and learning environment. This limitation was addressed in Study 4 but collaborators of this study requested that the project be positioned within the non-authentic learning environment of a university classroom. Further work is therefore required within the authentic learning environment of a different demographic of participant, to fully evaluate the scalability of the participatory design approach to serious games.

The short term nature of the design projects within this research methodology meant that the longitudinal nature of this research is also a potential limitation. Opportunities to return to work with participating schools and services were limited due to the number of studies undertaken as part of this research, and the necessary ethical approval required from both the university human ethics committee, and the ethics departments of collaborating schools and services. Although vital in research of this nature, this process of preparing and revising projects for ethical approval required a large investment of time in refining research methods and making sure they complied with good ethical practice. Thus time for revisiting the collaborators of each study to observe how methods had been integrated and adapted creating a more longitudinal approach to research was not feasible here.

A further potential limitation of this work is the reliance upon qualitative data to evaluate the research questions rather than both qualitative and quantitative data. Researchers study the activity structures of participatory design projects ethnographically using qualitative methods in situ (Derry & Steinkuehler, 2003). As these activities are context specific (case studies) they are often difficult to deconstruct for formal presentation of results. To avoid the qualitative methods applied in this research from resembling a subjective 'kaleidoscope' of data (Dye et al., 2000), measures to counteract the shortcomings of qualitative research as identified by Mittman (2001) were employed. These included the derivation of a formal research hypothesis and the specification of research variables in advance of data collection, the collection of data from at least two sources, and the use of pilot studies to identify appropriate timeframes and data capture methods. Provisions were also made to allow for flexibility in methods which resulted in different data (questionnaire responses, internet blog posts, observer notes, video-footage, game resources) being both generated and collected for each study, as it is vital in participatory design activities that methods are suitable both for the process, and the age of the participant (Druin, 2002).

Attempts to improve the credibility of the qualitative data established from the ethnographic methods used in this research include prolonged engagement in the field by repeating experiments with a variety of participants, across different age groups in a variety of different learning environments, and debriefing of peers to uncover reflection on process (Anfara, Brown & Mangione, 2002). Transferability of this data was improved by developing the required 'thick description' of process and product through provisions for a development history of work (Steinkuehler, 2008), and using purposive sampling techniques such as 'opportunistic' and 'convenience' sampling methods (Patton, 1990) and making use of whatever materials were available to the researcher (Bendixen-Noe, 2010).

The application of Hart's Ladder as an objective measure of student participation in serious games design is also a potential limitation to this research. Hart's Ladder was a new concept to the candidate uncovered from the literature review, and so this unfamiliarity with the model may have led to the researcher using it incorrectly. As there exists little, if any, evidence of Hart's Ladder being applied to participatory serious games design projects within the current literature on serious games, use of this

model is both a limitation to this research (as there is no evidence that it is being applied correctly) and also an advantage as its new application to the design of serious games represents an important contribution to the literature.

9.6 Recommendations for future studies

An interesting observation within this research is the prevalence of violent commercial action games amongst contemporary gaming preferences, especially those of children. Although there currently exists research into the links between computer game violence and real life violence in both the media (Stuart, 2010) and research literature (Grossman, 2000; Wright 2002), there is limited material on why these games are so appealing to gamers outside of their intended audience, and how they are so easily acquired by this demographic despite the introduction of tighter PEGI computer games classification (Deans, 2008). Further research is required into how and why children acquire and play these games if we want to prevent future games (including serious games) from being nothing more than simple derivatives of the COD franchise through focus group consultation with these gamers. As the popular franchises favoured by participants in this research (such as COD, Halo and Gears-of-War) are relatively new franchises (typically within the last 10 years), further research is required, working with young adults who have encountered these franchises during adolescence and are now moving into higher education, to establish if exposure to these games as children has translated into design preferences that still manifest in serious games design projects within higher education.

This research chose not to employ use of popular social networking tools such as *Facebook* and *Twitter* due to ethical concerns of conversing with children using these tools during extracurricular school activities. The internet blog used in Studies 1 and 3 allowed users to post comments anonymously, but was rarely used by participants of these studies to communicate outside of meetings. It is fair to assume that participants did indeed participate in digital discourses during these projects, but probably chose to use tools they were either more familiar with or that educators were unaware of. Future research into social media tools suitable for use with children during participatory projects, will uncover new and interesting methods of establishing a digital domain to supplement the work conducted in the physical meetings of design workshops.

To breach the firewall that exists between mainstream education and the online gaming community, educators must now work to transfer the exciting observations of knowledge dissemination from the online world into the classroom. This requires fine-tuning of the roles teachers, researchers and learners can play in activities such as multidisciplinary serious games design projects. Use of facilitators from different backgrounds should be further explored, including working with commercial serious games designers as consultants to a design project, in order to experiment with additional educational artefacts such as work experience placements and avenues of employment as by-products of serious games design projects.

9.7 Closing remarks

The idea of allowing children to instruct, monitor and evaluate the learning of their peers by making serious games has the potential to create new powerful learning environments. Intergenerational multidisciplinary design teams of learners, educators and researchers can form important social scaffolds where the avatar-mediated interactions prevalent in online gaming communities can be transferred into the physical classroom. However, the importance of a facilitator in this design process should not be underestimated, as educators maintain schedules and discipline amongst learners whilst encouraging the shared vocabulary, skills and tasks which make these multidisciplinary activities effective. Balancing the facilitation of students in constructing their own learning through design, allows the design process itself to be considered a serious game in its own right.

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Appendix A: Questionnaires from Study 1

Study 1: Library Investigation Questionnaire 1

Age: **Male / Female** **Favourite games:**

_____

What should our game do?

The aim of the game:

Remember that after playing our game, any player should:
- Know that a library contains more than just books!
- Know about the facilities a library has and how these work.
- Know that a library isn't the only place they can find information
- Be able to use / read / play with something fun that the library can offer!

Use this space to write down your idea for a library game:

Use this space to write down some aims for your game:

Use the space to tell a player what to do to complete your game:

Please hand your completed sheet to the investigators.

Study 1: Library Investigation Questionnaire 2

Age: **Male / Female** **Favourite games:**

_____

What can we learn from other games?

Did you enjoy the game Poptropica? **yes / no**

Did you learn anything while playing the game? **yes / no**

If so what did you learn? _____

What do you think this game is trying to teach? _____

Do you think you will play the game again? **yes / no**

Did you get stuck while playing the game? **yes / no**

Where / How? _____

Did you ask for help? **yes / no**

Who did you ask and could they help you? _____

Did you know you can find Poptropica help online? **yes / no**

Use your computer to visit the website http://poptropica.wordpress.com

Do you think this website is useful? **yes / no**

Why? _____

Have you used websites similar to this for games you play at home? **yes / no**

What gaming websites do you visit regularly? _____

Why do you visit these gaming websites? **reviews / cheats / help / discussions**

Do you ever get ever stuck on games you play at home? **yes / no**

How do you find help when you get stuck on a game? **website / magazine / friend**

Other: _____

What is the best way to solve a gaming problem? **ask for help / keep trying / give up**

What is the most important goal in a game? **high score / complete game / have fun**

Please hand your completed sheet to the investigators.

Study 1: Library Investigation Questionnaire 3

Age: **Male / Female** **Favourite games:**

_____

What are the rules of our game?

What is your game called?

How does a player win the game?

Are there any obstacles / enemies that a player must avoid?

Are there any special items / areas that will help a player to win the game?

Why must people play your game?

What are the rules to your game?

Rule 1:

Rule 2:

Rule 3:

Rule 4:

Rule 5:

Please hand your completed sheet to the investigators.

Study 1: Library Investigation Questionnaire 4

Age: **Male / Female** **Favourite games:**

_____

How should we create our game prototypes?

Have you had a chance to use the Sims Carnival games creator at home? **yes / no**

Was this your first time using the Sims Carnival games creator? **yes / no**

Did you find the Sims Carnival games creator easy to use? **yes / no**

Have you created your own game using Sims Carnival? **yes / no**

Did you use a tutorial to help create this game? **yes / no**

Use this space to write down some comments about the Sims Carnival games creator:

_____

Have you used Game-Maker before? **yes / no**

How would you describe yourself? **expert / average / beginner**

Were you able to complete the example? **yes / no**

Did you find Game-Maker easy to use to complete the example? **yes / no**

Did you get stuck with any part of the example? **yes / no**

Which part? _____

Who did you ask for help when you got stuck? **investigator / friend / internet**

Was this person able to answer your question? **yes / no**

Did you find this example useful? **yes / no**

What would you change about the example? _____

Use this space to write down some comments about the Game-Maker games creator:

_____

Which games creator software do you prefer? **Sims Carnival / Game-Maker**

Briefly explain why: _____

Would you use this software again? **yes / no**

Please hand your completed sheet to the investigators.

Appendix B: Questionnaires from Study 4

Study 4: Probation Investigation Questionnaire 1

Name: _____ Age: _____

1. I typically play computer or video-games:

   ☐ Every day
   ☐ Every week
   ☐ Occasionally
   ☐ Rarely
   ☐ Never

2. I would consider myself:

   ☐ Hardcore gamer
   ☐ Something between Hardcore and Casual
   ☐ Casual gamer
   ☐ I have no idea

3. I prefer the following way of playing games:

   ☐ Single player alone
   ☐ Single player with other people helping
   ☐ Multiplayer, in the same room
   ☐ Multiplayer, over the internet
   ☐ Team play or Clan play over the internet
   ☐ Virtual worlds or MMORPGs

4. Name your three favourite games (any game you enjoy counts):

   _____
   _____
   _____

Rate each of the following video-game experiences from 'love' for experiences you enjoy through to 'hate' for experiences you would try to avoid:

5. Playing in a group, online or in the same room.
   love / like / okay / dislike / hate

6. Talking with other players, online or in the same room.
   love / like / okay / dislike / hate

7. Working out what to do on your own.
   love / like / okay / dislike / hate

8. Co-operating with strangers.
   love / like / okay / dislike / hate

End of questionnaire.

Study 4: Probation Investigation Questionnaire 2

Name: _____ Age: _____

1. Why do you play video-games? **competition / puzzles / story / have fun**
2. Do you ever get ever stuck with games you play at home? **yes / no**
3. Where do you look for help? **website / magazine / friend**
4. What gaming websites do you visit? _____
5. What gaming magazines do you read? _____
6. Why do you visit / read these materials? **news / reviews / cheats / help**
7. How do you solve a video-game problem? **keep trying / ask for help / give up**
8. Did you get stuck today using the Game-Maker tutorial? **yes / no**
9. Where / How? _____
10. Did you ask for help with the tutorial? **yes / no**
11. Who did you ask for help? _____
12. Please rate the help they provided **good / average / poor**
13. Do you think you will use Game-Maker again in your own time? **yes / no**
14. What are your comments / improvements for the Game-Maker tutorial?

Comments	Improvements

End of questionnaire.

Study 4: Probation Investigation Questionnaire 3

Name: _____ **Age: _____**

What is your game called?

What does your game teach a player?

How does a player start / finish your game?

Start:

Finish:

What obstacles does a player have to avoid?

What special items can help a player to finish the game?

Think of five important rules for your game:

Rule 1:

Rule 2:

Rule 3:

Rule 4:

Rule 5:

End of questionnaire.

Study 4: Probation Investigation Questionnaire 4

Name: _____ Age: _____

1. Are you happy with the game you have created? **yes / no**

   Why? _____

2. What would you change about your game? _____

3. What was your role during the project? _____

4. Why do you think this role is important? _____

5. Please rate the following from 5 (excellent) to 1 (poor):

   a) How do you rate the facilities (computers etc.) for the project? **5 4 3 2 1**

   b) How do you rate the help provided from [candidate]? **5 4 3 2 1**

   c) How do you rate the help provided from your probation tutors? **5 4 3 2 1**

6. Have you learned anything new during the project? _____

7. Do you think the project has improved your skills in:

   computing / communication / presentation / team-work

   Other: _____

8. Do you think the project has helped with your employment training? **yes / no**

   How? _____

9. Would you recommend this project to a friend? **yes / no**

   Why? _____

10. What are your suggestions to improve the project?

    _____

End of questionnaire.

List of Publications

Bates, M., Brown, D., Cranton W., and Lewis, J. (2007a). Carving out a new approach to learning. *Proceedings of the 1st European Conference on Games-Based Learning (ECGBL)*, October 2007, Paisley, Scotland, pp.19-26.

Bates, M. (2007b). *Constructivism in the classroom: learning through play* (workshop on serious games). In: 27th BCS SGAI International Conference on Artificial Intelligence (AI-2007), December 2007, Cambridge, UK.

Bates, M., Brown, D., Cranton, W., and Lewis, J. (2008). *Playing to win: motivation for teaching and learning in today's gaming culture.* Paper presented at Interactive Technologies and Games (ITAG), November 2008, Nottingham, UK.

Bates, M., Brown, D., Cranton, W., and Lewis, J. (2009a). Gaming and the firewall: exploring learning through play via game design with children. *Proceedings of the 3rd European Conference on Games-Based Learning (ECGBL)*, October 2009, Graz, Austria, pp.8-16.

Bates, M., Brown, D., Cranton, W., and Lewis, J. (2009b). *A design for learning: exploring serious games design with children.* Paper presented at Interactive Technologies and Games (ITAG), October 2009, Nottingham, UK.

Bates, M., Brown, D., Cranton, W., and Lewis, J. (2010a). Facilitating a games design project with children: a comparison of approaches. *Proceedings of the 4th European Conference on Games-Based Learning (ECGBL)*, October 2010, Copenhagen, Denmark, pp.429-437.

Bates, M., Brown, D., Cranton, W., and Lewis, J. (2010b). *Formulating a serious games design project for adult offenders with the probation service*. Paper presented at Interactive Technologies and Games (ITAG), October 2010, Nottingham, UK.

Bates, M., Brown, D., Cranton, W., and Lewis, J. (in press). Formulating a serious games design project for adult offenders with the probation service. *International Journal on Games-Based Learning (IJGBL).*

Bates, M., Brown, D., Cranton, W., and Lewis, J. (submitted). *The optimal level of student participation in the design of games-based learning.* Paper submitted to the 5th European Conference on Games-Based Learning (ECGBL), October 2011, Athens, Greece.