Game-based learning in formal educational contexts: how subject matter experts and game experts could collaborate to design and develop games

by

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ABBREVIATIONS

3D	: three dimensional
BBC	: British Broadcasting Corporation
Becta	: British Educational Communications and Technology Agency
BESA	: British Educational Suppliers Association
BETT	: British Education and Training Technology
CEO	: chief executive officer
Consolarium	: Scottish Centre for Games and Learning
DiGRA	: Digital Game Research Association
ECGBL	: European Conference of Games Based Learning
ES1	: The first exploratory study
ES2	: The second exploratory study
ES3	: The third exploratory study
ESRC	: Economic and Social Research Council
FE	: Further education
FPS	: first-person shooter
GBL	: game-based learning
GX	: game experts
HCI	: human-computer interaction
HE	: higher education
ICT	: information and communication technology
ID	: instructional designer
IGDA	: International Game Developers Association
Indies	: independent game developers
IP	: intellectual property
ITTE	: Association for Information Technology in Teacher Education
JISC	: Joint Information Systems Committee
LSC	: Learning and Skills Council
MA	: Master of arts
MoLeNET	: Mobile Learning Network
N/A	: not available
Naace	: National Association of Advisers in Computer Education
NCET	: National Council for Educational Technology
NESTA	: National Endowments for Science, Technology and the Arts
Nintendo DS	: Nintendo Developers' System

ORO	: Oxford Reference Online
PGCE	: Postgraduate Certificate in Education
QA	: quality assurance
QS	: questionnaire surveys
R&D	: research and development
SAGSET	: Simulations and Games Society for Education and Training
SMART	: specific, measurable, achievable, result-oriented and time-bound
SMEs	: subject matter experts
SPSS	: Statistical Package for the Social Sciences
SR Model	: Spiral Research model
TEEM	: Teachers Evaluating Educational Multimedia
VLE	: virtual learning environment
WIE	: Warwick Institute of Education

DEFINITIONS OF TERMS

The following terms are used repeatedly in this study to refer to technical terms and groups of people involved in the collaboration of GBL. While some are fixed definitions within the practice of the game industry and the educational research community, the others are applied strictly for the purpose of this study.

concept	A mental construct of a group or class of objects, which may be abstract or concrete, seen as mediating between a term and whatever it denotes or is used to refer to (The Concise Oxford Dictionary of Linguistics 2007).
education	The process of receiving or giving systematic instruction (The Oxford Dictionary of English 2005).
formal education	The hierarchically structured, chronologically graded education system, running from primary school through the university and including, in addition to general academic studies, a variety of specialised programmes and institutions for full-time technical and professional training (Coombs, Posser & Ahmed 1973).
game	An activity, either a form or spell of play or sport, engaged in for amusement, especially an organised, competitive one played according to rules and decided by skill, strength or luck.
game-based learning	A form of learner-centred learning that uses electronic games for educational purposes (Tan, Johnston-Wilder & Neill 2008).
game experts	Professionals with expertise in the field of game production.
game industry	The branch of economic and commercial activity that is concerned with the production of games in studios and the distribution of games through publishers.
gameplay	The heart of the player's mental experience of a game, which consists of 'the challenge that a player must face to arrive at the object of the game, and the actions that the player is permitted to take to address those challenges' (Adams 2010).
indies	Game developers who do not receive money from a game publisher to create their game (Michael 2003); whereas [paid] game developers are individuals or businesses that produce games.
issue	Topic or problem which becomes important for debate or discussion.
learn-based gaming	A form of game design and development strategy that uses learning or coaching to support game playing and marketing.
learner-centred learning	Learning that urges learners to actively construct meaning and understanding during every phase of the learning process (Yilmaz 2008).
media	The agency or means of learning (The Oxford Dictionary of English 2005).
perception	The way in which something is regarded, understood, or interpreted (The Oxford Dictionary of English 2005), i.e. the intuitive understanding of and insight into GBL for formal education contexts.
potentials	The hidden qualities of games that need to be developed and converted into *overt benefits* to make GBL useful and successful. In the contexts of formal education, *overt benefits* mean measurable learning outcomes which could prove the learners' attainment of pre-determined objectives in GBL.
subject matter experts	Professionals with expertise in the field of education but usually without technical Game production knowledge.
use case	Stories about how people (or other things) use a system to perform some tasks (Adolph & Bramble 2003).

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DECLARATION

The work in this thesis was developed and conducted by the author between March 2008 and October 2010. I declare that, apart from work whose authors are explicitly acknowledged, this thesis and the materials contained in the thesis represents original work undertaken solely by the author. None of the work has been previously submitted for any other degree.

Papers published by the author during the doctoral study:

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Tan, W.H. (2010c). *Game experts' attitudes to game-based learning practice and collaboration: an interim survey report*. [Online] http://www2.warwick.ac.uk/fac/soc/wie/courses/degrees/docs/who/students/edrhal/research/publications/survey2.pdf

Tan, W.H., Johnston-Wilder, S. & Neill, S. (2008). Examining the potential of game-based learning through the eyes of maths trainee teachers, *In*: Joubert, M., ed. *Proceedings of the British Society for Research into Learning Mathematics Day Conference, 28* (3), King's College, London, November 15, 2008, pp. 120–124.

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Tan, W.H., Johnston-Wilder, S. & Neill, S. (in press). Game-based learning with dialogic teaching approach: deep learning and the use of Spore™ in A-Level Biology Lessons. *In*: Felicia, P., ed. *Handbook of Research on Improving Learning and Motivation through Educational Games: Multidisciplinary Approaches*. Hershey: IGI Global.

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Tan, W.H. & Xu, L. (2009). Deep learning and innovative skills development: a potential solution to education dilemma in China, selected as an excellent paper in *the First PhD Forum of Chinese Students and Scholars Association UK*, University of Nottingham, Nottingham, May 30, 2009.

ABSTRACT

This doctoral research aimed to investigate how subject matter experts (SMEs) and game experts can collaborate to design and develop games for use in formal educational contexts. The research began with a literature review of key concepts and issues associated with game-based learning (GBL), which led to the process of defining and redefining the overarching research question, along with its scope and position in academia. A three-phase strategy was adopted to segregate the research into exploratory, confirmative and explanatory phases, wherein each phase comprised interrelated studies. These studies were integrated through the Spiral Research model to enable temporal focus shift, cross-case analyses and cross-case syntheses. In the exploratory studies, the perceived potentials of games and GBL in the formal educational context were examined revealing the differing views between SMEs and game experts. This in turn guided the conduct of the confirmative studies which compared the attitude of SMEs and game experts in both the 'usual' and the 'ideal' conditions towards GBL practice and collaboration that involves teachers, SMEs and educational game experts. Two questionnaire surveys were carried out, and the findings revealed that, under ideal conditions, both SMEs and game experts held positive attitudes to GBL—the games used, the teachers who use games in teaching, the studios that develop educational games, and the collaboration between SMEs and game experts. However, the respondents were uncertain whether the perceived 'ideal' GBL conditions were usually the case or not. Follow-up interviews were conducted in the explanatory phase in order to uncover the reasons behind these changes in attitudes. While a variety of reasons were found and presented as parts of the findings of the research, particularly the challenges faced in GBL practice and the problems encountered in GBL collaboration, this thesis asserts that effective communication between SMEs and game experts is the key success factor in resolving issues associated with GBL. Besides, there was a pressing need for models of GBL collaboration; hence the integrated GBL model was also developed. The model not only incorporates GBL practice into GBL collaboration, but also highlights the importance of effective communication in those processes. Despite being limited by methodological constraints and available resources, both the Spiral Research model and the integrated GBL collaboration model have made substantial contributions to the research into GBL, particularly for formal educational contexts.

CHAPTER 1: INTRODUCTION

1.0 Overview

This thesis explores the similarities and differences between subject matter experts (SMEs) and game experts in perceptions of game-based learning (GBL) for formal education contexts. This introduction briefly outlines the motivation which lies behind the conduct of this research, the key research questions, the research aims, the hypothetical propositions and a short preview of each chapter.

1.1 Game-based learning in brief

GBL is defined in this research as a form of learner-centred learning that uses electronic games or e-games for educational purposes (Tan, Johnston-Wilder, & Neill 2008). The term GBL semantically combines two concepts, game and learning, and its focus is learning, rather than game; otherwise it would be called 'learn-based gaming'. To distinguish the difference between GBL and learn-based gaming, the term learn-based gaming is defined as a form of game design and development strategy that uses learning or coaching to support game playing and marketing. Yilmaz's (2008) definition of learner-centred learning is learning that *'urges learners to actively construct meaning and understanding during every phase of the learning process,'* an idea lying in the constructivist learning theory tradition.

GBL *per se* is not new, but the use of electronic games or e-games in education is relatively new, compared to other learning media. 'Media' is the agency or means of learning (The Oxford Dictionary of English 2005), and 'e-games' are a type of electronic media. Commonly, electronic media are also regarded as new media (The Canadian Oxford Dictionary 2004), but some electronic media such as television and radio are seen as traditional media in this research, while others like the Internet, e-books and e-games are considered as new media. The status of e-games as a type of new media is constantly maintained by their rapid development and evolution.

The phrase 'educational purposes' covers a wide range of concepts under the canopy of education. Education is the process of receiving or giving systematic instruction (The Oxford Dictionary of English 2005), which involves teaching and learning. At times, the term 'pedagogy' is used to denote education. However, the term pedagogy

focuses on the method and practice of teaching, rather than learning, especially as an academic subject or theoretical concept (The Oxford Dictionary of English 2005). To avoid misleading conception and interpretation, this thesis discards the use of 'pedagogy' and adopts the term 'education' which covers both teaching and learning. Therefore, 'educational purposes' means teaching and learning purposes.

1.2 Formal education contexts and the modes of learning

This research studied e-games used in formal education contexts. Formal education is the hierarchically structured, chronologically graded education system, running from primary school through the university and including, in addition to general academic studies, a variety of specialised programmes and institutions for full-time technical and professional training (Coombs, Posser & Ahmed 1973). In other words, non-formal and informal education contexts are beyond the coverage of this study. Coombs (1976, p. 282) defined non-formal education as *'a convenient label covering a bewildering assortment of organised educational activities outside the formal system that are intended to serve identifiable learning needs of particular subgroups in any given population;'* while informal education was defined as the truly lifelong process whereby every individual acquires attitudes, values, skills and knowledge from daily experience and the educative influences and resources in his or her environment (Coombs *et al*. 1973). This tripartite categorization of education contexts should not be confused with the different approaches to learning. After clarifying definitions related to the contexts of education, OECD (2007) shifted the focus of delineation from educational contexts to approaches to learning, based on two criteria: whether the learning is intentional and whether the activity has (a) learning objective(s). This leads to the definitions of four modes of learning, which are formal learning, semi-formal learning, non-formal learning and informal learning. The characteristics of each mode of learning according to OECD are depicted in Table 1.1.

Although this research is confined within formal education contexts, it has dealt with all four modes of learning that occur in each context. Formal education was targeted because the issue which this research dealt with relates to a phenomenon occurring in

such contexts. Also, the participants of this study have direct or indirect interaction with the phenomena in formal education contexts.

Table 1.1: The characteristics of four modes of learning, adapted from OECD (2007, p. 5).

Mode of learning	Characteristics
Formal learning	Learners may learn during courses or during training sessions in the workplace. The activity is designed as having learning objectives. Learners attend with the explicit goal of acquiring skills, knowledge or competence.
Semi-formal learning	Learners may learn during activities with learning objectives but they learn beyond the learning objectives. Learners have the intention of learning about something and, without knowing it, learn also about something else.
Non-formal learning	Learners may learn during work or leisure activities that do not have learning objectives but they are aware of learning occurrence/s. Learners observe or do things with the intention of becoming more skilled, more knowledgeable and/or more competent.
Informal learning	Learners may learn in activities without learning objectives and without knowing they are learning.

1.3 The use of electronic games in UK formal education

The use of games in formal UK education contexts started to take form since the 1960s, when associations like the Simulations and Games Society for Education and Training (SAGSET) was established (Tansey & Unwin 1969). However, the use of e-games was not begun until the BBC Micro computer became popular in British schools in the early 1980s through the BBC Computer Literacy Project (Radcliffe & Salkeld 1983). Many text-based adventure educational games, such as *'L' A Mathemagical Adventure* and *Granny's Garden*, attracted the interests not only of the players but also of school teachers, who were the pioneers that laid the foundation of today's GBL practices in the UK. The unique success of the BBC micro computer in formal education made the UK an atypical nation in global GBL history as compared to some other developed Western countries—which did not seek to support a home grown computer industry and had not promoted the micro in schools to such an extent.

The Department of Education and Science launched the Microelectronic Programme and started to host the Hi Technology and Computers in Education Exhibition, which

was renamed as British Education and Training Technology (BETT) in January 1985 (BETT 2010). This exhibition has become an annual showcase for members of the British Educational Suppliers Association (BESA) to display their latest information and communication technology (ICT) and new media products to UK educators and educationalists ever since. In order to improve the quality of teaching and learning with ICT, associations like the Association for Information Technology in Teacher Education (ITTE) and National Association of Advisers in Computer Education (Naace) were formed in the mid-1980s. The membership of ITTE is opened specifically to those who are involved in teacher education and researchers of ICT in education, while Naace's membership covers a wide range of professionals, including teachers, school managers, curriculum leaders, lecturers, local authority advisors, software developers and designers, sales personnel, etc. One encouraging effort carried out by Naace is an accreditation scheme called 'ICT Mark for Schools' which recognises *'schools achieving a good standard of mature and effective use of technology* (Naace 2010).'

In 1998, the British Educational Communications and Technology Agency (Becta) arose from the National Council for Educational Technology (NCET) to promote and integrate ICT in education in Britain. Treating e-games as a form of ICT, Becta funded a research series that was related to the use of e-games in formal education (e.g. Becta 2001, 2006b; Williamson 2009). Besides Becta, other publicly funded bodies like the Joint Information Systems Committee (JISC), Teachers Evaluating Educational Multimedia (TEEM), the National Endowments for Science, Technology and the Arts (NESTA), the Economic and Social Research Council (ESRC) and the Learning and Skills Council (LSC) also initiated or commissioned research on GBL. Some of these researches were pilot studies such as Becta's Computer Games for Education (Becta 2006b), while others were large scale like the MoLeNET programme which involves 20,000 learners and 4000 staff (Attewell, Savill-Smith & Douch 2009). The outcomes of selected research reports are reviewed in Chapter 3.

Many academic research centres and laboratories were set up by universities and independent not-for-profit bodies to study games used for educational purposes, including London Knowledge Lab, Future Lab, Serious Games Institute,

International Digital Lab, Consolarium (aka the Scottish Centre for Games and Learning) and MirandaMod to name a few. GBL conferences, workshops and seminars were organised annually in various regions of the UK, such as the first European Conference on Games Based Learning (ECGBL) in Glasgow (2007), the first (2009) and the second (2010) GBL Conference in London, GBL Symposium 2010 in Milton Keynes, Naace Conferences, Annual Games Education Conference in Brighton, and SAGSET Annual Conference, providing platforms for schools teachers, academics and game experts to meet, communicate and learn from each other.

Despite significant amounts of money, time and effort injected into the research and development (R&D) on the use of games in education, important issues like how and why games should be used in teaching remain the concerns of many UK teachers (Williamson 2009). School teachers find themselves coping with the work pressure incurred from endless evaluation and forever changing policies; thus justifying how and why games could be used in association to the evaluation and the policies becomes a continuous challenging task. While teachers are concerned more about the effectiveness or even usefulness of e-games for students' attainment in formal examinations (Williamson 2009); both academic researchers and game developers are attempting to identify and realise the potential and value of GBL (Egenfeldt-Nielsen 2007; Felicia 2009; Seeney & Routledge 2009).

Since research into GBL is a relatively new and developing field of study, academics from nearly all other fields have various degrees of interest in this phenomenon. For instance, there are at least five different game-related theories: Fisher's (1930) evolutionary game theory, Vygotsky's theory on play (1933), the mathematical game theory of Neumann and Morgenstern (1944), Berne's (1964) psychological game theory and Koster's (2005) theory of fun for game design. This scenario is complicated because all of these theories, and many others, can be applied in formal education contexts, and what counts as evidence of the potential and value of GBL can be a very different matter from one academic to another. As a result, the need to examine and delineate the underlying perceptions of GBL concepts cannot be overstressed.

The scenario in the game industry, on the other hand, is focusing on learn-based gaming rather than GBL. Unlike GBL, learn-based gaming focuses on game playing, and learning becomes a medium for playing. As indicated by Wilson (2008) in Gamasutra, Nintendo, the top game publisher in the world since 2008, published series after series of such commercial game titles, including *Big Brain Academy series*, *Professor Layton series*, *Brain Trainer series*, *Wii Music*, *Nintendogs* and *Mario Kart* which have been used, for example, by many school teachers in the UK, for example those who participated the Consolarium project in Scotland (Robertson 2009); and in the MoLeNET Project in England (Attewell, Savill-Smith & Douch 2009).

1.4 Introducing the experts: subject matter experts and game experts

This research is about a series of perception and attitude comparisons between subject matter experts (SMEs) and game experts. As depicted in the previous section, school teachers, academics and game developers face different issues in GBL practices but these issues might possibly be related. Therefore, examining experts' perceptions through comparison is necessary in order to propose solutions that could resolve the potential issues related to GBL.

Perception, according to The Oxford Dictionary of English (2005), is the way in which something is regarded, understood, or interpreted, i.e. the intuitive understanding of and insight into GBL for formal education contexts. In this sense, this thesis adopts the term 'perception' as a count noun (many perception**s**) rather than mass noun. When perception is denoted as a mass noun, it means *'the ability to see, hear, or become aware through the senses* (as in human perception or the perception of pain)*,'* which is inappropriate for the contexts of this research.

Attitude, on the other hand, is a settled way of thinking or feeling about something (The Oxford Dictionary of English 2005), i.e. the thinking or feeling about propositions related to GBL practice and collaboration. Similar to 'perception', the term 'attitude' is adopted as a count noun throughout this thesis.

The perceptions and attitudes of two kinds of experts were collected and analysed; herewith is a description of who these experts are and how the terms ‘SMEs’ and ‘game experts’ were selected to represent research participants.

SMEs are professionals with expertise in the field of education but usually without technical game production knowledge. They know how subject matter should be structured to ensure learning. Three types of SMEs participated in this research, namely school teachers, Postgraduate Certificate in Education (PGCE) trainee teachers, and academics in higher education.

Game experts are professionals with expertise in the field of game production. They can be broadly classified based on the nature of games they produce, such as leisure games and serious games, and each of the game types can be further subdivided into other categories based on the contexts where the games are played or used (see Section 2.4.2 in Chapter 2 for more explanation). The game experts who joined this research were those who work in commercial games or educational games studios, doctoral researchers or academics who study games as a subject of interest, and undergraduate students who develop games as independent game developers (commonly known as ‘indies’ in the game industry) or as part of their coursework. Indies are game developers who do not *‘receive money from a game publisher to create their games* (Michael 2003, p. xvii);’ whereas game developers are individuals or businesses that produce games. In this specific context, a game is a piece of software and the game developers are in fact software developers. The term ‘game developers’ was not used to denote game experts because some professionals who work in the game industry are not software developers, for example, game designers, animators, sound engineers, playtesters, etc. Furthermore, game production involves pre-production, production and post-production processes; treating a game as a piece of software only begins in the game programming task of the production process. As a result the notion of ‘game experts’ was chosen to reflect the actual scenario in the game industry.

The field of game production is commonly known as the game industry. The term ‘industry’ was originally defined as a particular form or branch of economic or commercial activity, which is concerned with *‘the processing of raw materials and*

manufacture of goods in factories (The Oxford Dictionary of English 2005).' Therefore, the game industry is the branch of economic and commercial activity that is concerned with the production of games in studios and the distribution of games through publishers. The game industry is a subset of the creative industries, which are those industries that focus on *'creating and exploiting intellectual property or providing creative services for business* (A Dictionary of Geography 2009).'

1.5 In search of a key research question

> *'Research solves problems by answering questions objectively, but the questions have to be the right ones! Evolving the "right" questions is often the most difficult part of research.'*
>
> *Richardson 2005*

When this research was officially embarked on in March 2008, the research question was 'how to enhance the effectiveness and efficiency of e-learning using computer games'. E-games were presumed at that time to be a potential component of e-learning which can definitely enhance the effectiveness and efficiency of learning. This presumption was challenged and collapsed as the preliminary literature review (Tan, Johnston-Wilder & Neill 2008; Tan, Johnston-Wilder & Neill 2010; Tan, Neill & Johnston-Wilder 2009; Tan & Xu 2009) indicated the following:

- GBL has emerged as a field of academic study of its own in the UK, thus the research should focus on GBL rather than e-learning, which is relatively general in term of research scope.
- There are two types of GBL literature—academic research publications and game experts' writing on game productions.
- There were concepts related to GBL which were not well defined and classified, causing miscommunication and misunderstanding among people involved in GBL practices.
- There were unsolved issues associated with the use of games in formal education, therefore it is necessarily to identify these issues and select the ones that are pragmatic to teachers, GBL researchers and game experts,

before any attempt at enhancing learning through games becomes practical.

While keeping abreast with the up-to-date GBL literature, three exploratory studies were conducted, aiming to identify the key research questions for this research (described further in Chapter 5). A major conclusion of these studies was that there was a discrepancy in the perceived potential of games between trainee teachers, game experts and advanced learners. After synthesizing the findings of these studies, the perceptions of SMEs and game experts about the following issues were recognised as important for the deployment of, and collaboration in, GBL and were worth further research:

- Differing attitudes of teachers who use games in teaching.
- Differing attitudes within studios that produce games for use in formal education contexts.
- How SMEs and game experts could collaborate to design and develop games for use in formal education contexts.

The key research question derived from the third issue, because the perceptions of the first two issues were conjectured to contribute to the experts' understanding of how GBL collaboration could be realised.

1.6 The research aim and research outcomes

The aim of this research is to investigate how SMEs and game experts could collaborate to design and develop games for use in formal education contexts. A research aim is defined as one indispensable potential result plus important constraints (Richardson 2005). Richardson's (2005) model of defining a research aim was also used to verify the practicality and feasibility of the research aim. Once an aim was set, a research work breakdown structure was created, which consists of a list of research outcomes. These outcomes were then arranged and presented in a hierarchical chart (see Figure 1.1). The function of these analyses was to develop task-oriented and measurable research outcomes. Further, the practicality of these outcomes was verified at the outset through Drucker's (1989) SMART (specific, measurable, achievable, result-oriented and time-bound) evaluation.

1.7 Thesis structure

This thesis contains nine chapters. Chapter 1 is the introduction, which presents the context of this research and defines key terms and the aim of this thesis. Chapter 2 analyses various concepts related to GBL and seeks to identify appropriate ones for issues concerning formal education. Chapter 3 reviews the literature on GBL to depict the contemporary research and development associated with GBL. Chapter 4 explains the research design and methodology used. Chapter 5, 6 & 7 present the research findings. Chapter 5 synthesizes the outcomes of three exploratory studies; Chapter 6 presents results of the statistical analysis of two questionnaire surveys; and Chapter 7 indicates the findings of an explanatory study which was drawn from a collection of interviews with SMEs and game experts. Chapter 8 discusses how the overall findings answered the research questions, offering possible explanations which are dissimilar to the literature. Chapter 9 concludes the research, and includes an account of involvement in a game project to justify the ecological validity and trustworthiness of the research findings. The conclusions also cover the contributions and limitations of the thesis and implications for further research.

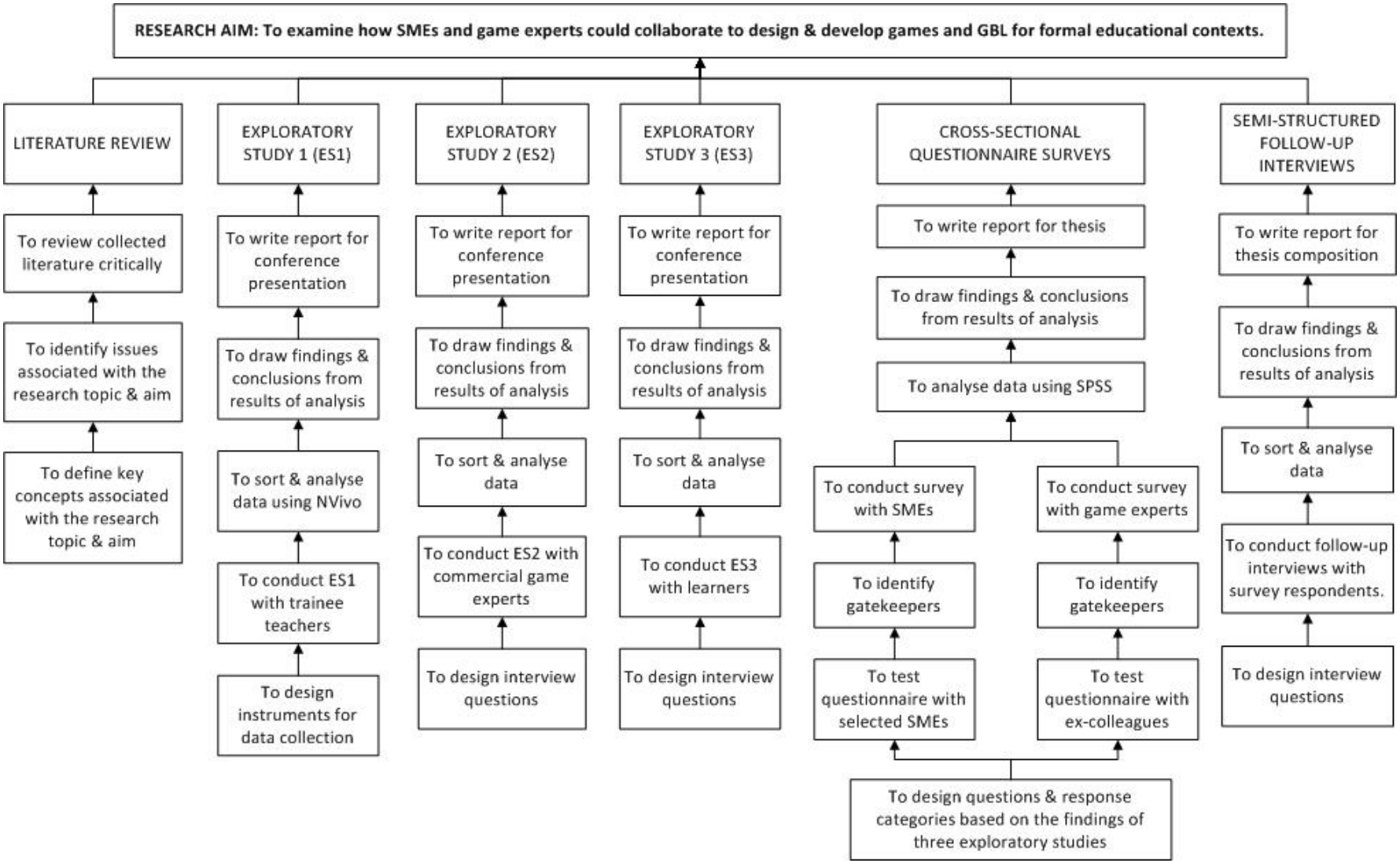


Figure 1.1: Research outcomes articulated for this research

CHAPTER 2: CONCEPTS ASSOCIATED WITH GBL

2.0 Introduction

This chapter examines concepts associated with GBL. The aim of the chapter is twofold: to juxtapose and compare the meanings of key concepts found in dictionaries and the perceived understanding of those concepts held by academics and game experts in the literature; and to recognise how these concepts shape the use of games in formal educational contexts.

Concept is a mental construct of a group or class of objects, which may be abstract or concrete, seen as mediating between a term and whatever it denotes or is used to refer to (The Concise Oxford Dictionary of Linguistics 2007). It determines the application of a term, thus plays a part in the use of reason or language (The Oxford Dictionary of English 2005). Having a concept means being able to express a term in making judgement, i.e. connecting a term with the group or class of objects when the term is applied, and understanding the consequences of its application (The Oxford Dictionary of Philosophy 2008). A concept is formed through *'exposure to examples of items that belong to the concept category and items that do not belong to it'*—a process that involves *'learning to distinguish and recognise the relevant attributes according to which items are classified and the rules governing the combination of relevant attributes* (A Dictionary of Psychology 2009).' Therefore, identifying key concepts and then juxtaposing and comparing the meanings of these concepts are essential tasks for constructing a foundation in academic research into GBL.

Key concepts and terms associated with this research are divided into three levels. As shown in Figure 2.1, the first level consists of the definitions and elements of games, plus explanation of how other concepts, such as play, game playing, gameplay, game design, simulations, simulation games, fun and engagement are linked to games. The second level focuses on electronic games or e-games; explaining how e-games inherit the essence of modern technology which differentiates them from traditional games. Synonymous and ambiguous terms like video games, digital games, leisure and serious games are discussed alongside with the genre of e-games. The third level is about how e-games are used in education,

where the concept of game-based learning (GBL) is re-introduced with three extended definitions, which involves seeing games used as learning media, games used as learning technology, and a combination of both. This research positions GBL as a form of educational approach which could embrace the dual-role played by e-games in education. The relationship between GBL and e-learning, game-based e-learning and learn-based gaming are also briefly discussed. The last section of this chapter explains the genesis of the definition of GBL adapted for this research, and how and why GBL is highlighted as a form of learner-centred learning. Apart from referring to academic literature and game experts' writings, Oxford Reference Online or ORO was chosen as the main reference for defining the concepts related to GBL in all three levels (ORO 2010).

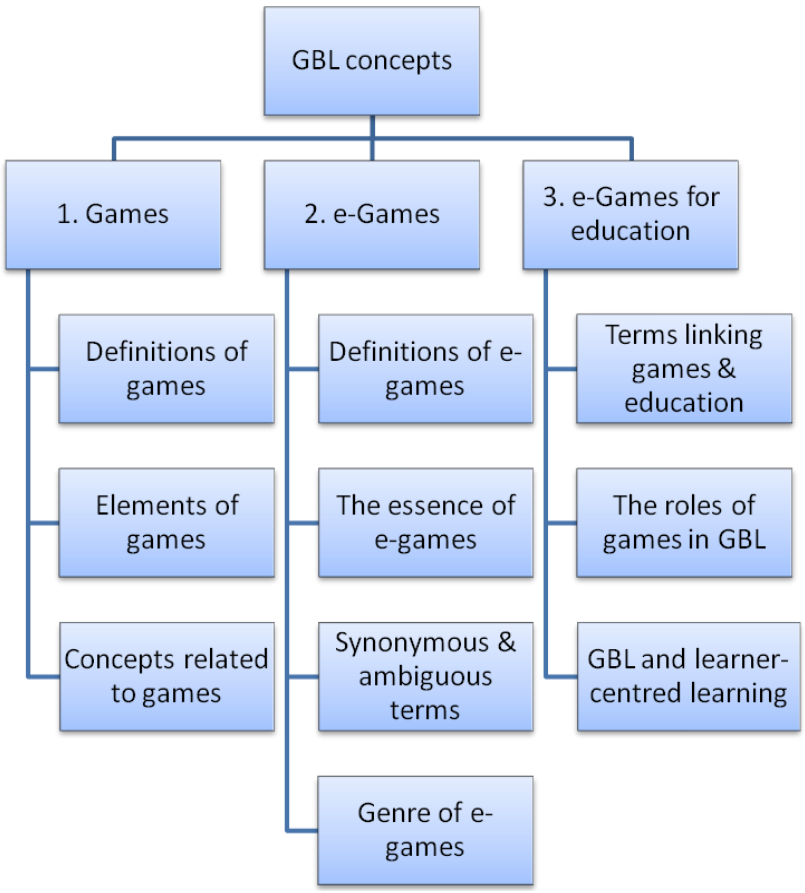


Figure 2.1: The hierarchical association of key concepts and terms in this research

2.1 Definitions of ‘game’

The definitions of *game* were studied through analysis and synthesis of meanings gathered from ORO (2010). These meanings of ‘game’ were regarded as analytic propositions. An analytic proposition is one that is true by definition, hence definitional truths (Tiles 1987).

According to the Oxford Dictionary of Word Origin (ORO 2010), *‘amusement, fun, or pleasure’* were the original meanings of game, dating back to Old English. It was a form of *‘sport derived from the chase, hence wild animals pursued for sport* (The Concise Oxford Dictionary of English Etymology 1996).’ In the Oxford Dictionary of Sports Science and Medicine (2007), ‘game’ was defined as *‘a contrived competition experience existing in its own time and space,’* which directed the search for meanings of *‘contrived competition experience’.* Thus from the sports science perspective, games are planned, competitive and experiential in nature.

Collectively, 24 meanings of ‘game’ were extracted from nine English dictionaries and thesauruses in ORO (see Table 2.1). All sources of reference including the earlier definition of ‘wild animals hunted for sport or food’ as part of their meanings used to denote ‘game’ include the concept of rules, reflecting that the conventions of game hunting are related to rules, e.g. the Migration Game Birds Convention Act regulated by the Federal Government of Canada (Environment Canada 2010). Instead of choosing one meaning among the sources, a synthesized meaning is proposed for use in this thesis: an activity, either a form or spell of play or sport, engaged in for amusement, especially an organised, competitive one played according to rules and decided by skill, strength or luck.

A relational diagram has been developed based on the analytic propositions (see Figure 2.2). The concepts defining ‘game’ are divided into primary, secondary and tertiary. While primary and secondary concepts are deduced from the meaning of ‘game’ extracted from ORO, the tertiary concepts are proposed based on intuitive interpretation of the primary and secondary concepts.

Table 2.1: Meanings of the word ‘game’ extracted from Oxford English dictionaries and thesauruses

Meanings	Source	*f*
1. Wild animals hunted for sport or food; the flesh of these animals, used as food (A7 = wild fowl, prey, big game).	A–I	9
2. A form or spell of play or sport, esp. a competitive one played according to rules and decided by skill, strength, or luck.	A–F, H	7
3. a single portion of play forming a scoring unit in a match or contest	A–C, E–H	7
4. The equipment or apparatus used in playing a board game, computer game, etc.	A, B, D–F, H	6
5. A meeting for sporting contests, athletic event, esp. track and field.	A–F	6
6. Athletics or sports as a lesson or activity in school.	D–F, H	6
7. One’s level of achievement, performance, standard in a game	A–C, E, F, H	6
8. A piece of fun; jokes; tricks; jest; dodges; practical jokes; prank; hoax	A, E–I	6
9. A scheme or undertaking, regarded as a game	A, E–I	6
10. A type of activity or business, esp. when regarded as a game.	B–D, I	4
11. A winning score in a game; the state of score in a game	A, E, F, H	4
12. A policy or line of action (A1 = game plan).	A, E, F, H	4
13. A hunted animal; a quarry or object of pursuit or attack	A, E, F, H	4
14. An activity engaged in for amusement.	C, D, G	3
15. A complete episode or period of play, ending in a definite result.	B–E	3
16. An diversion, pastime, entertainment, recreation, distraction	A, G, I	3
17. A kept flock of swans	E, F	2
18. A person’s method or style of play	A, B	2
19. A secret and clever plan or trick	B, D	2
20. Match, tournament, round, bout	G, I	2
21. Business, line, occupation, trade, profession, industry, enterprise, activity, calling	G	1
22. Plot, ploy, stratagem, strategy, cunning plan, tactics, artifice, device, manoeuvre	G	1
23. An instance of deception or psychological manipulation	A	1

A = The Canadian Oxford Dictionary; B = The New Oxford American Dictionary; C = OED;
D = The Concise Oxford English Dictionary; E = The Australian Oxford Dictionary;
F = The New Zealand Oxford Dictionary; G = The Oxford American Thesaurus of Current English;
H = The Oxford American Dictionary of Current English; I = The Oxford Paperback Thesaurus.

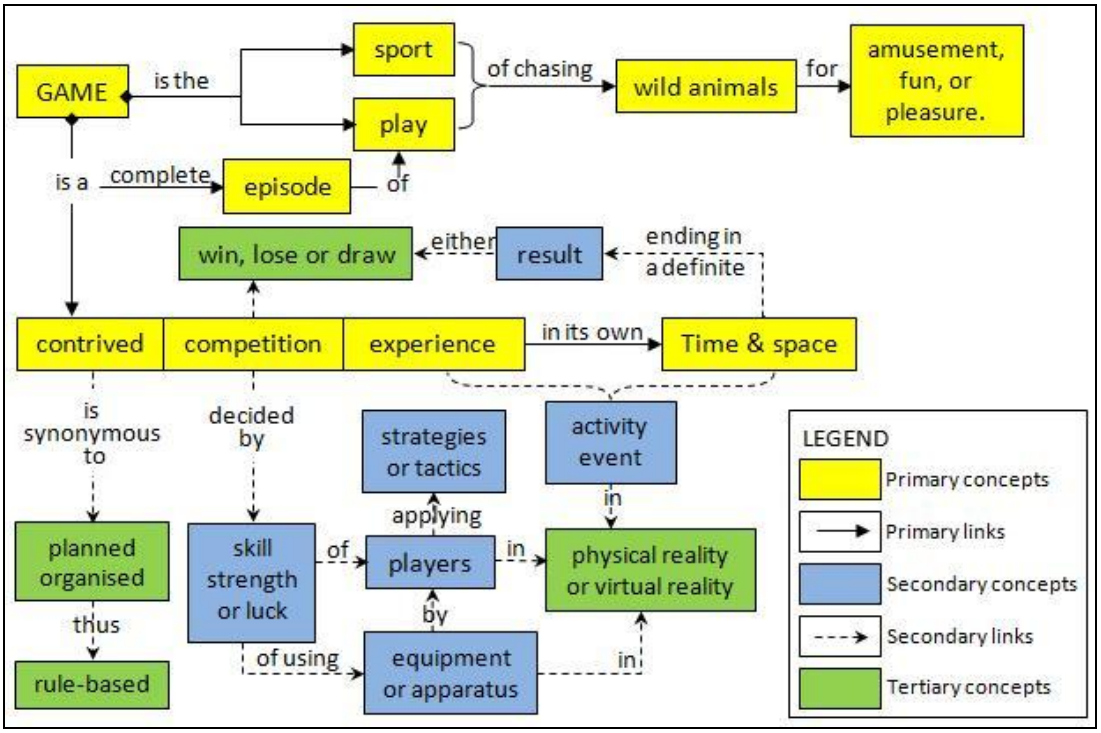


Figure 2.2: Primary, secondary and tertiary concepts related to ‘game’

2.2 Elements of games

When attempting to justify why games engage human beings in the form of fun and play, Prensky (2007) suggested six key structural elements of games: rules, goals and objectives, outcomes and feedback, problems, interaction, and representation or story (see Table 2.2). The first three were seen as the classic elements and the latter three were considered as additional elements, especially for the structure of e-games. Prensky’s (2007) linked the three classic elements to form a triangulated structure, in which he used the structure to differentiate games from other form of interactive activities, such as free or spontaneous play, toy and simulations. As shown in Figure 2.3, this structure is very similar to the fundamental structure of learning in formal education, which could be revealed by replacing the core of the structure—games—by ‘learning’. This is Prensky’s agenda in highlighting the potential and value of games in education and training, which promotes his ideal form of ‘digital game-based learning’.

Table 2.2: The characteristics of the key structural elements of games, adapted from Prensky (2007, p. 119–124)

Elements		Characteristics
Classic games	Rules	Games are rule-based, hence organised play. Rules differentiate games from free or spontaneous play. The limits imposed by rules force players to take specific paths to reach goals and ensure that all players take the same paths, which also draw the boundary between inside and outside of a game world.
	Outcomes and feedback	Outcomes and feedback are the mechanism in which players measure their progress against the goals. The outcome is the win-lose state of play; while feedback occurs when something in the game changes in response to what players do, hence making game playing interactive. It is from the feedback in a game that learning takes place. This includes learning how the game works, what the game designer's underlying model is, how to succeed and win. Through feedback, players either get rewarded for mastering something or they get word that they have failed at something, and have to try again or seek help, until they can do it. The goal of feedback is to enhance players' experience and move them along in the game.
	Goal or objectives	Games are goal-oriented. Goals or objectives differentiate games from toys, which are a form of non-goal-oriented play. The goal is often stated at the beginning of the rules, which requires players to devise strategies for achieving despite being limited by the rules. The process of achieving the goal within the rule-based conditions makes most of the players enjoy game playing.
e-games	Problems	Conflict, competition, challenge and oppositions are four forms of problems in e-games players try to solve in safe and non-threatening conditions. In e-games, players can set their level of difficulty—a unique feature compared to classic games. Keeping the level of problem in synch with the player's skills and progress is called 'balancing' in game design.
	Interaction	There are two aspects of interaction in game playing. The first is the interaction of the player and the computer, which is a key element in classic e-games. The second is the inherently social aspect of games, involving one player with another, hence multiplayer.
	Representation	A game is about something, abstract or concrete, direct or indirect. Representation includes narrative, story or fantasy elements in the game.

Besides Prensky's (2007) structural view of games' elements, Roger Caillois suggested six characteristics of games from a sociological perspective (Caillois 1961), which are: fun, separated in time and place, uncertain, non-productive, governed by rules, and fictitious. The fundamental similarity of these two sets of elements lies on the functional role of fun in a rule-based environment. Fun is seen as the key factor that drives human beings to play games. The uncertain nature of game playing enriched Prensky's elaboration on the outcome and feedback of games. However, the non-productive and fictitious characteristics of games become the

unique features of Caillois' social perspective on games. This could be interpreted as- game playing does not accomplish anything useful (in the short term) because players are aware of the fictional reality when playing games. In the long term the skills learnt from games can be applied to real challenges.

Figure 2.3: The classic key structural elements of games proposed by Prensky (2007)

Caillois' view of games as social activity was echoed by Berne (1964), who analysed games from a psychological perspective (see Table 2.3). In Berne's (1964) classification of human behaviour, games were positioned as the third class of human behaviours, which are socially programmed, partly exteropsychic—*'a portion of the external world that has become an integral part of the internal world* (Erskine 2002)*.'* Other behaviours under the same order include pastimes, operations and manoeuvres and intimacy; but two unique characteristics: the ulterior quality and the pay-off, differentiate games from others (Berne 1964). Psychologically speaking, *'a game is an ongoing series of complementary ulterior transactions progressing to a well-defined, predictable outcome'* (Berne 1964). According to Berne (1964), a typical game has nine elements: thesis, antithesis, aim, roles, dynamics, examples, transactional paradigm, moves, and advantages. This set of elements was meant for analysing the psychology of human relationships. Despite its targeting to general

readers, Berne's (1964) *Games People Play: the Psychology of Human Relationships* contained many psychological jargon terms in describing the nature of games, thus the elements are more appropriate to use in psychological studies, rather than education.

Table 2.3: The characteristics of the elements of games, adapted from Berne (1964, p. 48–52)

Elements	Characteristics
Thesis	A general description of the game, including the immediate sequence of events and information about their psychological background, evolution and significance.
Antithesis	The presumption that a certain sequence constitutes a game, which is tentative until it has been existentially validated. This validation is tested by a refusal to play or by undercutting the payoff. For clear understanding of a game, the antithesis should be known and its effectiveness demonstrated in practice.
Aim	A statement of the general purpose of the game, which sometimes may have alternatives.
Roles	A way to describe games: two-handed, three-handed, many-handed, etc., according to the number of roles offered. Sometimes the ego state of each player corresponds to the role, sometimes it does not.
Dynamics	The psychodynamic driving forces behind each case of a game. There are alternatives in stating dynamics, but it is usually possible to pick out a single psychodynamic concept which usefully, aptly and meaningfully characterises the situation.
Examples	Cognates which are worth-while to search for in making formal descriptions of games. The cognates could be the childhood origin of a game, or its infantile prototypes that are instructive to study.
Transactional paradigm	A paradigm where the transactional analysis of a typical situation is presented, giving both the social and psychological levels of revealing ulterior transaction.
Moves	Elements of a game that correspond roughly to the strokes in a ritual. As in any game, the players become increasingly adept with practice. Wasteful moves are eliminated, and more and more purpose is condensed into each move.
Advantages	The general advantages of a game consist in its stabilising or homeostatic functions. Biological homeostasis is promoted by the stroking, and psychological stability is reinforced by the confirmation of position. The advantages are further divided into internal psychological advantage that has a direct effect on the psychic economy (libido); external psychological advantage which is the avoidance of the feared situation by playing the game; internal social advantage that is designated by the name of the game as it is played in the individual's intimate circle; and external social advantage which is designated by the use made of the situation in outside social contacts.

Another set of games' elements which are also discipline-specific is linked to the game theory developed by mathematician John von Neumman and economist Oskar Morgenstern (1944). Game theory is the branch of mathematics concerned with the analysis of strategies for dealing with competitive situations where the outcome of a participant's choice of action depends critically on the actions of other participants

(ORO 2005). The theory has been further studied and applied in disciplines beyond mathematics and economics, such as the study of convention in philosophy (Lewis 1969; Skyrms 1996), evolutionary biology and ecology (Maynard Smith & Harper 2003; Maynard Smith & Price 1973), interactive computation modelling in computer science (Goldin, Smolka, & Wegner 2006), and voting systems in political science (Brams 1976). Interestingly, some philosophers or ideologists were regarded as game theorists although their work ceased long before the field of game theory came into being in 1944. The ideas of game theory were 'seriously' included in Thucydides' *History of the Peloponnesian War* and Plato's *Republic: the Challenge to Socrates* (Stanford Encyclopedia of Philosophy 2010); Sun Tzu's *The Art of War* (Tao 2006); Wang Chan's 鬼谷子(*Gui Gu Zi*, a classic text of Taoism) (Mei 2006) and Niccolò Machiavelli's *The Prince* (Binmore *et al.* 1993, p. 23).

Some contemporary GBL researchers stress that game theory should not be confused with games studies, particularly in games for use in education and training. Simon (2007) argued that *'game theory and games studies obviously hardly ever met,'* because game theory *'is very much interested in games with outcomes that have very serious non-negotiable consequences.'* Based on this argument, the singular 'game' in 'game theory' was limited to refer to the mathematical-logical studies of games, while the plural 'games' in 'games studies' refer to the humanities based research of games (Simons 2007). However, this avoidance approach may prompt more arguments rather than clarifying the overlapping situations as it would be unreasonable to deny that the notions of 'game' in game theory and game playing or even in GBL share common characteristics. This thesis attempts to clarify, instead of diffusing, the similarities and differences by analysing why game theory was coined as game theory, i.e. what elements of games exist in a typical game of the theory to qualify its use of the notion 'game'. Straffin (1993) studied the nature of games in game theory and listed four components possessed by a typical game in game theory (see Table 2.4).

Table 2.4: The explanation of game components in game theory, proposed by Straffin (1993, p. 3)

Components	Explanation
Player	An entity who makes a choice in a game or who receives a payoff from the outcome of those choices. There are at least two players, but the entity does not have to be human being.
Strategies	Courses of action which each player may choose to follow in a game.
Outcome	The outcome of the game is determined by the strategies chosen by each player.
Payoffs	A collection of numerical representation associated with each possible outcome of the game, one to each player. These payoffs represent the value of the outcome to the different players.

In terms of interactivity, the game in game theory is either sequential or simultaneous, which are two types, each of many moves, that could be taken by players as feedback in the structure of a classic game, as proposed by Prensky (2007). The emphasis on goal or objectives orientation in game theory is limited to achieving either zero-sum (where gain to one player is loss to another) or non-zero-sum (where both or all players can gain or lose simultaneously) outcome. These limitations are indeed reflecting the 'rule-based' nature of classic games. As a result, a typical game in the game theory is not contradictory to the essence of classic games; it is just the rules of the game that are set to suit specific game playing contexts, and the playing is focusing on the strategies' deployment and the payoffs, rather than winning the game. Therefore, game theory could be a theory applicable to game playing if the conditions of the playing meet the rules set by the theory. In other words, discarding game theory from games studies is actually a non-issue.

2.3 Other concepts related to games

As shown in Figure 2.1, concepts related to games can be grouped according to their hierarchical linkage with the 'game'. Some of these concepts, particularly play, game playing, gameplay, game design, simulations, fun and engagement are synonymous or ambiguous to games across various disciplines and in day-to-day life. For example, Crawford (2003) saw games as a form of creative expression and attempted to differentiate games and non-games from this point of view (see Figure 2.4). However, Crawford's (2003) taxonomy does not fit the classic structural elements of games adopted by this research, because the structural view indicates that games do not require direct challenges from others. In other words, puzzles and competitions are also regarded as games in this thesis. The inclusion of Crawford's diagram in this

chapter was not meant to prove whether a perception is better or worse than others, instead it demonstrates the presence of multiple perspectives on games and other concepts related to games. Acknowledging this vision is important before juxtaposing concepts related to games. The intention of this juxtaposition is to expose the relationship among these concepts in relation to games.

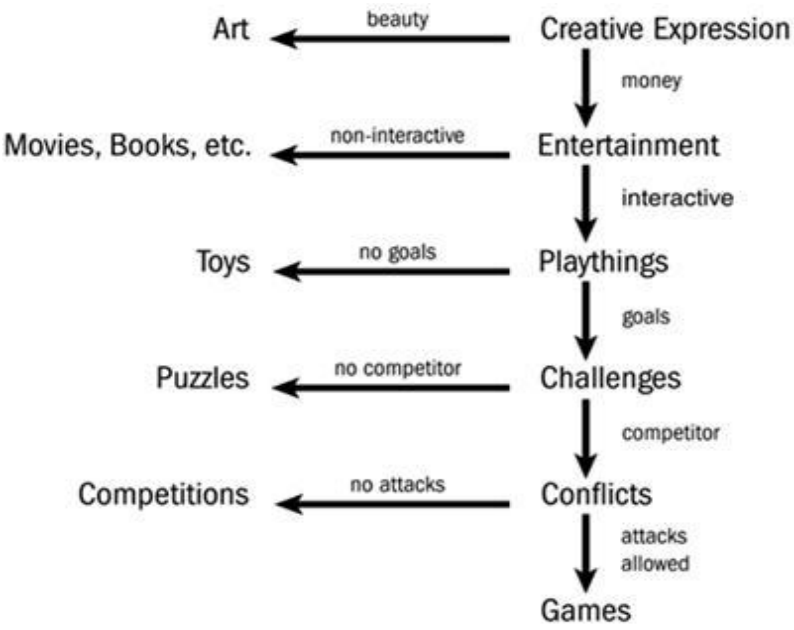


Figure 2.4: Crawford's (2003) taxonomy of creative expression

2.3.1 Play and game playing

Games are just one form of play. Apart from games, there are other forms of play such as role play, drama, toy play, simulations, etc. Figure 2.5 shows the hierarchical relationship between play and game, a diagram adapted by Prensky (2007) from Encyclopaedia Britannica.

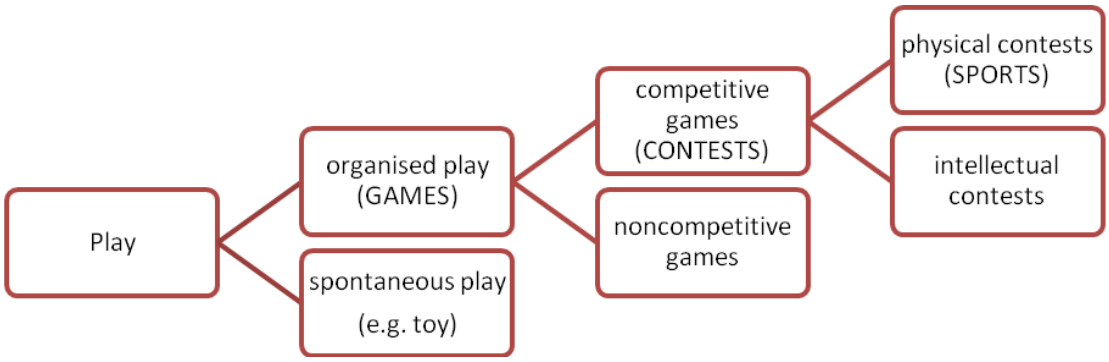


Figure 2.5: Prensky's (2007) positioning of games as a form of play

Huizinga (1949, p. 13) attempted to define play in his Homo Ludens:

> *'…[play is] a free activity standing quite consciously outside 'ordinary' life as being 'not serious,' but at the same time absorbing the player intensely and utterly. It is an activity connected with no material interest, and no profit can be gained by it. It proceeds within its own proper boundaries of time and space according to fixed rules and in an orderly manner. It promotes the formation of social groupings which tend to surround themselves with secrecy and to stress their difference from the common world by disguise or other means.'*

Despite being an anthropological meaning, the definition covers a limited type of play for specific purposes. As Caillois (1961) criticised it for being *'too broad and too narrow'* at the same time. After identifying the pitfalls of the definition, Caillois offered another version—an activity that has six essential qualities: free, separate, uncertain, unproductive, governed by rules, and make believe. In addition, four rubrics of play were proposed to cover only fundamental types of play, and the rubrics were actually named as the classification of games (see Figure 2.6).

	AGÔN (Competition)	ALEA (Chance)	MIMICRY (Simulation)	ILINX (Vertigo)
PAIDIA Tumult Agitation Immoderate laughter	Racing, Wrestling, Etc. } not regulated Athletics	Counting-out rhymes Heads or tails	Children's initiations Games of illusion Tag, Arms Masks, Disguises	Children "whirling" Horseback riding Swinging Waltzing
Kite-flying Solitaire Patience Crossword puzzles	Boxing, Billiards Fencing, Checkers Football, Chess	Betting Roulette		Volador Traveling carnivals Skiing Mountain climbing Tightrope walking
LUDUS	Contests, Sports in general	Simple, complex, and continuing lotteries*	Theater Spectacles in general	

Figure 2.6: Caillois' (1961) four rubrics of play

In contrast to Caillois' mixture of positive and negative qualities, Jaffé (2006) insisted that 'the innate ability to play is essential for the emotional, physical and intellectual development of children,'…and through play, 'children are able to explore, understand and interpret the environment around them and their inner,

imaginative worlds.' Nevertheless, the mixed views of playing have been extended to people's perceptions on game playing, which this research attempted to explore.

2.3.2 Gameplay and game design

While game playing is a form of activity, gameplay is not—it is a technical term used frequently by game designers (Rollings & Adams 2003). Adams (2010) defined gameplay as *'the heart of the player's mental experience of a game,'* (p. 11) which consists of *'the challenge that a player must face to arrive at the object of the game, and the actions that the player is permitted to take to address those challenges.'* In other words, the relationship between the challenge and the action is the essence of gameplay.

The design of games, in the sense of gameplay, involves the design of challenges, which could be either implicit or explicit. According to Rollings and Adams (2003), an explicit challenge is an intentional challenge specifically designed by the game designer; while an implicit challenge is one that is not specifically designed in, which forms the emergent feature of the game. The characteristics of both implicit and explicit challenges could either be pure, applied or conceptual (Rollings & Adams 2003). Table 2.5 shows how gameplay is characterised based on the types of challenges involved in game design. This method of categorising games has formed loose but pragmatic e-game genres, which will be further discussed in Section 2.4.2. The delineation between explicit and implicit challenge is important to differentiate simulations and simulation games, which will be discussed in Section 2.3.3.

Table 2.5: Characteristics of gameplay and types of challenges, summarised from Rollings and Adams (2003)

Characteristics of gameplay	**Types of challenges**	
Pure challenge	Logic and inference Lateral-thinking Memory Intelligence-based Knowledge-based Pattern-recognition	Moral Spatial-awareness Coordination Reflex/reaction time Physical
Applied challenge	Races Puzzles Exploration	Conflict Economies
Conceptual challenge	N/A	

Besides examining the nature of gameplay, Adams (2010) studied the elements of game design and proposed three key components: the core mechanics, interactivity and storytelling. The terms ‘core mechanics’ and ‘gameplay’ are sometimes being used interchangeably to represent a computer programming term ‘game mechanics’.

After comparing six definitions of game mechanics (see Bjork & Holopainen 2005; Cook 2006; Hunicke, LeBlanc, & Zubek 2004; Järvinen 2008; Lundgren & Björk 2003; Rouse & Ogden 2005) and also ‘game procedures’ (see Fullerton, Swain, & Hoffman 2004), Sicart (2008) defined game mechanics as *‘the methods invoked by agents, designed for interaction with the game state*’—an attempt he claimed to relate rules and challenges in game design to computer science. Sicart’s (2008) technical view and Adams’ (2010) experiential perspective are in fact two faces of the same coin in the sense of game design.

While both concepts of gameplay and game mechanics are still disputed by academics and game experts, the term ‘core mechanics’ is less disputable as it basically means the rules that define the operation of the game world (Rollings & Adams 2003). In fact, many game designers just denote it as ‘the rules’ for pragmatic reasons. In the eyes of game designers, the setting of rules is the key factor that determines the quality of a game. If a game designer intends to turn a game into an e-game, computer programming knowledge is essential. The major task of programmers is translating the rules from human languages into programming language which is understandable by computers. In this sense, a game designer who cannot program has to rely on programmers to convert a game into an e-game.

2.3.3 Simulations and simulation games

The terms *simulations*, *games* and *simulation games* were indeed some of the most confusing concepts in the study of games. Jones (1995) regarded all these concepts as interactive methodologies. In the attempt to differentiate six modes of thought and behaviour, Jones (1995, p. 18) made the following descriptions for *simulation* and *games*:

> *‘a simulation is an event in which the participants have functional roles, duties and sufficient key information about the problems to carry out these duties without play acting or inventing key facts;…whatever the motive for*

running a game, all the participants are in one role—players. As players, they have a duty to try to win and a scoring mechanism is provided to enable them to ascertain winners and losers.'

Abt (1970) elaborated a vivid relationship between simulations and games, by giving two examples:

'While all games simulate something from the real world, not all simulations are games. For example, computerised simulations of traffic flow or chemical reactions are not games because their outcomes, while complex to calculate, are predetermined, and there is not winning or losing outcome, only a set of results.'

With reference to the US Department of Defense definition (1997, p. 160), Hays (2006) compared the nature of simulations and games. He concluded that all simulations are based on models of reality, in which the models were implemented over time to *'provide the rules and data that are used to represent some portions of reality'* (Hays 2006, p. 252). A specific type of simulation called 'microworld' was used as an example that reflects that definition. Microworlds are simulations that attempt to capture the relevant aspects of some topic or phenomenon so learners can interact within it to observe the effects of their interactions (Miller, Lehman, & Koedinger 1999).

Meanwhile, simulations are technically seen as toys (Prensky 2007, p. 125), which are *'interactions that have neither goals nor objectives,'* while Jeffé (2006, p. 13) defined toy as plaything, an object to be played with. In other words, a toy or a simulation can be turned into a game by setting or imposing goals or objectives on it. Conversely, when the goal or objective structure is removed from a game, the game becomes a simulation or a toy.

As for 'simulation games', Jones (1995, p. 19) criticised the term as being confused and contradictory; he regarded it as a form of ambivalent—any *'interactive event that is incompatible and conflicting methodologies operate simultaneously.'* However, to certain e-game developers, there is a specific genre of games called simulation games, which exist concurrently with simulations. A simulation game

should have an explicit cost/benefit challenge, which includes consideration of aims, cost and, opportunity cost to achieve the aims, reward gained through accomplishment of the aims and punishment received after failing to achieve the aims. Without such an explicit challenge, a program is regarded by game developers as a simulation, although simulation in the outside world is understood to have a similar implicit cost/benefit structure (Hays 2006). When a program is treated as a simulation rather than simulation game, the gameplay will be geared towards virtual reality exploration but the players will be given the liberty to ignore any cost/benefit challenge, thus leading players to perceive the simulation as having no cost/benefit challenge at all. Meanwhile, if a program is designed as a simulation game, the gameplay would include explicit aims and a cost/benefit structure. In this case, players need to take the cost/benefit structure seriously if they intend to achieve the aims.

Both simulations and simulation games could be used in GBL. The success or failure of the GBL in using either one of them depends on the seriousness of players' involvement. To acquire a positive attitude, knowledge or skills in the GBL environment, learners ought to be directed or guided to be serious in the game playing process.

2.3.4 Fun and engagement

Despite the nature of its meaning, fun is a serious concept in game production. A profession called 'playtesting' is dedicated to ensure game playing is fun (Fullerton *et al.* 2004). Most game designers regard fun as the key factor that a game needs to engage players. Koster (2005) proposed a theory of fun for game design and defined a good game as *'one that teaches everything it has to offer before the player stops playing.'* He regards games as teachers, and fun is just another word for learning. Barwood (2000) supports the theory by organising all the varied emotions a game can produce under the heading of 'fun'. He claimed that a fun game makes for a pleasurable experience, which is why people play. Despite the number of supporters fun has, there are game designers who challenge its usefulness in game production, including Chris Crawford, the 'grand old man' of computer game design:

'Fun is a misleading word to be using just yet. It is a semantic chameleon, changing its meaning in each new context. I continue to use the word informally and loosely, but I never use that word in serious design analysis. Games don't have to be fun to provide entertainment, rewarding play, or just nice feelings. Condemning a game as 'not fun' is about as useful as calling it 'crummy'; it expresses an emotional reaction but offers absolutely nothing that you can get your hands on. Let's banish this term from our serious game design discussions.'

(Crawford 2003)

Fun is merely a stand-in term for a more complex phenomenon that no one really understands. Crawford also proposes the following typology which lists eight categories of pleasure players derive from game playing as an antidote to the concept of fun:

- sensation: game as sense-pleasure,
- fantasy: game as make-believe,
- narrative: game as drama,
- challenge: game as obstacle course,
- fellowship: game as social framework,
- discovery: game as uncharted territory,
- expression: game as self-discovery, and
- submission: game as masochism.

This research holds a positive view toward the term 'fun' in both learning and game playing. It is regarded as a key factor which engages the learning materials and learners. This perception is supported by many GBL researchers who study the potential of games in motivating learners (see Read, MacFarlance, & Casey 2002).

To 'engage' means to attach by pleasing qualities; to attract, charm or fascinate (The Oxford Dictionary of English 2005). In game playing, there is a state called 'flow'

that depicts the conditions of an engaged player (Kii 2009). Csíkszentmihályi (1991, p. 40) described flow as *'the optimal experience in which attention can be freely invested to achieve a person's goal, because there is no disorder to straighten out, no threat for the self to defend against.'* When flow occurs, '*players would have intense concentration, often to the point where previously difficult tasks become easy and whatever they are doing becomes enormously pleasurable.'* (Prensky 2007, p. 124) Meanwhile, there is another view on defining 'engaging' in academia. O'Brien and Toms (2008) define engagement as the ability of a computer application to initiate and sustain users' attention and interest over a period of time by providing adequate levels of aesthetic and sensory appeal, feedback, challenge, control, novelty, customization, and motivation. The view, treating engagement as a scale, contradicts with the belief held by practitioners in the creative industry, who regard engagement as a state (Tan *et al.* 2008).

2.4 Electronic games (e-games)

Electronic games or e-games are any interactive games operated by computer circuitry (Encyclopædia Britannica Online 2010). The emergence of e-games was the outcome of the affinity between games and computers. This relationship, as described by Juul (2005), allows traditional games to have a home on computers. In turns, the computer allows new game forms to appear, hence the genesis of e-games.

The machines, or 'platforms', on which e-games are played include general-purpose shared and personal computers, arcade consoles, video consoles connected to home television sets, and handheld game machines (Encyclopædia Britannica Online 2010). Thus, e-games are actually computer software or applications which are written or programmed to be operated by computer circuitry. Since, the computer circuitry is electronic in nature, e-games are also known as computer games. The term 'computer' used here means digital computer, therefore the term 'digital games' is also widely used to mean 'e-games'. Another popular synonymous term is 'video games'. The term 'video games' can be used to represent the totality of these formats, or it can refer more specifically only to games played on devices with video displays (Encyclopædia Britannica Online 2010). The commonly used video displays are television, arcade console and computer monitor.

This thesis selects ‘e-games’ (in plural noun form) rather than computer games, digital games or video games to represent all the games that are electronic in nature. Also this is meant to overcome the dilemma faced by the other terms. The term ‘computer games’ has always been used to mean e-games played on a personal computer as opposed to consoles (Juul 2005); while the concept of ‘digital games’ has invited challenges from historians as most of the earlier e-games were actually created and played using analogue-based computers. As for ‘video games’, besides being used constantly to describe console-based games only (Juul 2005), it also excludes some e-games which require no video display—those designed for blind people (e.g. BISCT 2009). ‘E-games’ not only precludes these issues, but also congregates the strengths of those concepts. The concept of e-games becomes one of the optimum forms of electronic technology in modern society, which is the core reason why research into e-games, rather than games in general, had been favoured by many, apart from this thesis.

2.4.1 The essence of e-games

> *‘Those who do not thoroughly comprehend the dangers inherent in employing the army are incapable of truly knowing the potential advantages of military actions.’*
>
> *Sun Tzu (6th century BC)*

Being electronic, e-games have two unique characteristics: transmediality and enframing. These characteristics are both the advantages and disadvantages of e-games, thus comprehending the essence of e-games is crucial before exploiting their potentials in other disciplines, particularly in formal education, which is the context of this research.

The transmediality of games is reflected through the phenomenon that a game can be played in different media (Juul 2005). Juul (2005) used chess and soccer as examples to differentiate two types of transmediality:

> *‘Chess can be played on a board, on a computer, or blind [blindfold chess, aka sans voir]. Soccer can be played as a physical sport or as a video game. Computer chess is an implementation of chess, where everything that can be*

done in normal chess can be done on the computer and vice versa; but computer soccer is an adaptation, because only selected aspects of the sport is included in the video game.'

The incapability of e-games to 'implement' physical games is gradually losing its ground with the advent of innovative computer technology, such as games produced for Nintendo Wii consoles and Microsoft's Project Natal, where players are required to interact physically with artificial intelligence-driven characters and virtual environments in the games. The evolving transmediality of e-games has indeed broadened the boundary of potentials for further exploration and exploitation.

The second characteristic of e-games, enframing or *Gestell* is an inheritance of being a form of electronic technology. In the *Question Concerning Technology*, Heidegger (1977) roots the concept of enframing in *techne*, the etymological origin of 'technology' in Greek. According to Heidegger, everything has an essence which is concealed to human beings. While having the option to accept the concealed, technology provides a means for 'unconcealment', in which the true forms are revealed, granting access to the truth. Heidegger compared the difference between traditional technology and modern technology, and concluded that the essence of modern technology moves beyond 'unconcealment' and becomes 'enframing', which is a challenging-forth of human beings to reveal the truth as ever-present and to use the 'standing-reserve' (*Bestand*) of potentials.

In the contexts of game playing, the essences of games in general are concealed and their potentials are reserved, but because of being 'electronic', e-game players are challenged to reveal the essence and exploit the reserved potentials, which in turn involves revealing the truth perceived by game designers. This essence of e-games has captured the attention of academia since the birth of the first e-game in the 1940s (DeMaria & Wilson 2002). It also prompted the idea of 'serious games', a term coined by Abt (1970), but which only became popular after the launch of the Serious Games Initiative in 2002 (Serious Games Initiative 2008), in which the potential of e-games were and still are exploited for non-entertainment purposes. The gameplay and contents of e-games are tailored to engage specific players, who are students, soldiers, managers, doctors and professionals in other serious entities in real life.

With the rapid advancement of computing technology, particularly in artificial technology (AI) and biotechnology, the authenticity of both physical and virtual reality created for e-games might reach a harmonized stage, where fictional scenes in sci-fi movies like *Artificial Intelligence* (directed by Steven Spielberg in 2001) and *Gamer* (directed by Mark Neveldine and Brian Taylor in 2009) become real scenes of humans' daily living—just like the tagline of *Gamer* says, *'in the near future, you don't live to play…you play to live.'*

Heidegger (1977) thought that the technology may constitute a chance for human beings to enter a new epoch in their relation to being. Indeed, the positive and negative potentials of e-games have created a new era of education with numerous uncertainties that needs careful and in-depth academic studies, and this research intended to make such contribution, specifically in its exploratory stage.

2.4.2 Classification of e-games

Depending on the standpoint of a person, games could be classified in multiple ways. An example of pre-electronic game classification was Caillois's (1961) rubrics of play, in which games were studied as a form of social phenomena. As for e-games specifically, Apperley (2006) compared several types of e-games classification to explore the inherent tension between narratologists and ludologists in media studies. Other common-sensical classifications of games include single-player versus multi-player; console games and computer games; fun or boring games, etc. To fit the purpose of this research, the classification approaches employed by game experts who work in the game industry and academics who study games for educational purposes were examined.

Practitioners in the game industry commonly use 'genre' to categorise e-games and the genres are mainly based on the gameplay challenges as discussed in Section 2.3.2. However, the genres are evolving in accordance to the advancement of social and technological change. Two prominent figures in the game industry, Chris Crawford and Ernest Adams revised their classifications of games over time (see Table 2.6 & Table 2.7). Instead of being more specific in differentiating games according to their gameplay, Crawford synthesized the genres he proposed in 1984 into either electronic or non-electronic games. Also he particularly separated

computer games from video games, although he argued that *'the distinctions have shifted and blurred somewhat'* over time (Crawford 2003, p. 20).

Table 2.6: The change in Chris Crawford's classifications of games over two decades

Publication	*The Art of Computer Game Design (1984)*		*Chris Crawford on Game Design (2003)*
Games' genres	Skill-and-action games - Combat games - Maze games - Sports games - Paddle games - Race games - Miscellaneous games	Strategy games - Adventures - Dungeon & Dragons games - Wargames - Games of chance - Educational & children's games - Interpersonal games	Non-electronic games - Old-style games - Board wargames - Others Electronic games - Video games - Computer games

Building on the basis of Crawford's classification in 1984, Rollings and Adams (2003) adjusted the genres to suit the practices in the game industry in the early 2000s. Seven years later, when Adams (2010) revised the second edition of *Andrew Rollings and Ernest Adams on Game Design*, half of the genres were either changed or removed, while two generic genres—real-world simulations and hybrid games were introduced, as shown in Table 2.7.

Table 2.7: The change in Ernest Adams' classifications of games in recent years

Publication		*Andrew Rollings and Ernest Adams on Game Design (2003)*	*Fundamentals of Game Design (2010)*
Game genres	**Constant**	- Action games - Strategy games - Role-playing games - Adventure games - Puzzle games	- Action games - Strategy games - Role-playing games - Adventure games - Puzzle games
	Changed	- Construction and management **simulations** - Vehicle simulations - Artificial life - Sports games - Online games	- Construction and management **games** - Real-world simulations - Hybrid games

In contrast to game experts' genres, academics tend to classify e-games based on the content rather than gameplay or challenges, hence the birth of 'edutainment' on 2 May 1983, a term used by *Fortune* in the following context (as documented in The Oxford Dictionary of English 2005):

> *'Software specialists believe that the greatest growth may come from so-called "edutainment" games that attempt to make learning fun.'*

Edutainment is an activity or product, especially in the electronic media, intended to be educational as well as enjoyable (The Oxford Dictionary of English 2005). The term was adopted by academia, particularly educationalists, to denote e-games which combine both educational and entertainment contents. An e-game of any genre could be seen as edutainment as long as the game contains educational contents. Due to this overlapping nature between two classification approaches, debates regarding the proportion of educational contents in edutainment broke out among academia, especially after the use of computers and e-games in formal education settings captured the attention of various stakeholders in education. The focus of the debates lay on the emphasis of edutainment on fun—often at the expense of educational content. However, ten years after the creation of the concept, the criticism of edutainment for its ambiguous role and questionable value in education reached a peak, with the re-introduction of 'serious games' in the Serious Games Initiative. Sawyer and Smith compiled a comprehensive 'serious games taxonomy' with the intention to provide a snapshot for the state of the serious games industry in 2008. They argued that *'most labels define a specific output ignoring the larger possibility space for serious games* (Sawyer & Smith 2008)*.'* This thesis echoes their proposition on the basis because *'this implies the possibility space for serious games only equals that specific label* (Sawyer & Smith 2008).' In conjunction with the use of self-explanatory phrases like 'educational games' or 'instructional games' (see Ma, Douglas, Louise, & Charles 2007), 'serious games' are used to represent games in which education is the primary goal, rather than entertainment (Michael & Chen, 2006). Alongside with serious games, the concept of 'leisure games' was created to discriminate e-games used for educational or instructional purposes from those which are not. Being seen as a side-product of serious games, leisure games' characteristics in entertaining human beings are not favoured by certain academics.

Some researchers used serious games interchangeably with GBL (de Freitas 2006). However, such a mutually exclusive classification might disqualify the use of leisure games in formal education. The interchangeable use of serious games and GBL

could also lead to the diffusion if not confusion of how e-games could be used in educational contexts, which will be discussed in the next section.

2.5 e-Games for education

Depending on the learning objectives, e-games can be used as either learning technology or learning media or a combination of both. When a game is used as a form of learning technology, it functions as an entity that delivers specific learning contents. In contrast, if a game is treated as a learning medium, the game itself acts as an entity which holds specific learning contents. In the case study conducted as part of this doctoral research (Tan *et al.* 2009), Spore™ was used as a learning technology to teach deep learning rather than to teach biology, despite the fierce criticism the game received from academia which accused Spore™ for teaching wrong concepts of biology—seeing the game as learning media for biology (Cavanagh 2008; Robertson 2009). No doubt one can argue that media are a form of technology, but such a deconstructive loop of debate might do more harm rather than good for a pragmatic understanding of e-games for education.

As stressed in Chapter 1, GBL is a form of learner-centred learning that uses e-games for educational purposes. In other words, GBL is an educational approach, which could also be seen as a method of delivering learning contents—a view of GBL that overlaps with the function of learning technology. However, such an overlapping view reflects the dual-functionality of e-games, for which three extended definitions of GBL were proposed:

- GBL is a form of learner-centred learning that uses e-games as **learning media** for educational purposes.
- GBL is a form of learner-centred learning that uses e-games as **learning technologies** for educational purposes.
- GBL is a form of learner-centred learning that uses e-games as **both** learning media and learning technology for educational purposes.

Nevertheless, these three extended definitions will only be used in situations where discrimination of the particular function of a specific e-game is crucial; otherwise the generic definition is preferred throughout this thesis.

In the case where e-games were used as learning technology for educational purposes, the instance of such GBL practice is regarded as e-learning. The definition proposed by Tan *et al.* (2005) was updated: e-learning is any use of electronic networks and Internet technology to deliver solutions that aim to enhance the educational process. Some, for example, Gütl *et al.* (2005) preferred to use 'game-based e-learning' to highlight the function of e-games as learning technologies, although the term is relatively less popular as compared to GBL.

When an e-game was specifically produced for use in education, the output of the production will be labelled as 'educational game' or 'educational title'. Sometimes the game was labelled as either 'instructional game' to stress the implicit role of an instructor, or 'courseware' to relate the game to courses delivered via a software program or over the Internet (Mason & Rennie 2006). The problem with defining concepts of games used in education occurred when a game was not dedicated for educational purposes, but was actually used in education. Some described this as *'the use of leisure games in learning,'* (JISC 2007, p. 1) while others just simply regard them as either leisure games or 'commercial-off-the-shelf games' (de Freitas 2006).

This research uses 'learn-based gaming' to represent the practice of using 'learning' as a marketing strategy in commercial game production, for which the focus of e-games is entertaining rather than learning. It is worth reinforcing that learn-based gaming is beyond the concern of this research, since this research is not interested in how to market games (either educational or entertainment games) for use in education. Nevertheless, a section of this research (Section 5.4.1) contributed to the evidence of successful use of entertainment games in formal educational contexts. Other GBL research projects, including Becta (2006a) and MoLeNET (Attewell *et al.* 2009) also supported the benefits of GBL with leisure games.

2.6 GBL and learner-centred learning

Apart from the definition used in this research, there are many other definitions, which were adopted or adapted by academics who also shared similar interests and passion for GBL studies. This section shows how the definition of GBL used in this thesis took form while explaining its relationship with learner-centred learning.

When this research tilted its focus on GBL rather than game-based e-learning, in mid-2008, JISC (2007, p. 1) adopted an official definition, in which GBL referred to *'different kinds of software applications that use games for learning or educational purposes.'* Despite intending *'to inform readers about GBL and to assist those interested in finding out more about the area,'* this definition would confuse rather than clarify what GBL is to readers, as the description included many other non-game learning media or learning technology:

> *'Also termed 'serious games', these games applications can include fully immersive environments (or 'metaverses'), such as Second Life, where 3D graphics capabilities are providing opportunities for learners to take on virtual presence in virtual worlds. Equally, simpler games such as quiz games akin to e-assessment tools as embedded in higher and further education (HE and FE) VLEs are being used, and web-based or Flash animations are gaining popularity with tutors and learners, particularly for improving English and Maths or language learning skills. The use of leisure games in learning is also notable and games such as Brain Trainer promote a blurring between formal and informal learning, which may have benefits for supporting learning in HE and FE contexts.'*
>
> *JISC (2007, p. 1)*

To avoid inheriting the limitations set in this definition, other literature was referred to, specifically *Digital Game-based Learning* written by Prensky (2001, 2007). Prensky (2007) condemned the 'tell-test' and content-based learning in traditional learning, and claimed that digital GBL is the solution for solving various learning, and motivation in learning, problems. Although this writing was not grounded on academic research and was targeted specifically to readers who work in business and corporate training contexts, some of the GBL ideologies of Prensky (2007) could be

transferred to GBL in formal educational contexts. Prensky (2007) argued that defining learning is a difficult task because once a particular analytical definition is chosen, certain learning forms or types might be filtered out by the definition. In this sense, when a game has been designed and developed based on a specific learning theory, certain learning forms or types that embrace other learning theories might be rejected in the GBL practice that involved the game. As a pragmatic perspective to handle this mutual exclusion problem, Prensky (2007) suggested that the focus of GBL should be on how do learners learn *what* instead of how do learners learn. In this sense, any definitions, theories, styles or forms that relate to learning can be linked to GBL to suit the requirements of *what* is to be learned. Prensky (2007, p. 80) further explained:

> *'There is a variety of materials or content to be learned by students…all of which are best learned differently…the first cut is not by type of learner, but by type of material to be learned. Learning style, or type of learner, can still be, and should be, a second cut.'*

According to this perspective, different types of content to be learned require different skills, learning tools, and methods. Within any of these ways of learning there is considerable room for style, age, gender, and other individual variations. This would allow teachers to concentrate on the learners and provides tremendous opportunities to innovate new pedagogic and learning methods, hence creative teaching (Prensky 2007). Such a form of GBL practice was seen as learner-centred learning, which Prensky (2007) contrasted it with tell-test or teacher-centred learning.

Mason and Rennie (2006, p. 110) also compared the differences between teacher-centred learning and learner-centred learning. The comparison was made after generalising the following ten similar concepts:

- learner-centred learning or student-centred learning,
- self-directed learning,
- learner-focused learning,

- autonomous learning,
- independent learning,
- collaborative learning,
- experiential learning,
- authentic learning,
- problem-based learning, and
- constructivist learning.

In the eyes of Mason and Rennie (2006, p. 110), all these concepts share a similar theme: an approach to teaching in which the experience of the learner is central. The role of teaching was retained in the theme, thus teachers' presence in learner-centred learning is still essential, where the teachers should focus on *'how the learners are learning, what they experience and how they engage in the learning process.'* The learners are given *'greater autonomy and control over choice of subject matter, learning methods or pace of study.'* (Mason & Rennie 2006, p. 110) In turn, the learners need to *'assume a high level of responsibility in the learning situation and be actively choosing their goals and managing their learning.'* Yilmaz (2008) echoed a similar need, as learners are urged to *'actively construct meaning and understanding during every phase of the learning processes.'* In the contexts of GBL practices, such need is central.

2.7 Evaluation of games used in education

The game evaluation process is divided into four stages by the game industry: first playable, alpha, beta, and gold release, as shown in Figure 2.7 (Bethke 2003). Levy and Novak (2010) divided the evaluation process of games into two: the production testing and the quality assurance (QA) testing, in which the former starts in late alpha stage while the latter begins with beta or late beta.

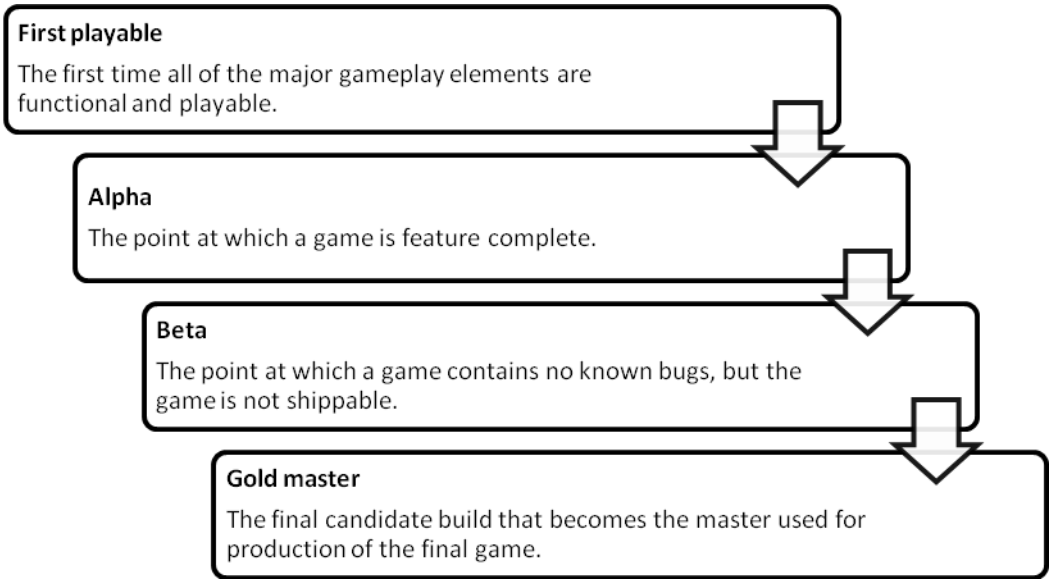


Figure 2.7: Stages in game production in relation to QA and testing

While both production testing and QA testing are aiming to debug the game, there is another form of evaluation called playtesting, which is to review the game by analysing the fun factors. In recent years, academics who studied games brought ergonomic evaluation techniques which were specifically used in human-computer interaction (HCI) into game testing. Methods like usability testing, heuristic analysis and ease-of-use analysis are gradually gaining their place in the game industry. However, formative and summative evaluation methods which were used in the design and development of instructional materials design were discarded in advice given by Prensky (2007).

Table 2.8 shows a comparison among different types of evaluation methods used in the game industry, HCI and instructional systems design. This thesis argues that if games were designed and developed for use in formal education, educational evaluation methods should be used to measure the games' effectiveness and efficiently, superseding the QA and production testing established by the game experts. Because the purpose of evaluation set by two different evaluation systems could be contradicting and yet complementing each other, conflicts between SMEs and game experts emerged (see Section 7.5.3.4). However, since the focus of this research is GBL rather than learn-based gaming, educational evaluation methods are set as the foundational approach, in which elements of quality assurance mechanism

which are relevant to teaching and learning will be adopted and mapped into the instructional system design of GBL.

Table 2.8: Types of evaluation involved in using games for educational purposes

Domains	Evaluation methods
Game evaluation stages in game industry	QA testing
	Production testing
	Playtesting
Evaluation methods of human-computer interaction	Usability
	Heuristics
	Engagability
Evaluation in instructional systems design	Formative
	Summative

2.8 Summary

While not intended to be encyclopaedic in any sense, this chapter discussed key concepts associated with GBL to explain how these concepts shape GBL practices in formal educational contexts. The discussion started by sorting primary, secondary and tertiary concepts that construct the definitions of 'game'. Next, three versions of game elements were studied to form a structure that can be used to differentiate games and non-games. Several synonymous or ambiguous terms were selected for subsequent discussion to demarcate their relationship with games. Then, the chapter directed attention to e-games, explaining why the thesis concerns only e-games rather than games in general. The essence and the classification of e-games were investigated before narrowing down the focus to e-games used in education, which eventually led to the introduction of GBL and learner-centred learning, along with the perceived teacher roles in learner-centred learning. Some of the elaboration might be overwhelming, but the understanding of these concepts is indeed very important—at least for this research—for analysing and synthesizing issues related to GBL, which is the core of the next chapter.

CHAPTER 3: ISSUES ASSOCIATED WITH GBL

3.0 Introduction

Having understood the key concepts alone might not be sufficient to carry out a GBL research project which is still in search for a solid ground for itself—to be regarded as a standalone field in academia. Thus, exploring and understanding current GBL issues were important to determine the choice of research topic that would contribute to the nurturing of the field by the time a doctoral research reaches an end. This chapter presents issues associated with GBL and how these issues were studied in academia. The aim of the chapter is twofold: to identify recent GBL issues which concerned teachers, academics and game experts; and to capture the lessons learnt along the literature review journey. Figure 3.1 shows the structure of this chapter, in which the content was organised into three hierarchical levels.

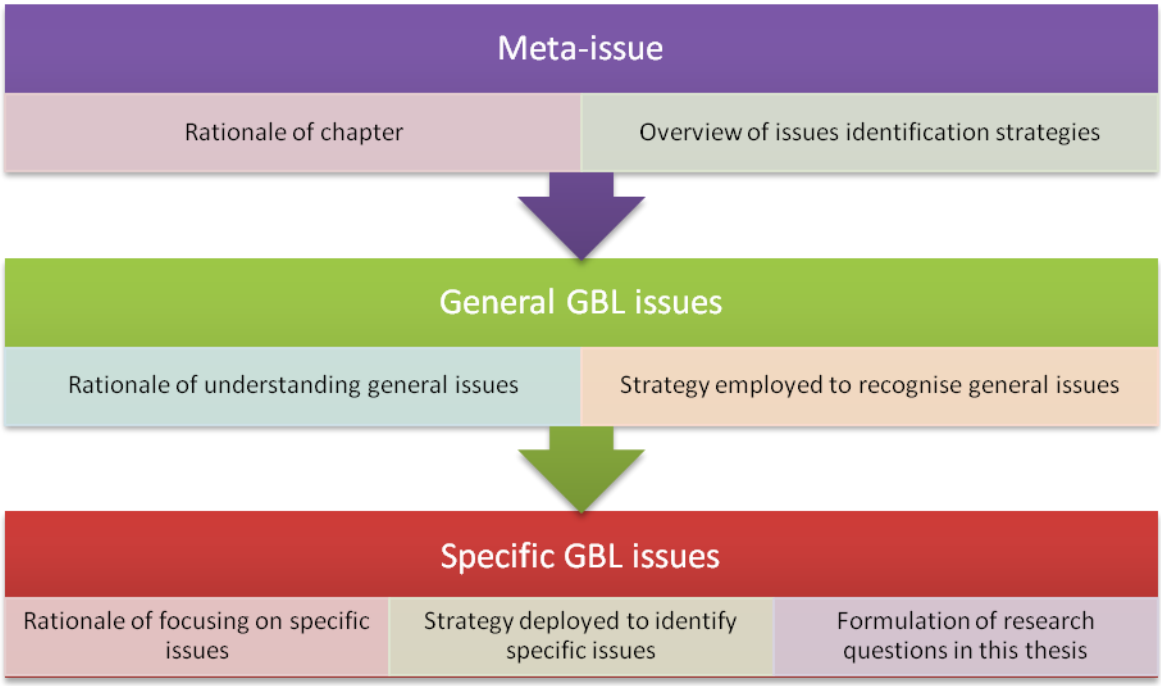


Figure 3.1: The structure of Chapter 3; organised into three hierarchical levels

When a topic or problem became important for debate or discussion, the topic turned into an issue (OED 2005). To determine whether a particular topic or problem is important enough to be regarded as an issue in GBL, the frequency of the topic being debated or discussed in academia and game industry was examined. Formal and

informal publications in both fields such as academic journals, conference proceedings, academic research reports, industrial research reports, theses, patent documents, books, game magazines, forum, blogs and web pages were explored. These publications were divided into academic research literature and practitioners' writings on games. Unlike other games studies which heavily relied on scholarly reviewed publications, the research valued informal publications produced by game experts as these are indeed the channels to understanding the world of the game industry. However, due to the legal constraints set by colleagues in game industry via non-disclosure agreement, a lot of the information gathered from game experts was classified as trade secrets. Therefore the thesis has to rely mainly on academic literature which only represents part of the knowledge and experience accumulated throughout the doctoral journey. Effort and time were injected to ensure the wholeness of this chapter while acknowledging its unavoidable deficiency.

What was included in this chapter is actually a summary of a series of literature reviews carried out from the beginning to the end of this doctoral study. Table 3.1 reveals the nature and rationale of these reviews. Both bottom-up and top-down reviews played important roles at different stages of the doctoral journey, in which the purpose of each review suited the temporal shift of focus: exploratory review at the beginning and then followed by explanatory review at the end. Writing articles and papers and having those writings reviewed and commented by peers in GBL research communities contributed a lot to the progression of this study. The accumulation of lessons learnt through those writing experiences layered the foundation of the research design and the propositions claimed at each milestone of the study.

In the bottom-up preliminary literature review, three reviews, produced by Future Lab (Kirriemuir & McFarlance 2004), Robert Hays (2006, including pre-e-games era research), and JISC (de Freitas 2006) were investigated to capture the overarching GBL issues. These issues were then re-examined to identify possible knowledge gaps. The gaps of knowledge were mapped on to the issue classification streams of a GBL conference series to verify their potential ecological validity. Three exploratory studies were carried out alongside with the meta-review, which demonstrated the validity of those issues. Once the relevance of these issues towards contemporary

GBL studies was confirmed, a key research question was chosen for this thesis, along with three secondary questions. The selection of research questions and the process of defining and redefining the research aim had taken nearly 18 months.

Table 3.1: The nature and rationale of the literature review conducted throughout this doctoral study

Nature of literature review	Associated activities	Rationale of literature review
Bottom-up preliminary literature review	Meta-reviewed GBL related literature (Kirriemuir & McFarlance 2004; Hays 2006; de Freitas 2006) Reviewed pre-doctoral research writings (Perumal, Tan & Kumaran Menon 2006; Tan & Richardson 2006; Tan, Zalizah Awang Long, Fauzan Shukor & Richardson 2005)	Understanding the key issues and research trends in GBL studies Justifying the research position in academia and game industry
	Comparing analytic propositions collected from dictionaries and encyclopaedias with perceived understanding of concepts associated with GBL in literature	Understanding the nature and essence of games and e-games Examining perceived definitions of GBL related concepts used in literature
	Explored formal and informal publications of game experts	Justifying the ecological validity and relevance of issues being studied in the game industry
Top-down structured literature review	Reviewed literature related to issues focused in Exploratory Studies 1, 2 and 3 (Tan, Johnston-Wilder & Neill, 2008, 2010, *in press*; Tan, Neill & Johnston-Wilder 2009)	Reviewing literature related to issues being examined in exploratory studies
	Reviewed literature related to issues studied in Confirmative Study (Tan, Neill & Johnston-Wilder 2010b)	Comparing findings with other GBL researchers' conclusive propositions.
	Externalisation: participation in GBL research related organisations and events	Reviewing papers and presentations written by peer GBL researchers Supporting feedback given to other GBL researchers' papers, presentations, etc.
	Conceptual papers written on research journey and research design (Tan 2010a; Tan, Neill, & Johnston-Wilder 2010a; Tan & Wu 2010; Tan & Xu 2009)	Comparing the strengths and weaknesses of R&D framework of others' GBL studies

Table 3.2 shows the evolution of the research aim. The change of research interests was reflected through the shift of the research aim; while the shift of the aim projected some presuppositions held behind the scenes. Games were predetermined as being able to enhance the effectiveness and efficiency of e-learning systems.

However, as whether or not games are ‘genetically’ effective or efficiency in itself was in doubt; the focus was narrowed down into the elements of games, rather than games as a whole. These elements were regarded as the engaging elements, which the thesis assumed can be extracted from games and injected into the teaching process to make learning fun and engaging. To identify the presence of those elements in games and to justify the success or failure of the transfer, an assessment mechanism was determined as essential, in which the initial focus of the thesis was expanded to include the R&D of an engagability measurement tool. However, further investigation revealed that the fun and engaging elements of games were actually subjective perceptions of individuals, rather than the objective attributes of those elements (see Section 5.4.1). This discovery forced the model of measurement to assess perceptions of people who use games and people who develop games, rather than games in isolation. Having the intention to measure perception had placed the research into a dilemma of confronting the debate between positivists and interpretivists in social studies (see Section 4.1). Because the then emerging research questions were circling around how GBL could be developed and evaluated, the issue of collaboration came to sight and eventually became the key research question (see Section 5.4.5). Nonetheless, the results of three exploratory studies conducted alongside the literature review, continued to challenge the feasibility of the research aim. The aim was finalised only after the deployment of the major perception measuring tool to collect data in July 2009. The following sections of this chapter illustrate how the literature review and exploratory studies intersected with one another along the doctoral research journey.

Table 3.2: Chronological order of the change of research aims

Time	Research aim
Mar 2008	To enhance the effectiveness and efficiency of e-learning systems in Malaysia by using game-based e-learning framework.
Apr 2008	To create an instructional design model which can be used to transfer the engaging elements of computer games into the teaching process, in order to make learning fun and engaging.
Jun 2008	To create an instructional design model which can be used to: - design and develop GBL, - make learning fun and engaging, - measure the level of fun and the level of engagement, and - measure the perceived level of teaching performance.
Jul 2008	To propose a game-based learning model which depicts: - How GBL could be developed to engage learners. - How GBL could be evaluated in terms of its perceived level of fun and its perceived level of engagement. - The possible roles and responsibilities of trainee teachers/teachers, teacher trainers and game experts in producing GBL collaboratively.
Feb 2009	To improve the collaboration between subject matter experts and game experts in the design and development of GBL for use in formal educational contexts.
Jul 2009	To explore how subject matter experts and game experts can collaborate to design and develop games for use in formal educational contexts.

3.1 In search of a research position in academia and the game industry

The immediate issue faced at the beginning of this GBL study was to identify its position in the world of academic research. As GBL relates to the use of e-games for educational purposes, this research positions GBL studies as subset of educational studies, under the canopy of social studies (see Figure 3.2). Coincidentally, the belief held about 'educational studies' in this research was in line with the objective of the MA Educational Studies programme, offered by Warwick Institute of Education (WIE 2009):

> *'It intends to provide teachers and others with opportunities for extended academic study through which to develop and strengthen their practice. It explores the relationship between theory and practice in schools and colleges.'*

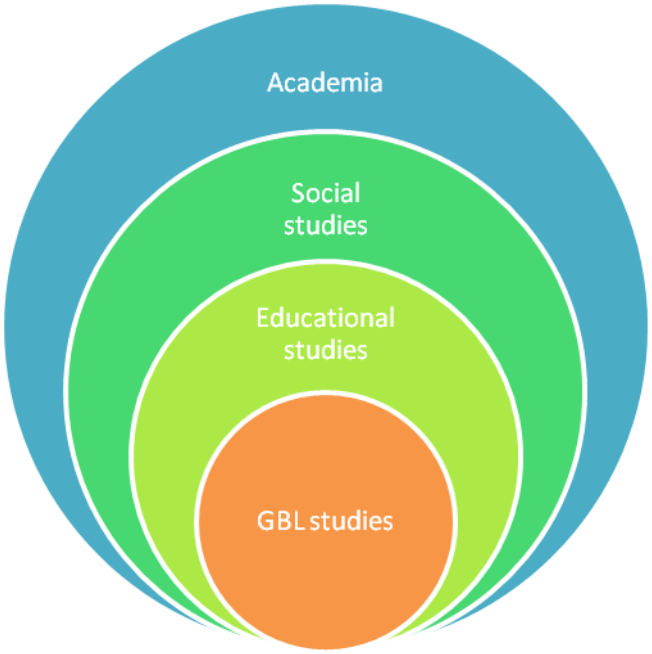


Figure 3.2: Position of GBL studies in academia

Nevertheless, the scope of this research was extended beyond academia because issues associated with games involve professionals who design and develop games in the game industry. Therefore, literature from both academia and the game industry were treated as equally important in understanding contemporary GBL phenomena.

It is important to stress that educational studies are seen as parts of the formal education systems and as a discipline of social studies rather than social sciences. Non-formal and informal education systems are both legitimate areas for serious GBL studies but they were not the contexts of this research.

Highlighting that educational studies were grouped under social studies rather than social sciences is essential because social sciences are the fields of academic scholarship which explore aspects of human society (Kuper & Kuper 1985), while social studies integrate social sciences and humanities to promote civic competence (National Council for the Social Studies 2010). In other words, the perspectives of humanities were taken into consideration, rather than focusing only the empirical evidence in social sciences. The rationale behind this decision was based on the belief that game design and education are both amalgamations of art and science, an approach advocated by Eisner (1997) in educational research and Parberry, Kazemzadeh and Roden (2006) in game programming.

Meanwhile, despite intending to cover issues related to the game industry, GBL studies were not regarded as parts of the R&D activities conducted in the game industry, because the research focus of game experts is playing rather than learning. Research into games or games studies have been a serious field of research among practitioners in the game industry. Multi-billion dollars and pounds were poured into research related to game equipment, game production pipeline, and in-game learning mechanism. Game-focused research institutions and expert groups in the game industry, such as Nintendo Entertainment Analysis and Development, Sony Computer Entertainment, Microsoft Research, Entertainment Art Research Incorporation have been pioneering research into learning in game playing for decades. For example, in the production of the awards winning *Professor Layton and the Curious Village* by Level-5 (a Japanese game publisher/developer company) for the Nintendo DS console, Professor Akira Tago, a psychologist from Chiba University directed the game's production. In fact, the puzzles in the game were either designed by the professor or adapted from his famous (12 million copies sold in Japan) *Head Gymnastics series* of puzzle books (East 2009). Another success story of research into learning that had connection to the game industry was the creation of *Dr. Kawashima's Brain Training: How Old Is Your Brain?* game series. The series was actually based on a neuroscientist—Professor Ryuta Kawashima's - book titled *Train Your Brain: 60 Days to a Better Brain* (AFP 2008). The research interests of learning for game playing spans different phases in the game production process, selected examples of research strands are shown in Figure 3.3. Compared to academic research, commercial research is private and highly confidential. Publication in academic journals or conferences is not the priority; the target is patent application and commercialisation. Herewith three examples of publications of patent applications: 1) Whitten (2005) who worked in Microsoft Research invented a presentation mechanism of in-game tips which claimed to be helpful for game players to learn features of gameplay; 2) Zalewski and Turner (2010) patented a user-generated and context appropriate gameplay advice management system which allows game players to learn and access advice from other players during the game playing session; 3) Vrignaud and Gruhl (2009) applied for a patent in the US for a contextual game help system which could provide game players guidance to succeed at particular challenges encountered in the game world. The above

mentioned patents were examples of research interests of the game industry into learning. Learning was seen as a crucial aspect of game playing which might determine the reception of commercial games (Becker 2007). However, since the purpose of this research is to support game playing, and in turn pushing the sale of games in the consumer market, the games studies were regarded as learn-based gaming rather than GBL, hence beyond the scope of this doctoral research.

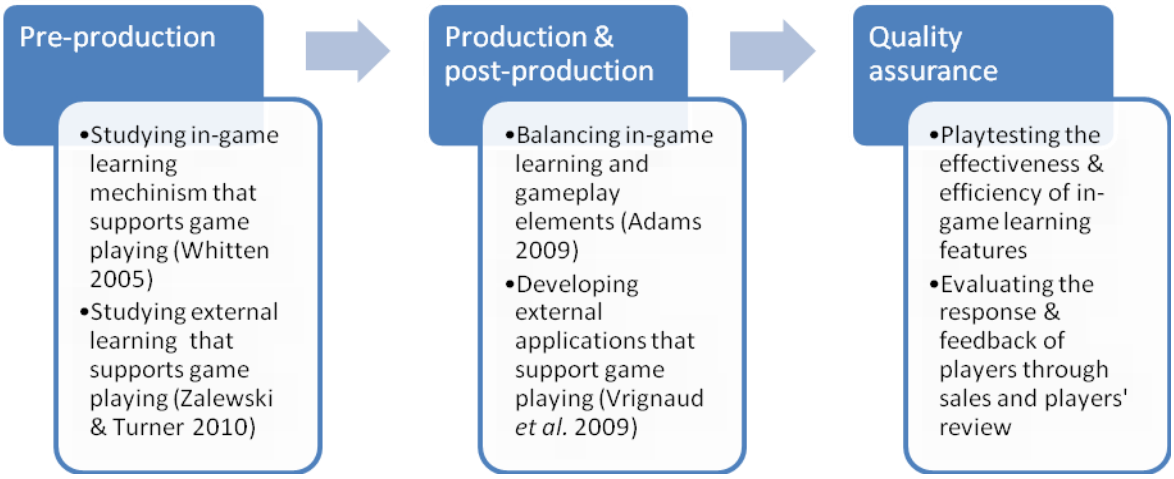


Figure 3.3: Position of learning-related research in the game industry

Occasionally, GBL researchers who gain access to the R&D results of learn-based gaming would be surprised by the advancement and achievement of learning-related research in the game industry, but due to the non-disclosure agreements signed between GBL researchers and commercial game research bodies, no information of such a kind can be reported in academic writing, including a PhD thesis.

Apart from game production research conducted in or for the game industry, game design and programming graduates along with their tutors, lecturers and professors in academia also are involved in game-related research activities. Figure 3.4 depicts how this doctoral research delineated two types of professionals who have interests in game-related studies. The first type of professionals are those who had studied games as a subject matter through formal education or non-formal education and subsequently became game experts upon the completion of their study—they are denoted as ‘game experts’ throughout this thesis. Game experts who underwent formal educational programmes would possess at least an academic qualification; while those who received non-formal education in games, professional qualifications

such as Autodesk 3ds Certificate or Autodesk Maya Certificate would have an official proof of qualification. However, for those who intend to work in the game industry, a strong portfolio of work or completed projects is essential; but to those who want to join academia, excellent academic performance plus some working experience in the game industry might be more important.

The second type of professionals are those who received no qualification in games but became experts through involvement in academic research. Konzack (2007) suggested that professionals in eight fields of study—technology, economy, anxiety, learning, gender, ideology, narratology and ludology had been influential in games studies, which reflects the argument that research into games has no longer been exclusively limited to the first type of professionals mentioned above:

> *'Researchers are no longer just approaching video games as technology and through market research, but as a new kind of culture with significant meanings in contemporary society. Each approach to the study of video games is constituted by a specific rhetorical frame that shapes how video games are understood and each of these rhetorical frame shapes what is (and can be) said about video games…if we consider the relation between video games and rhetoric from a more optimistic angle, we might instead argue that, indeed, each rhetoric helps create a new school of video game research.'*
>
> *(Konzack 2007, p. 110)*

Based on the suggestion given by Konzack, Type-2 professionals were grouped under three disciplines: arts and humanities, social sciences, and computer sciences (see Figure 3.4). Although studying games as a subject of interest, the academic researchers generally perceive games form a viewpoint based on the field where they originally come from, hence developing the multi-faceted nature of GBL studies.

While game experts who are working in academia welcomed the cross-disciplinary research conducted by Type-2 researchers, experts in the game industry generally see Type-2 professionals as 'ivory tower dreamers' (Hopson 2006). In an open letter to

academic game researchers, Hopson (2006) argued that the game industry as a whole has ignored the entire field of study dedicated to studying games because:

> *'the average piece of academic games research just doesn't get the job done. It's not a question of the quality of the research or the intelligence of the researcher or the game makers; it's a question of bridging the gap between the academic and business cultures.'*

In other words, for academic researchers who want their ideas to be taken seriously and applied by the game industry, specific practical recommendations or a measurable impact on the final game ought to be included, as professionals in game industry value only two things in a research presentation: the recommendations and their predicted effects (Hopson 2006).

As a beneficiary who is indebted to the nurturing efforts across the game industry and academia, it would be meaningful to make useful recommendations that could bridge the gap between the game experts and academics at the end of this research. Thus, the thesis was set to be cross-disciplinary. Having positioned the scope of this GBL study in academia and considered the suggestions given by game experts, the journey of exploring the general GBL issues moved on.

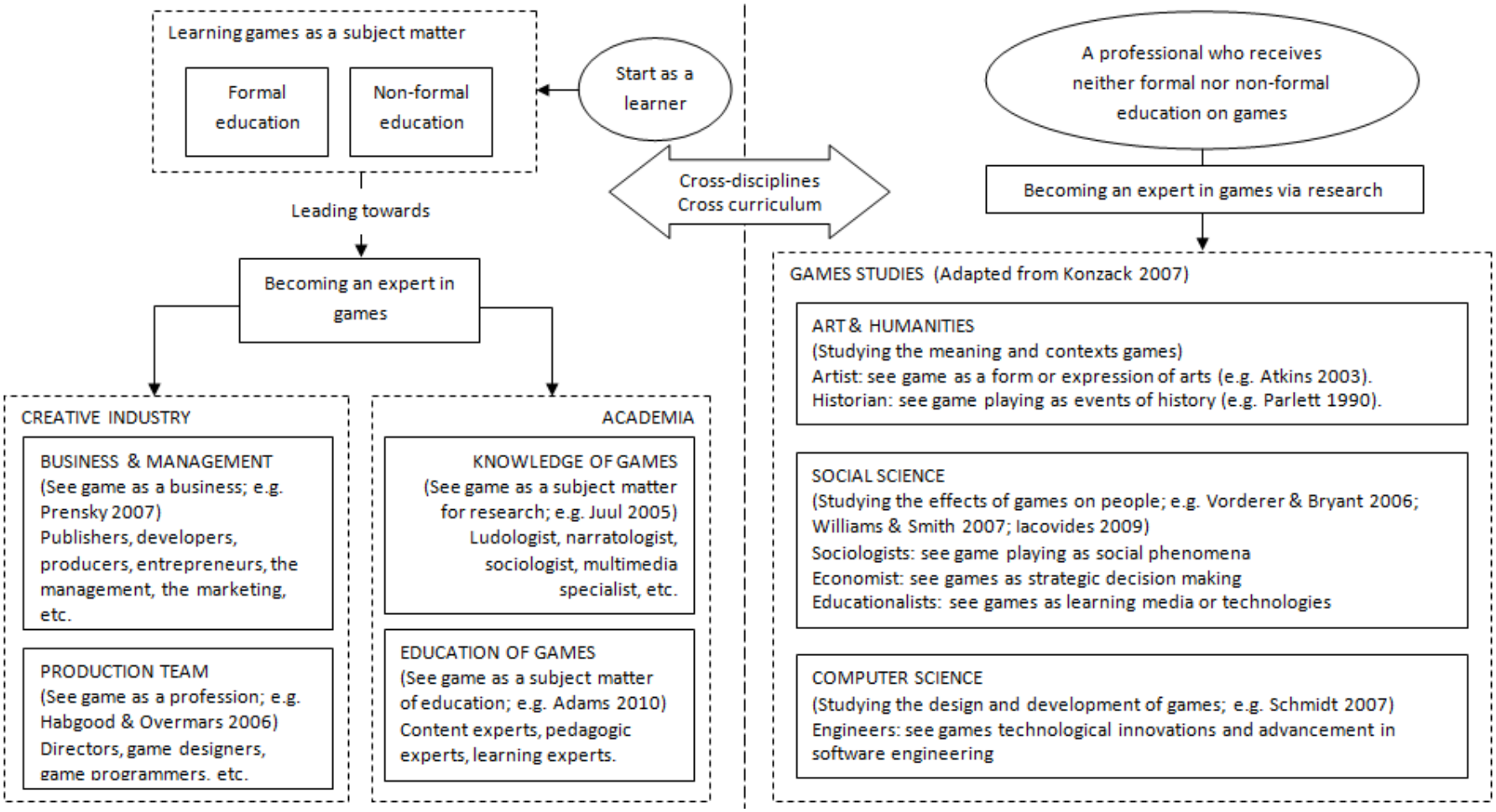


Figure 3.4: General perceptions of games by game experts and game researchers

3.2 From e-learning to game-based e-learning and then GBL

In a paper published before starting this doctoral research, the potential interdependent relationship among global education, global learning and e-learning was examined (see Tan & Richardson 2006). One interesting phenomenon was found about global learning: online game playing that spreads across the globe could be far more effective and efficient than e-learning practices in terms of learning delivery, because e-learning has been struggling with a series of standardisation problems for decades, particularly in issues like the pitfalls of e-learning (Clark & Mayer 2008), the use and abuse of reusable learning objects (Mogharreban & Guggenheim 2008; Polsani 2003), the interoperability of learning materials in different learning platforms (Friesen 2004; Stracke 2010), and cross-cultural difficulties (Edmundson 2007). Meanwhile, the world of commercial games is very much Darwinian-driven, as in the eyes of players, games are either fun or boring to play, and perceived boring games have no place in the consumer market, thus translating game ideas into a final product remains a constant challenge to experts in the game industry (Callele, Neufeld, & Schneider 2005). Fun and engaging were seen by many (e.g. Qiunn & Connor 2005) as the secret of successful games, and the secret was related to Csikszentmihalyi's (1991) concept of 'flow'.

The contrast between e-games being seen as a form of promising learning media (e.g. Quinn & Connor 2005; Prensky 2001 & 2007) and e-learning facing ongoing technical challenges (Tan & Richardson 2006), prompted the idea of marrying game-playing and e-learning, hence the birth of 'game-based e-learning'. In the context of this study, the term was used in the title of the early versions of the PhD proposal—*Meta-learning in new media: a study of game-based e-learning systems.* The concept 'game-based e-learning' was also used by others who were working in the multimedia and ICT domain (e.g. Klaila 2001). While the majority of researchers practically saw game-based e-learning and GBL as a similar entity, there were people who attempted to set a clear boundary between the two concepts. In the study of adaptive e-learning with eye-tracking to support various didactic models and learning paradigms, or put simply, an AI related e-learning project, Gütl *et al.* (2005) claimed that game-based e-learning can be used to overcome the following weaknesses of GBL:

- The content of GBL has to be created hand-made to suit particular curricular learning objectives.
- The creation of learning content for the production of curriculum-relevant games require tremendous work by teachers and learning content providers
- The use of game scenarios is confined to the specific subject matter, which makes the updating of content difficult.
- The human and financial resources required to cover the entire curricula, which could provide alternative learning approaches for learners may be too expensive.

While the revealing of these weaknesses were reasonable and acceptable, although the perceived weaknesses could also be applicable to most teaching or learning media that require the genuine contribution of content experts, the claim that game-based e-learning had advantage over GBL made scarce sense because it sounded like *'a learning technology (e-learning) is better than an educational approach (GBL).'* Regrettably, such arguments of 'non-issue' were and are still made by researchers who possess limited understanding of the nature of e-games. However, empathy should be given to them—including the conductor of this doctoral research at its early stage - because the gaining of such insight was not only time-consuming but also depending on others' contribution to the field of study. In fact, the thought of changing from game-based e-learning to GBL appeared only after analysing the GBL literature reviews described below.

3.3 Issues of GBL practices

After determining the research scope, three approaches were taken to grasp recent GBL issues: structured literature review, semi-structured interview and planned participation in GBL related academic events. While the remainder of this chapter depicts how the structured literature review helped in keeping abreast with the recent GBL issues, the semi-structured interview was included in this thesis as the second exploratory study (see Chapter 5) and the influence of participating in GBL related events were included in the Discussion chapter.

The structured literature review began from identifying and re-examining academic literature reviews of GBL. At the beginning of this research, three literature reviews were analysed and synthesized, including *Literature Review in Games and Learning* (Kirriemuir & McFarlane 2004), Hay's (2006) chapters on *Instructional media: issues and research* and *Research on the effectiveness of instructional games*, and de Freitas' (2006) *Learning in Immersive world: A review of game-based learning*.

Kirriemuir and McFarlance (2004) reviewed the findings of research into the relationship between games and players, and the theoretical and actual implications for learning. They argued that the study of games or game players cannot be mapped onto one research discipline because the research evidence is complex, which implied that their review was bottom-up rather than top-down. In a top-down review approach, as the research discipline was pre-determined, games studies which match the research criteria can be mapped onto the particular discipline. Hay's (2006) review on instructional games could be seen as an example of such a top-down approach. The report de Freitas (2006) produced was a mixture of both bottom-up and top-down approaches. She synthesized the key issues and themes arising from the literature she reviewed on GBL plus seven retrospective case studies she conducted. After that, she consulted 13 researchers who study games and 22 members of the JISC Pedagogy and e-Learning expert group to deduce GBL trends.

3.3.1 Generalisation of the findings about games

One key conclusion made by Kirriemuir and McFarlance (2004) was that any attempts to generalise the effect of games or gaming may be unhelpful because different genres of games are played differently, which in turn differentiates the games' potential to support learning. In other words, arguing the general effects and potentials of games like Egenfeldt-Nielsen (2005, 2007) did may be meaningless. Instead, it may be necessary to distinguish more clearly the nature of gaming and the nature of learning and the learner, in order to better understand how games contribute to learning.

Hays (2006) made a similar conclusion after he discovered that although there were many articles written and published on the use of games in education, most of the literature was based on the writer's opinions about the potential of games and the

arising questions on how games should be developed for educational purposes, rather than studies that provided empirical evidence. Over 270 documents in the literature he gathered, only 48 provided empirical data on the effectiveness of games. Despite their being empirical research, Hays listed the following problems with the claims made by those studies:

- The research examined the games' effects for a wide range of age groups, which made generalisation of the results of a study conducted with one age group to another age group impossible.
- Some research examined the effectiveness of games for many different tasks, which made generalisation of the results from one instructional task to tasks in another domain problematic.
- The empirical research does not make a compelling case for games as the preferred instructional method, thus disallowing conclusions like 'games are more effective than other well-designed instructional activities' to be made.
- Many studies contain methodological problems that make it difficult to draw valid conclusions about the effectiveness of the games.

Hays (2006, p. 302) further challenged the quality of the empirical studies by comparing what he found with Greenblat's (1981) review about the efficacy of games used for instructional purposes (see Table 3.3).

The general picture of the effectiveness of games used in education portrayed by Hays (2006) seems discouraging. However, the doctorate in general experimental psychology he received influenced his perception of valid empirical studies. The influence was revealed in his criticism of others' research (Hays 2006, p. 300-301):

> *'Too much of the empirical research on instructional games contains methodological problems (e.g., experimental confounds) that make it difficult to draw valid conclusions about the effectiveness of the games. Researchers need to ensure that they understand experimental design and apply sound decisions when designing and reporting their research. In addition, editors of*

educationally oriented journals need to filter out studies that do not follow sound experimental design procedures.'

In fact, this discipline or research paradigm driven filtration in his literature review might mislead beginning GBL researchers in exploring games related studies as a whole. However, a review that possesses relatively loose selection could be equally unhelpful, so balancing bottom-up and top-down literature review approaches is very important.

Table 3.3: Evidence comparison made by Hays (2006), based on Greenblat's (1981) six categories of 'claims' about the efficacy of instructional games

Categories of claims	Evidence prior to 1981	Evidence between 1981 and 2005
1. Motivation & interest	Strongest support. A great deal of anecdotal reports. Only one study used several indicators of motivation to show simulation-games generated greater interest than other modes of teaching	Little additional evidence. A few studies found that learners indicated that they enjoyed games and spent more time playing. However, only weak connection between this and improved performance.
2. Cognitive learning	Some weak empirical evidence favouring games. Some showing no differences.	Similar pattern. Some studies show that games are effective for some learning tasks, but do not show them superior to other instructional approaches. Some evidence shows that games can be detrimental to learning if they do not include instructional support. Some games are more effective if they are followed by a debriefing session that highlights the importance of the game experiences in terms of instructional objectives.
3. Changes in later course work	None	None found
4. Affective learning (re: subject matter)	Mixed results. Some anecdotal evidence. Empirical evidence shows increases in both positive and in negative attitudes.	Two studies provide some additional support. There are indications that a game is more effective if used in the appropriate context.
5. General affective learning	Almost none	None found
6. Changes in classroom structure and relations	None	None found

3.3.2 The perceived potential of games

Despite stressing the unhelpfulness of generalisation of the effect and potential of games, most GBL researchers believe that games have educational potentials. Kirriemuir and McFarlance (2004) listed seven potentials of game playing, which were recognised by teachers and parents: strategic thinking, planning, communication, applications of numbers, negotiation skills, group decision-making and data handling. These perceived general potentials were indeed unhelpful—matching what Kirriemuir and McFarlance (2004) claimed, because other forms of interactive learning media such as Web 2.0 applications could carry the same potentials. Nevertheless, while agreeing that generalising the effect of games may be unhelpful to learners, this thesis believes that recognising the educational potentials of games in general is important to motivate teachers to embark on GBL practices. Also, positive evidence might be used to encourage game developers to design bespoke educational games which could eventually benefit learners.

Kirriemuir and McFarlance (2004) discovered that 'why games are engaging' is a topic that constantly attracts researchers. Concepts like fantasy, challenge and curiosity, and 'flow' were related to explain the engagement with games. Quinn and Connor (2005), Knight (2006), Lazzaro (2008) and Kii (2009) and those who study funology (e.g. Blythe *et al.* 2005) in the field of human-computer interaction are examples of researchers who dedicated their effort into this topic of games. Like others, Hay and Singer (1989) were also convinced that games have the motivational potential to engage learners. In justifying this potential, Hays (2006) composed a heuristic framework based on the findings of Malone (1981) and Malone and Lepper (1987) (see Table 3.4). The framework could be applied for designing intrinsically motivational instructional environments. Although this framework was developed for educational games in the 1980s, which probably shaped the heyday of edutainment in the early 1990s, they are still regarded by Hays (2006, p. 261) as *'most relevant for the design of instructional games.'*

Table 3.4: Design heuristics for motivating instructional environments

Types of motivation	Design features	Heuristic approach
Individual	Challenge	Goal: Clear, fixed goals or ability for players to generate goals for themselves.
		Uncertain outcomes: Variable difficulty; multiple levels of goals; hidden information, selectively revealed; and randomness
		Performance feedback: Frequent, clear, constructive, and encouraging
		Self-esteem: Gradually increasing difficulty levels to promote feelings of competence. Goals that are meaningful to the learner
	Curiosity	Sensory curiosity: May be promoted using variable audio and visual effects
		Cognitive curiosity: May be promoted by using surprise, paradoxes, incompleteness and using activities that contain topics in which the learner is already interested.
	Control	Contingency: Learning environment should be responsive to learner actions
		Choice: Activities should provide learner with choice over various aspects of the learning environment (e.g. narration or full text)
		Power: Activity should allow learner to produce powerful effects
	Fantasy	Emotional aspects: Appeal to the emotional needs of learners
		Cognitive aspects: Use appropriate metaphors or analogies for the material to be learned
		Endogeneity: Fantasies should have an integral (endogenous) relationship to the material to be learned
Inter-personal	Cooperation	Design some activities to promote cooperation among learners
	Competition	Design some activities to require learners to compete with one another (e.g. actions affect each other)
	Recognition	Learners' efforts should receive social recognition so they are appreciated by others

De Freitas (2006) echoed the motivational effect of games as she highlighted that the key rationale for using games in education is the beliefs held by GBL practitioners that game playing can motivate learners, and motivation was seen as the key to effective learning. She further listed four factors to justify the rationale: players' sense of challenge, game realism, opportunities to explore or discover new information, and learner control. These factors of motivation distinguish e-games from other learning media or new media which might also motivate learners and promote effective learning, although this insight was not clearly indicated in the review. However, the motivation cultivated through GBL needs to be sustained; while sustaining motivation involves active reflection and feedback responses (de Freitas 2006). In other words, GBL practices must be able to engage, support and

interest learners. These, according to de Freitas (2006) can be achieved by relating the games to clear learning outcomes and real world contexts. Thus, the key challenge of GBL practices is balancing delightful play and specified learning outcomes.

This thesis not only shares the same belief of games' potential in motivating learners—like Hays (2006) and de Freitas (2006), but also believes that GBL practices can motivate teachers and game experts. Although de Freitas (2006) listed the barriers faced by teachers and educational institutions to using games in formal contexts, the suggestions provided to counter problems were insufficient to motivate teachers or game experts to start bringing games into classrooms. De Freitas (2006) argued that teachers need empirical evidence and understanding of what effective GBL were like in practice, but empirical evidence and understanding of effective GBL are passive drivers—teachers might need more than passive drivers to become successful GBL practitioners. The use of games might also be limited as games were perceived as violent and promoting aggression.

In the attempts to explore the perceived educational potentials of games, the first two exploratory studies of this doctoral research discovered a discrepancy between the perceived engagement of games among game experts' writings, trainee teachers in England and game experts in Malaysia (Tan *et al.* 2008; Tan *et al.* 2010). The trainees viewed engagement in GBL as a scale; while the game expert's writings insisted that engagement is a matter of life and death; but the game experts in Malaysia saw immersion in game playing as addiction rather than engagement (see Chapter 5 for further explanation). The inconsistency of perception had become an interesting issue in GBL practices because what teachers described as less engaging games could be in fact be a failed game in the eyes of game experts; but what teachers found as engaging games might lure learners to become addicted to game playing in the view of other game experts. Further investigation of this interesting issue was needed to uncover the reasons behind the discrepancy.

3.3.3 Game playing, violence and gender

In terms of the contents of games across genres, there is an issue around violence and game playing (Kirriemuir & McFarlance 2004). Kirriemuir and McFarlance (2004,

p. 3) identified two diverse and yet legitimate conclusive propositions on the violence issue: *'games increase aggression or games provide a release for pent-up aggression.'* Again, like engagement versus addiction, this issue is another example of two faces of the same coin that relates to the potential of games. Arguing the potential, either positive or negative, has to link to a specific game which was designed for use in a particular context. Action games, especially the shoot'em up genre were heavily used in military training across the globe. *America's Army* is an example of this game that was developed by the United States Army as a recruitment promotional initiative (America's Army 2010). Li (2003) studied the potential of the game as civilian-military public sphere after its inception in 2002. Contemporary philosophical arguments were synthesized to form the militarization critique, in which Li (2003, p. 65) agreed that the game was a form of *'the perversion of public sphere communicative rationality.'* Thus even a perceivedly positive game could be seen negatively, so understanding the perceptive potential of games is more practical than judging the aggression related to game playing.

Game playing issues associated with gender was recognised by Kirriemuir and McFarlance (2004) as a common subject of research. These issues included the image of females within games, the role of gender in influencing gameplay, and the impact of increasing numbers of female players on game design. Diane Carr from London Knowledge Lab conducted a series of researches on gender representation in games (Carr 2005, 2006). While Carr's interests are focusing on learners, Williamson (2009) examined gender and game playing among teachers in England. In the female-dominant games survey, teachers were concluded to be a non-significant gaming population. The survey revealed a small but significant gender gap in the teaching profession, in which there are more male teachers who play games for pleasure than females. Based on these findings, Williamson (2009, p. 24) argued that:

> *'The fact that over 40% never play games at all is likely to be a contributing factor to the lack of knowledge and skills in gaming often cited as a key reason for teachers not to use games in schools, although it is notable that just over a fifth of them do in fact play games on a weekly basis.'*

3.3.4 The use of commercial games in formal education

As there was a rapid growing interest in using commercial games in education, researchers started to investigate the development of competences and literacy during play sessions and the roles of games in forming learning communities (Kirriemuir & McFarlance 2004). However, Kirriemuir and McFarlance (2004) argued that mainstream games were unlikely to be integrated into the school curriculum, and they provided five reasons to support their arguments:

- Teachers face difficulty in identifying promptly the relevance between a particular game and components of the statutory curriculum, as well as the accuracy and appropriateness of the content within the game.
- Persuading other stakeholders in schools to visualise the educational potential of games is difficult.
- Teachers do not have sufficient time to familiarise themselves with the game and good GBL practices.
- Irrelevant content or functionality of games that could not be skipped has wasted valuable lesson time.
- Traditional school-based learning may not meet the learners' expectations and preference of learning from game playing activities.

While what they revealed would probably was the case in the early 2000s, de Freitas (2006) highlighted that academics recognised how three specific forms of game playing—multiplayer online, mobile and augmented reality gaming - could be used in formal education. With the supports of cognitive tools such as discussion fora and bulletin boards, multiplayer online games were claimed to be able to relive situations and conflicts in different settings and conditions in groups. On the other hand, the portability and adaptability of both mobile and augmented reality gaming were seen as enabling features for outdoor GBL practices.

The introduction of Nintendo Wii and DS consoles in 2007 accelerated the adoption of commercial games used in formal education. While the vast majority of teachers

who used games in teaching have used school PCs or laptops as the platform for GBL, some teachers did use console games, for which Williamson (2009) suggested that affordability and portability of commercial games have become emerging issues in GBL practice. Miller and Robertson (2010) conducted a case study using a games console in the primary classroom to examine the effect of Nintendo's *Brain Training* game on computation and self-esteem. They claimed that the GBL study had contributed to improvements in both accuracy and speed of computation, and in self-esteem of the participants. They argued that it was hard to find recent studies with which to compare their findings. Even the research carried out by Sandford *et al*. (2006) to investigate the use of commercial games in classrooms was not comparable because the games and outcomes measured used in the study were different. Again, neither Sandford *et al*. (2006) nor Miller and Robertson (2010) could generalise their findings because research into the effectiveness of a specific game or a GBL practice should not be generalised to the use of other games or other GBL practices. Instead, these successful uses of games in formal educational contexts could be used to convince teachers that GBL can be a beneficial approach that is worth practising. In fact, the third exploratory study conducted in this thesis was another positive example of GBL practice (Tan *et al.* 2009; Tan *et al.* in press). Instead of aiming to generalise the effectiveness of the specific game, the case study identified the characteristics of an effective GBL teacher, which could be imitated by other teachers who intend to use games in classrooms. These characteristics could also be referred to by ICT teacher trainers who intend to nurture GBL teachers.

In a broader research setting, Felicia (2009) wrote a handbook for school teachers, which include guidelines for justifying GBL practices, choosing appropriate games for the classroom, and conducting play sessions. The guideline was produced under the European Schoolnet's Games in School project. In the UK, research-based recommendations for using games in formal educational contexts were made available to both teachers and researchers through several agencies or bodies, including two defunct bodies: Becta (Becta 2001, 2006a & 2006b) and Learning Skills Councils (Attewell *et al.* 2009). Instead of producing another set of probably similar guidelines for teachers, this thesis tries to compare teachers' expectation for GBL and how they see their own practice in normal conditions.

3.3.5 Developing and using educational or instructional games

Issues of developing games for education were synthesized by Kirriemuir and McFarlance (2004) into two themes: the desire to harness the motivational power of games in order to 'making learning fun'; and a belief that 'learning through doing' in games such as simulations offers a powerful learning tool. The first issue was related to the failure of edutainment, where the following five reasons were listed to provide generalised explanation:

- Edutainments have been too simplistic as compared to commercial games.
- The play in edutainment is repetitive, thus quickly becomes boring.
- The design of edutainment does not support progressive understanding.
- Edutainments offer a limited range of activities which are usually concentrating on one skill, or accumulation of homogenous content.
- The learners become aware that playing edutainment is coerced them into 'learning', which might lead to a patronising format.

As for the second game development issue, Kirriemuir and McFarlance (2004) argued that assuming children do not enjoy learning and then using this assumption to make learning fun through games was a non-issue because research evidence reveals that children do enjoy learning, particularly when they sense the progression they made and the relevance of learning. Thus instead of focusing on fun and on concealing the learning within educational games, Kirriemuir and McFarlance (2004) suggested that GBL studies should revisit research that analysed the relationship between 'flow' and gameplay. Two sets of guidelines were composed based on Malone's (1980) findings on the characteristics of the flow state. These guidelines could direct GBL researchers to understand the deep structures of the game playing experience that contribute to 'flow', which in turn leads to building these structures into game environments that support learning.

In analysing retrospective cases of GBL practices, de Freitas (2006) grouped seven studies under three modes of use: games as metaphors for learning, games and simulations as microworlds, and games as tools for rehearsing and skills therapy.

Through the case studies, two strengths of GBL over other educational approaches were revealed. When games were used as metaphor for learning, the role play and narrative nature of games enabled learners to imagine and empathise with people or events from history or with future scenarios (de Freitas 2006). Also, games allow learners to experiment and rehearse skills in safe and protected environments.

In the review conducted by Hays (2006), e-games were seen as a form of instructional media rather than learning media. According to him, the media were developed to assist instructors to more effectively communicate instructional information. This instructor-led or teacher-centred perspective lays the burden of educational quality assurance on the shoulders of instructors or teachers, rather than learners, which contrasts with the learner-centred view held by this research. Prensky (2007) related the instructor-led scenario to instructional system design (ISD), a field that Schiffman (2008, p. 14) described as *'a blend of psychology, education, communications, management, systems theory, and social science.'* However, Prensky (2007, p. 83) criticised ISD-relevant views on games in education as *'not very creative'* and he claimed that designing effective learning does not require any formal instruction or specialised knowledge; *'rather, it takes a thoughtful and creative approach to reaching the desired outcomes.'* This criticism might be unfair because it discarded the professionalism of teachers, tutors, lecturers and professors who applied knowledge of ISD in designing and planning lessons.

The use of increasingly more sophisticated media such as e-games had led to a debate between those who believe that the choice of medium is the most important decision in instructional design and those who believe that instructional media are only vehicles for the delivery of instructions. Hays (2006) called researchers who assert the former belief 'the instructional media camp', as opposed to those who support the latter—'the instructional methods camp'. In the context of GBL studies, the former type of researchers are interested in the design and development of a particular game or a genre of games in education, so the focus lies in the content creation of the games; while the latter type treats e-games as a component of a specific educational approach, thus their study investigates the roles and functions of games in this approach.

Reiser (2001a & 2001b) who compiled important historical events of the development of instructional media and technology in the USA regarded Robert Gagne (1985) as the then leader of the instructional media camp. Gagne's (1985) assumptions on conditions of learning and 'nine events of instruction' are central components of instructional design programmes. Reiser (2001a, p. 58) regretted that *'most of the practises related to instructional media have occurred independent of developments associated with instructional design.'* Based on this understanding, he predicted that the changes brought about by digital media in instructional practices, both in schools and on other instructional settings, are likely to come about more slowly and be less extensive than most media enthusiasts had predicted.

On the other hand, Clark (1994, p. 25) who is a representative of the instructional methods camp, concluded that there is no compelling evidence in the past 70 years of published and unpublished research that media cause learning increases under any condition. In other words, the focus of instructional design should be on instructional methods, not on the media that deliver instruction. Hays (2006) compiled a list of researchers who support this view and classified these researchers as the 'instructional methods camp'; as opposed to the 'instructional media camp' who believe that *'specific media have critical attributes that recommend them as the choice for teaching specific types of tasks.'* (p. 221) Hays compiled a list of 15 multimedia principles based on the findings of the instructional methods camp (see Table 3.5), and most of the studies were led by a cognitive psychologist, Richard Mayer, who is a proponent of research into multimedia learning (e.g. Mayer 2009, 2005 & 2003).

Table 3.5: Multimedia principles proposed by the instructional media camp. Adapted from Hays (2006, p. 224–228)

Media principles	**Key ideas**	**Selected proponents**
Appropriate instructional cues principle	The instructional medium or mix of media should be chosen on the basis of the media attributes that will facilitate the learning of specific tasks.	Levie and Dickie 1973
Media choice principle	Pictures are useful for presenting spatial information, especially for complex tasks.	Marcus, Cooper and Sweller 1996
	Simple illustrations with captions are more effective than text for summarizing information.	Mayer, Bove, Bryman, Mars and Tapangco 1996

	Choose the medium that best communicates the information to be learned. For a small amount of information to be remembered for a short time, audio is better than text. Text is better than sound for longer retention.	Najjar 1998
Interaction principle	A cognitively engaging, interactive user interface appears to have a significant positive effect on learning from multimedia.	Najjar 1998
Pacing control principle	The cognitive load imposed on the learner can be reduced and deeper learning can be achieved by allowing the learner to control the rate of presentation.	Mayer and Chandler, 2001
Multimedia principle	Students learn better from words and pictures than from words alone.	Mayer, 2003
Spatial contiguity principle	Students learn better when corresponding words and pictures are presented near rather than far from each other on the page or screen.	
Temporal contiguity principle	Students learn better when corresponding words and pictures are presented so they coincide meaningfully.	
Voice principle	People learn better from narration when the voice is human and speaks with a standard accent.	
Personalisation principle	Learning is facilitated in multimedia lessons when the words are in conversational style rather than formal style.	
Pre-training principle	People learn better from multimedia when they already know something about the topic.	
Signaling principle	Multimedia explanations using narrated animations should include highlights of the key steps, sections headings that correspond to the key steps, and/or other techniques to signal the importance of the information.	
Irrelevancy principle	Students learn better when extraneous words, pictures and sounds are excluded rather than included.	
Modality principle	Students learn better from animation and narration than from animation and on-screen text.	
Redundancy principle	Learning is facilitated by increasing the redundancy of relevant cues and reducing the number of cues that are irrelevant to the learning task.	
Prior knowledge principle	High knowledge and high aptitude learners can adjust to and benefit from almost any media design.	

Hays (2006) stressed that *'it is important to distinguish games from other instructional activities'* before commencing research on instructional games (p. 251). This is an emphasis shared by this thesis as well, in which Chapter 2 was devoted to clarify concepts synonymous with games.

According to Hays (2006), most definitions of games do not include any reference to instruction. Most games are played because they provide enjoyment, not because the player wants to learn something. Nonetheless, instruction is a specific type of interaction where players have interactive dialogue with the instructional material.

The control of the learning experience is an essential matter for game designers to justify the motivational value of games in education. Hays (2006) listed the following four minimum requirements for effective instructional games:

- Instruction must be designed to support specific learning objectives, which are determined by task requirements.
- Instruction must include the opportunity for players to interact with the learning content in a meaningful way.
- Players' performance must be assessed to determine if they have learned what was intended.
- The results of the assessment must be presented to the players in a relevant and timely manner to either reinforce correct actions or to provide remediation for incorrect actions.

The above mentioned elements are straightforward but how to integrate these elements with learning outcomes and game features remains the key challenge faced by subject matter experts, instructional designers and game designers together as a team in GBL collaboration.

In preparing for the JISC e-Learning Programme, de Freitas (2006, p. 9) explicitly mentioned that the aim of her report was to facilitate greater opportunities for using games, thus a 'fairly neutral approach' was adopted in defining concepts associated with games for learning. She defined games for learning as *'applications using the characteristics of video and computer games to create engaging and immersive learning experiences for delivering specified learning goals, outcomes and experiences.'* Furthermore, de Freitas (2006, p. 9) made no secret that *'due to the fast changing nature of the field (of GBL) that these definitions are rather more fluid than are generally usual in other educational and academic contexts.'* Nonetheless, the blended usage of loosely defined concepts likes simulations, games, microworlds and immersive spaces would probably overlook the unique strengths and weaknesses of each of those entities, which was what Hay (2006) insisted on avoiding in research into GBL practice and R&D for new instructional games.

Another prerequisite suggested by Hays (2006) for studying games is to familiarise oneself with the descriptions and classification of games, as shown in the previous chapter. However, de Freitas (2006, p. 53) proposed an opposite solution to issues related to games terminology and classification:

> *'There is a need for educational games to appropriate their own terminologies although this may create greater confusion when researchers and game developers attempt to work together.'*

While agreeing with the presence of the terminology problem, this thesis opposes the idea of creating an academic-specific terminology for GBL because this will hinder the effectiveness of collaboration among academics, teachers and game developers. Perhaps, this prompted a need for alternative solutions for the terminology problem. Nevertheless, any possible solutions should at least consider the trends predicted by de Frietas (2006) (see Table 3.6). These trends had indeed directed the choice of specific issues that formed the research of this doctoral study.

Table 3.6: GBL trends predicted by de Frietas (2006)

Predicted trends	Findings through consultation
Widespread use of game technologies and serious games movement	Wider use of game technologies in the home is increasing the interest in the use of games in educational contexts, and in turn leading to increasing use of games in formal educational contexts.
	The serious games movement is a trend towards designing and analysing the use of games for supporting formal education and training objectives and outcomes.
	The serious games movement aims to meet the significant challenge of bringing together game designers and educationalists to ensure fun and motivation as well as demonstrating educational value.
Authoring and developing of immersive world	The potential of GBL is perceived through the trend of modifying game applications for educational purposes.
	The game modification-related trend has implications on the learning design and the changing roles of teachers/ tutors.
	Self-authored content may promote opportunities for team and cross-disciplinary teaching and learning.
Growth of online gaming and online gaming communities	Online games may be used in formal education to support learning outside formal learning contexts and to support distance, lifelong and distributed learning groups.
	Online gaming produces seamless learning experience which blends learning at work or home with formal learning institutions.
	Learning that follows from online experience may place a greater emphasis on team learning and collaborative learning, which could then form and maintain dedicated learning 'communities of practice'.

3.4 Reflection in the search for research issues

Reflection played an important role in the incubation and development of this doctoral study. The reflection involved a continuous introspection of pre-doctoral learning and working experience. The introspection of accumulated knowledge and experience was complemented by a series of research idea externalisations, where concept papers, work-in-progress reports and milestone research papers (see list of papers published under this doctoral research, p. xix) were written, reviewed and published officially or semi-officially (web-based). The introspection and externalisation activities were planned as a journey of exploration at the beginning of the research. Figure 3.5 illustrates the journey of searching GBL issues between the initial topic of interest in March 2008 and the final decision in February 2009, which was led by the positive shift of personal interest. The entire research domain was in the dark at the start of the study, providing ground for GBL researchers to study and to shed light for each other within the domain. The coverage of each research study reviewed in the literature was subjected to the expertise and experience in the domain. As shown in the illustration, key players in the research domain are stars in various sizes, while others are in different forms, shapes or colours. Several technically and financially restricted areas were discovered, as research into GBL could involve the use of costly psychological and physiological equipment while game development requires computing hardware, software and technical skills which are expensive to acquire in terms of time and money. Several waves of preliminary literature review were carried out, mainly to examine the phenomena and the concepts used in constructing the understanding of the phenomena. While the literature reviews which defined and explained key GBL concepts were compiled as Chapter 2 in this thesis, most of the earlier GBL issue-related reviews were discarded because they were no longer the focal point of this thesis and these references are not included in the list of references. The interest of this thesis changed over time during the exploration before finalising the specific GBL issues of concern.

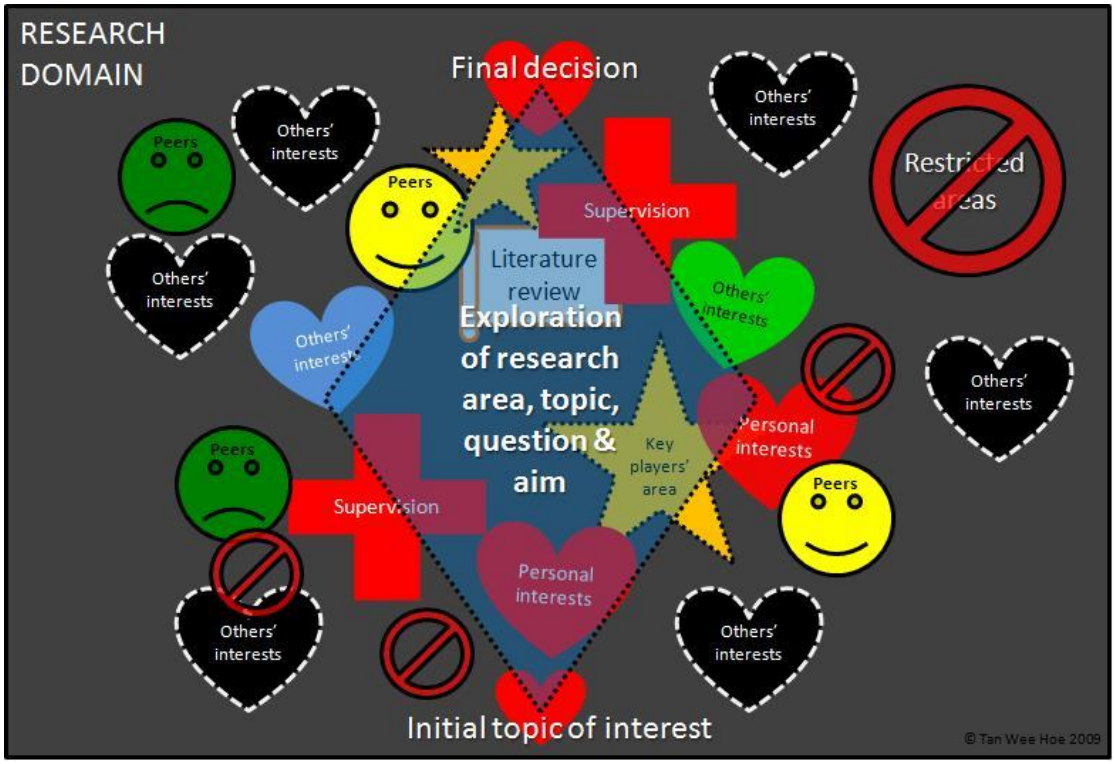


Figure 3.5: The illustrated journey of exploration between March 2008 and February 2009 in searching GBL issues that were feasible and worth researching at doctoral level

3.5 Selecting a specific research topic

After collecting papers submitted for a GBL conference, the host of the conference classifies the selected papers into a list of themes or streams (Table 3.7). This practice was used here to verify the ecological validity of GBL issues identified in this research. The themes of GBL studies were used to map those issues, in which certain issues of games which were not generally interesting to GBL research communities were discarded. After the filtration, one key issue and several associated issues were chosen.

Table 3.7 shows the classification of papers presented in European Conference on Games Based Learning (ECGBL) from its inception in 2007 to 2010. These papers were explored to identify gaps of research which are worth researching at doctoral level. Despite being a regional academic event, ECGBL had attracted participants and presenters who research into GBL from all over the World, thus justifying the importance of conference as an object of research.

Table 3.7: Streams of papers published in ECGBL proceedings between 2007 and 2010 (listed in order of number of papers)

2007		2008		2009		2010	
Stream	***f***	**Stream**	***f***	**Stream**	***f***	**Stream**	***f***
'Serious' games	7	Learning behaviours	10	Games &higher education	8	Doctoral colloquium	9
Engaging learners	7	Games based collaborative learning	7	Language, culture & politics	6	Educational games/ computer games	7
Evaluations using GBL	7	User-centred learning game design	6	Games in school-age education	5	Game research methods	6
GBL for educational institutions	2	Business simulation	6	Teacher's role, identity & presence in GBL	5	Game design	6
GBL in schools	2	Serious games	5	Design	3	Serious games	4
GBL for business training	2	GBL for history, heritage & politics	4	Simulation	3	Impact of GBL	4
Designing games	2	Non digital	4	Pedagogy & assessment	3	Group learning processes	3
Developing & using games	2	GBL in schools	3	Facilitating & analysing games	3	Games for children	3
Simulations	2	GBL in classroom	3	Video games & virtual learning	3	Application of games	3
		Game design	3	Games & health	3	Evaluation	3
		Mobile learning	3	Models & frameworks	3	Mobile gaming	3
		Social awareness / issues	3	Games in business & games classification	3	The teachers role	3
		Application	3	Problem appropriation & creative learning	2	Language learning & literacy	3
				Challenges & reflection	2	Analysis & assessment	3
Total	33	Total	60	Total	52	Total	60

Of course many of these 'streams' are overlapping but it can be seen that game design is a consistent area of interest with 19 papers on this theme Game design is not only an interest in ECGBL but also in other academic events and publications, such as the annual conference of The Society of the Advancement of Games and Simulations in Education and Training (SAGSET 2009), the special issue of British Journal of Educational Technology (BJET) titled *Learning from Games* (Maja 2007), and the upcoming International Journal of Game-based Learning (IJGBL). In conclusion, this issue of GBL was seen as worth studying and it also generated sufficient enthusiasm for a three-year individual research.

3.6 Focus of this thesis

After conducting three exploratory studies, the research aim was revised and finalised, leading the research to focus on examining how SMEs and game experts can collaborate to design and develop games for use in formal educational contexts. This focus was indeed the central issue that was affected by the perception discrepancy occurring among academics, teachers and game experts about the following GBL issues:

- the educational potentials of games,
- their terminology and classifications,
- the choice between bespoke educational games and commercial games, and
- the design and development of educational games.

In other words, the inconsistent perceptions held by those involved in GBL collaboration might be the core factor in moulding GBL practice as commonly practiced in formal educational contexts. Therefore, this research is not about GBL per se, it is about a series of perception comparisons between SMEs and game experts.

Perception is the way in which something is regarded, understood, or interpreted (The Oxford Dictionary of English 2005), i.e. in this case the intuitive understanding of and insight into GBL for formal education contexts. The perceptions of two kinds of experts were collected and analysed. As introduced in Chapter 1, SMEs are professionals with expertise in the field of education but usually without technical game production knowledge; while game experts are professionals with expertise in the field of game production. The notion of ‘game experts’ was limited to those involved in game production, not those who teach or research into games for academic purposes (see Figure 3.4 for comparison).

After synthesizing the findings of the literature review, reflection, and exploratory studies, the perceptions of SMEs and game experts about the following three issues were set as the scope of this research:

- Differing attitudes of teachers who use games in teaching.
- Differing attitudes within studios that produce games for use in formal education contexts.
- How SMEs and game experts could collaborate to design and develop games for use in formal education contexts.

3.7 Summary

This chapter has provided a literature framework for the GBL issues associated with this research and how the framework determined the choice of the key research question. It illustrated how the research justified this choice in both academia and the game industry and then depicted the bottom-up and top-down review approaches used in exploring GBL issues. The search for a feasible research topic was regarded as a journey that involved literature review, reflection and exploratory studies. The selected research topic is how SMEs and game experts can collaborate to design and develop games for use in formal educational contexts, while four GBL issues were recognised as influential aspects that relate to the formation of an ideal collaboration model.

CHAPTER 4: RESEARCH DESIGN

4.0 Introduction

This study adopted the definition of 'research design' coined by Bogdan and Taylor (1975) which refers to the entire process of research from conceptualising a problem to writing research questions, and the data collection, analysis, interpretation, and report writing. It is the logical sequence that connects the empirical data to a study's initial research questions and, ultimately, to its conclusions (Yin 2009). This includes the specific design features from the broad philosophical and theoretical perspectives to the quality and validation of a study (Creswell 2007). Based on these understandings and personal doctoral research experiences, a mind map which depicts factors that influence the research design of this study was created, as a representation of reflection at work (see Figure 4.1).

In practice, instead of proceeding to the instrumentation stage based on the proposal submitted for PhD candidature application, the initial rationale of the research design was reviewed through the act of introspection. New research knowledge and skills were gained to identify potential problems and limitations of the research design—reflexivity in practice. Based on these understandings, the research methodology and methods were refined rapidly. Along with the change in research questions, the study evolved from quasi-experimental design to correlational design, ethnography design and finally to mixed methods research design. Table 4.1 shows the evolution of the research design. The nature of the chosen research methodology is explained in the remaining sections of this chapter.

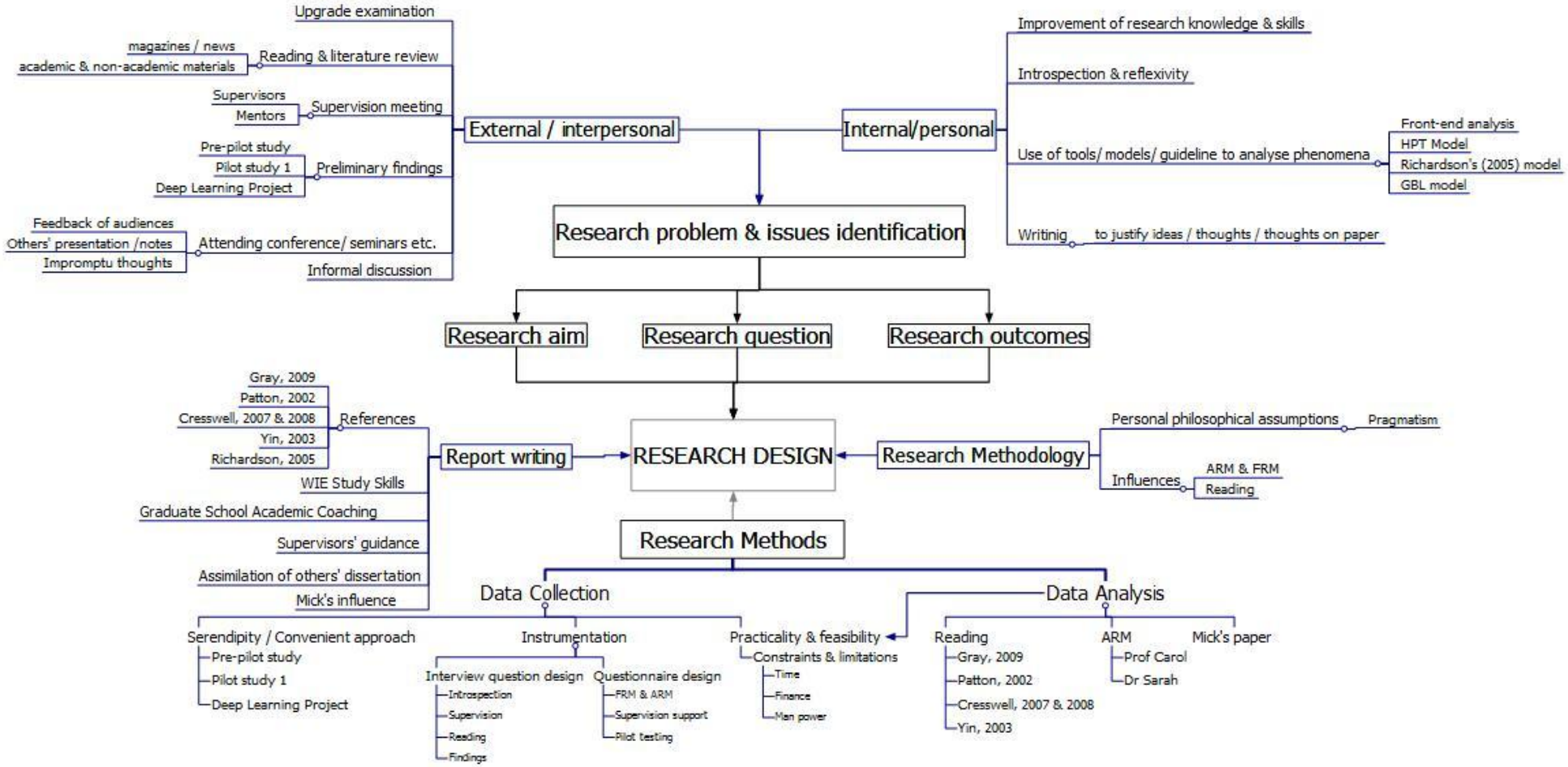


Figure 4.1: Factors and entities which have shaped the research design of this study, a representation of reflection and reflexivity at work

Table 4.1: The evolution of the research design

Version	Research methodology	Research methods	Reasons for change to next version
1	Quasi-experimental research	Quasi-experiment	Change of research aim, context & question.
2	Mixed methods: correlational design and ethnographic design	Survey, participant observation, interview	Longitudinal study might stretch beyond the funding and time provided.
3	Ethnography	Participant observation	
4	Mixed methods	Interview, observation, case studies	Change of inquiry paradigm
5	Multiple case study design model	Case studies	A more complex model is required.
6	Mixed methods: Spiral-segregated case study research design model	Semi-structured interview, focus group & questionnaire surveys	Adding or modifying components to the model
7			
8			The shift of research focus at the end of the study
9	Mixed methods: Evolutive spiral-segregated case study research model		
10			Final research model

4.1 The nature of inquiry

How a particular research is shaped, depends on the inquiry paradigms held by the researcher who designs the research (Creswell 2007). *A paradigm is 'a basic set of beliefs that guide action'* (Guba 1990). Besides being called paradigms, they are also regarded as worldviews (Creswell 2007); philosophical assumptions, ontologies, and epistemologies (Crotty 1998).

Educational research is always grouped under the two opposition paradigms—positivism and interpretivism (Cohen, Manion & Morrison 2007). Positivists believe that there can be objective knowledge, existing independently of the observer, that abides by universal laws and can be measured, quantified and predicted; while interpretivists argue that the social world is not the same as the physical world, thus a deep understanding of the particular is needed to form multiple meanings that are subjective and experiential (Cohen *et al.* 2007).

However, research is not a choice of paradigm. Having recognised these paradigm assumptions, this study takes a pragmatic approach in which the research question determines the choice of methods. Pragmatism is an inquiry paradigm that claims to have no commitment to any one system of philosophy and reality (Murphy & Rorty 1990). Instead of asking about reality and the laws of nature, pragmatists believe that

truth is what works at the time and it is not based in the dualism between reality independent of the mind or within the mind (Cherryholmes 1992).

Like other pragmatic research, this study focuses on the outcomes—the action, situations, and consequences of inquiry, rather than antecedent conditions (Creswell 2007). The key concern is what works and problem-based solutions rather than how the method works (Patton 2002). Therefore, the problem being studied and the questions asked about this problem are the determinant factors of the choice of research methods (see Rossman & Wilson 1985). Usually, according to Creswell (2007), researchers who embrace pragmatism will:

- use multiple methods of data collection to find out answer(s) for their research question,
- collect and analyse both quantitative and qualitative sources of data,
- focus on the practical implications of the research, and
- highlight the importance of conducting research which could best address the research problem.

Both quantitative and qualitative are terms which refer to data, not to methods *per se*. In this study, qualitative data was gathered to examine the complexity of issues related to GBL practices and collaboration in depth, and to form meanings and hypothetical propositions; while quantitative data was collected to generate numerical answers and to test hypotheses.

Data, whether they are quantitative or qualitative, are raw materials collected in a research study to be processed—normally through analysis, to become information. So information is processed data. When information is interpreted to become meaningful, knowledge is constructed. So knowledge is meaningful information, which could be used to answer research questions. Figure 4.2 shows the pragmatic view held in this research on how data analysis, information interpretation and knowledge construction relate to each other. In this sense, knowledge is regarded as justified true belief, or belief that is beyond reasonable doubt (Lagemaat 2005). In other words, knowledge requires justifications and the justifications have to be

acceptable—this prompts the issue of reliability which will be discussed in Section 4.7.

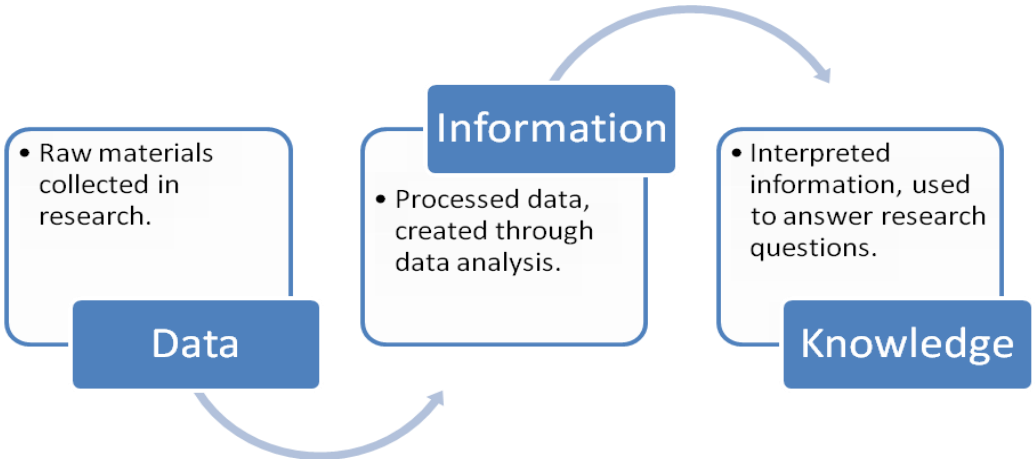


Figure 4.2: How knowledge could be constructed to answer research questions

4.1.1 The researcher's role in data analysis

In data analysis, one can either analyse raw data or processed data. Analysing raw data should include reflection on one's role played as the data collector and the investigator; while revisiting the processed data, one should involve meta-reflection, which encompasses the role played as the data processor and information interpreter in the past analysis process. Discrepancy may occur between the roles played by one researcher in two different timeframes. This discrepancy could lead to a self-disagreement state faced by the researcher from the outcomes of reflection and meta-reflection. To generate consistent and persistent outcomes of data analysis, the outcome of analysed data should be revisited as the knowledge and experience of the researcher accumulate, using the same method of analysis. The need for revisiting analysed data is echoed by Bryman (2008, p. 682) in which, *'social researchers should be reflective about the implications of their methods, values, biases, and decisions for the knowledge of the social world they generate.'* Once the analysis reaches the saturation state, third party, preferably experienced, researchers should be requested to review the final outcome, especially to challenge the fairness of data analysis.

4.1.2 Research diary

An online research diary was created at the early stage of this doctoral research. This diary acted as a log of research activities. The record of what has been done at different stages in the doctoral research serves four purposes:

- an *aide-mémoire* of short notes for later reflection (Gray 2009),
- a description of events related to doctoral research such as participation in GBL related workshops or conferences,
- a reflective account of initial impressions of collected data or tentative interpretations of analysed data, and
- a reflexive perception or reaction toward past events, such as ideas or insights that occur in mind after encountering event-related stimulation.

The chronological recordings of research activities gradually project the entire study as a journey, thus leading the creation of the evolutive spiral-segregated case study research model, which will be elaborated in Section 4.9.

4.2 The reflection–reflexion continuum

Qualitative studies are commonly challenged for their validity and reliability or trustworthiness due to the potential inconsistency in the data analysis process. The criticism relates to the role and awareness of the researcher as the core data interpreter or data analyser, regardless of their experience in doing research. Novice researchers, particularly those who are conducting doctoral research, usually face a self-disagreement problem with their own interpretation of qualitative data in different timeframes of their study, as they are constantly in the process of building knowledge and understanding of their field of study along the doctoral research journey. This problem, if left unsolved, might impair the confidence of researchers and become a barrier to their data analysis task. However, this problem of instability and inconsistency could be solved if the qualitative data analysis involves a systematic and structured reflection and meta-reflection process. This approach, in

turn could make the varied analysis outcomes become a strength of qualitative studies.

A model called ‘the reflection–reflexion continuum’ was developed and adapted to solve the problem of the inconsistency and instability of the outcome of qualitative data analysis in this research (see Figure 4.3). The model was used to juxtapose the change of roles when a particular dataset was analysed or interpreted in different timeframes: when the data were raw data, after the data were processed and became information, and after the information was interpreted and became knowledge. The role also changed in different stages of the research —as beginning researcher; as informed educational researcher. The continuum divided the differences between the act of reflection and the act of reflexion in terms of their influence on the research outcomes. The former consists of personal past experience, knowledge, skills and attitudes in educational research and the field of study; the latter involves the roles played as a doctoral student, an educational researcher and a specialist in the field of research.

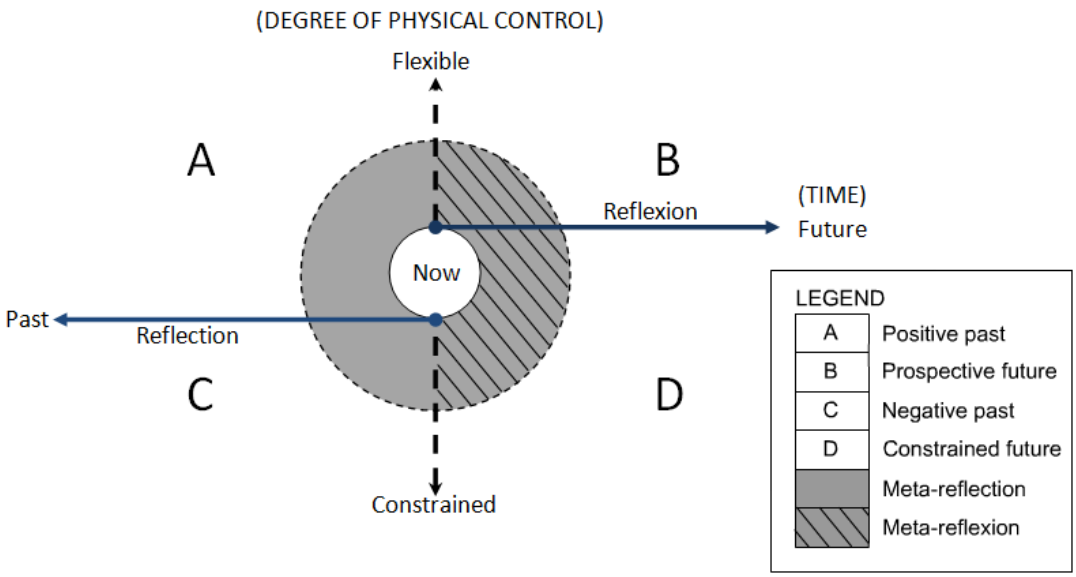


Figure 4.3: The reflection–reflexion continuum

In the development of this model, two key concepts—reflection and reflexion were compared, as shown in Table 4.2. Reflection is defined as serious consideration about research activities, especially one that is related to data analysis and results interpretation; while reflexion is the account of research activities that is recorded as

a response to stimulus without serious thought. Both reflection and reflexion share similarities in terms of flexibility: positive stimulus or past events increase the control over meta-analysis and meta-interpretation; while negative stimulus or past events limit the control. The control includes the choice of the methods and depth of analysis and interpretation. The fundamental difference between these two concepts lies in the temporal basis. Reflection is based on events in the past, which means it is asynchronous with the research activities that are under consideration. In contrast, reflexion happens immediately after encountering the stimulus of research activities. In other words, reflexion is synchronous with real-time events. With this comparison, this thesis attempts to revitalise the term 'reflexion', which has been regarded as an archaic spelling of reflection by The Oxford Dictionary of English (2005). Besides, since 'meta' is *'a prefix placed before a word in order to describe properties about the original word'* (A Dictionary of the Internet 2009), meta-reflection is reflection about reflection, while meta-reflexion is reflexion that is based on reflexion. However, as meta-reflection and meta-reflexion are based on the range of their associated reflection or reflexion, a hypothetical compound, denoted in grey colour in the continuum was drawn to represent the conceptual, rather than physical, boundary.

It is worth mentioning that the concept of reflexion must not be confused with an ambiguous concept 'reflexivity'. Although both reflexion and reflexivity share an identical root word 'reflex', reflexivity emphasizes the importance of self-awareness, political / cultural consciousness, and ownership of one's perspective (Patton 2002). Indeed, as the existing meanings of reflexivity in social sciences do not suit the context of the continuum, the need to revitalise 'reflexion' is reinforced. Meanwhile, Hertz's (1997) explanation on being reflexive echoed the characteristics of reflexion in qualitative analysis. According to Hertz (1997), being reflexive involves self-questioning and self-understanding, which relates to an ongoing self-examination of what one knows and how one knows about a particular experience while simultaneously living in the moment.

Both reflection and reflexion are further divided into two opposing domains in the continuum, by referring to the degree of the researcher's physical control. The degree of physical control is associated with the extent of manipulation one could

have upon the quality and quantity of data. Unlike quantitative studies, the collection of qualitative data is generally cross-sectional, i.e. linked to phenomena that happened in a specific, defined section of time. While recognising events that took place during data collection are not reversible in natural settings, three core activities: analysing raw data, interpreting processed data, and constructing knowledge are indeed revisable in qualitative studies. During the revisiting of data analysis process, positive events or stimuli like helpful research participants, acquiral of effective analysis methods or motivation given by peers allows room for improving the quality of research outcomes (as in quadrants A and B); while negative events or stimulus such as difficult participants, insufficiency of resources or the loss of mental support, would restrict the yield of research outcomes (in quadrants C and D).

The main function of the reflection–reflexion continuum in qualitative data analysis is to act as a framework for classifying research outcomes, which could contribute to the attainment of a saturation state in the data analysis process, in turn justifying the trustworthiness of the research findings.

Table 4.2: Comparison between reflection and reflexion

	Reflection	**Reflexion**
Root word	Reflect	Reflex
Definition	Serious consideration about research activities, especially one that is related to data analysis and interpretation.	Account upon research activities that is recorded as a response to a stimulus without serious thought.
Temporal basis	Based on events in the past.	Based on stimulus encountered in real-time.
Relationship with stimulus	Passive, delayed and asynchronous.	Active, immediate and synchronous.
Degree of physical control	Reflection or meta-reflection on positive past events could increase the flexibility of meta-analysis and meta-interpretation.	Reflexion or meta-reflexion on positive stimulus could increase the flexibility of meta-analysis and meta-interpretation.
	Reflection or meta-reflection on negative past events might limit the flexibility of meta-analysis and meta-interpretation.	Reflection or meta-reflexion on negative stimulus events might limit the flexibility of meta-analysis and meta-interpretation.

The proposed model was developed based on a comparative analysis of the role played by reflection and meta-reflection in this study and on a review of a similar role undertaken by reflection in a completed doctoral research study, which aimed to explore the experience of Asian students in the UK in a natural setting (Tan & Wu 2010). Both of these studies intended to answer research questions using mixed methods, and their main approach is qualitative. They also shared an exploratory nature in natural settings. Based on these commonalities, the design of the studies were compared and contrasted to juxtapose the similarities and differences in terms of their mixed method nature, data collection methods, data analysis methods and the conduct of reflection and meta-reflection along the doctoral journeys. The juxtaposition is meant to extract the elements of reflection and reflexion in the studies and to map those elements into a model that could justify their value in the research process.

Besides analysing two doctoral studies, the development of the model also gained inspiration through the research methodology literature. According to Gibbs (2007), the quality of qualitative analysis depends on its claimed objectivity—its freedom from bias or partiality. A constant proposal for safeguarding the quality of qualitative research is to include reflexivity components in one's research (Gray 2009). Thus, Patton's (2002) triangulated inquiry model was used to direct the interpretation of qualitative data, in which the analyses were conducted from three perspectives: the inquirer or the researcher, the inquired participants, and the key stakeholders of the research (see Figure 4.4). Each of the perspectives took predetermined reflexive screens into consideration during the analysis, which could be culture, age, gender, class, social status, education, family, political praxis, language and value. While these directions may assist researchers to increase the number of perspectives targeting the research issues, they may not help the researchers' interpretation reach a saturation state over time, hence justifying the need for a mechanism that focuses on how the reflection and reflexion could be structured to make interpretation stable, consistent, persistent if not saturated. To resolve this challenge in the current research, a mixed methods research design model, followed by an evolutive spiral-segregated case study research design model were developed. The following sections of this chapter explain the design and development of these models.

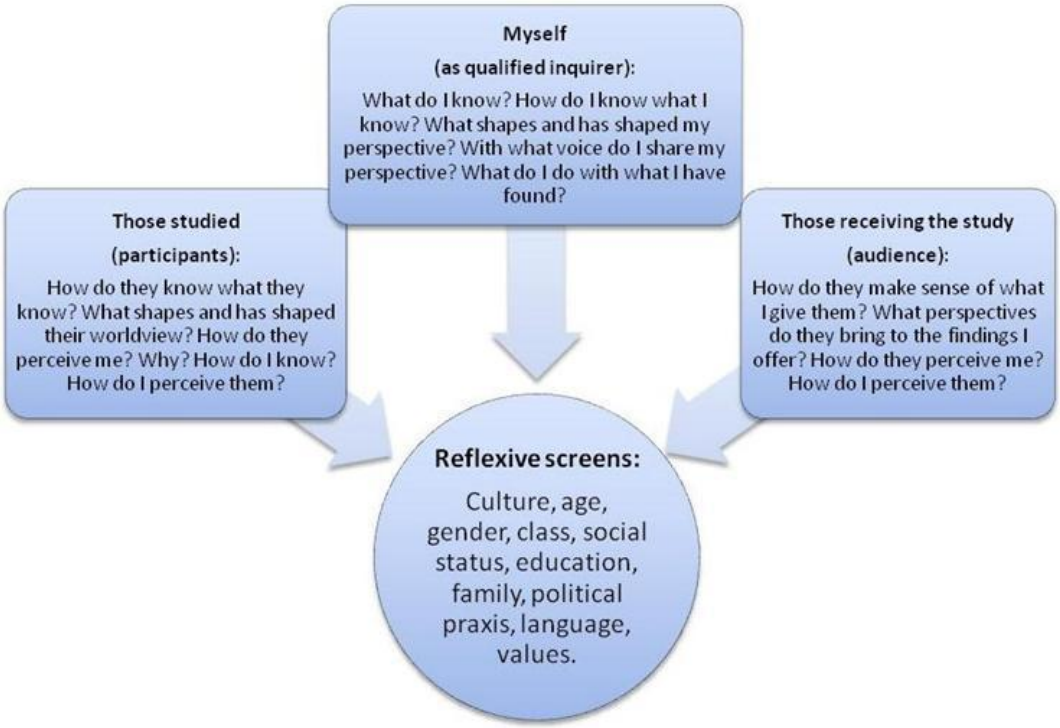


Figure 4.4: Triangulated inquiry model. Source: Patton 2002

4.3 Mixed methods research design

Mixed methods design is a type of research which involves *'the collection or analysis of both quantitative and qualitative data in a single study in which the data are collected concurrently or sequentially* (Creswell 2003, p.215).' Both quantitative and qualitative traditions were combined in this research on the basis that *'research issues in education are often so complex that the insights of both approaches are required if we are to gain a good understanding* (Newby 2010, p.128).' Creswell's (2008) explanatory mixed methods design was adapted as a major part of this research. The overall design is divided into three stages: exploratory, confirmative and explanatory (see Figure 4.5). The linear sequence of these stages is planned, as suggested by Gray (2009, p. 206), *'mixed methods design is used in circumstances where relatively little or nothing is known about the research setting or research problems. In such situations, it would be unfeasible and impractical to design a questionnaire, since the constructs being measured are either unknown or not sufficiently understood.'* The exploratory studies, then, *'explore, identify and can provide clarity about the kinds of variables requiring further investigation.'*

4.3.1 Exploratory–confirmative–explanatory nature of studies

This research began with an exploratory, bottom-up analysis framework which provided the ground for the identification and classification of key issues and concepts. The identified concepts and issues were classified and discussed in Chapter 2. Two issues were chosen for further investigation—the problematic delineation of the perceived potentials of e-games between SMEs and game experts; and how the potentials of e-games can actually be converted into benefits to achieve preset learning objectives in a formal education context. The findings of the three exploratory studies directed the development of a questionnaire survey which was used to collect quantitative data. The questionnaire acted as a validating instrument for the qualitative findings in the exploratory studies. The questionnaire findings were then excavated and deepened by follow-up semi-structured interviews; while the findings of the interviews were used to explain the rationale behind the views of those respondents in the questionnaire surveys. The explanation of the phenomena constructed the 'justified true belief', which is the perceived knowledge which supports the foundation of the conclusions of this research. Table 4.2 presents the purposes of conducting each study at each stage of this research, alongside with the types of participants and the selected data collection methods.

Each research stage consists of two core tasks, which are data collection and data analysis. The combination of all instruments or techniques deployed in a particular stage is regarded as the research methods of the stage. Such separation of research methods is crucial in this research because 'semi-structured interviews' were used to collect data in both exploratory and explanatory stages but with different intentions. Although most of the interview questions used in the former stage were reused in the later stage, my role as the interviewer turned from behaving as an active inquirer to being a passive listener. The change was intentional in both stages. In the exploratory stage, most of the interviewees were my ex-colleagues and/or ex-course mates, therefore the active inquiry would prompt them to justify their opinions, conceptions and misconceptions, hence generating more narrative texts for bottom-up analysis. In the follow-up interviews, the participants had already been prompted to project their perceptions in their response to the questionnaire. They chose to

participate further voluntarily because they intended to comment on the issues highlighted in the questionnaire, thus my being a passive listener was more research-effective.

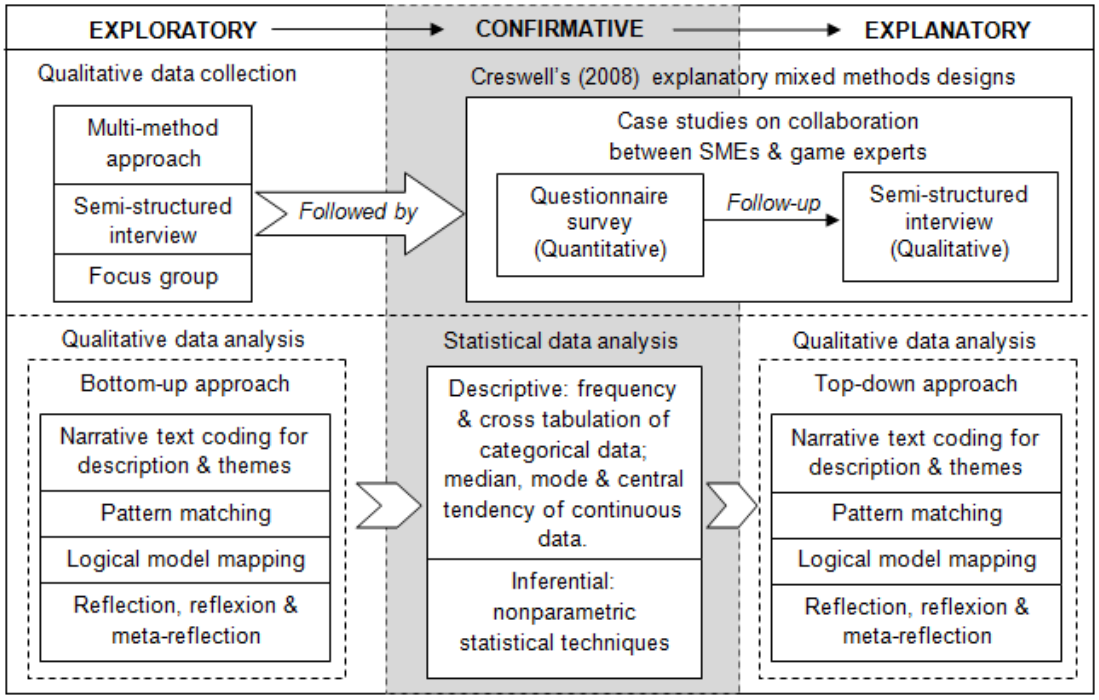


Figure 4.5: The mixed methods design of this research

Meanwhile, the data analysis techniques used in both exploratory and explanatory phases are identical but the approaches are different. A bottom-up approach was adopted in the former, in which the search for and the formation of research outcomes was emergent, *'proceeding from the bottom or beginning of a hierarchy or process upwards;'* (The Oxford Dictionary of English 1989) while in the explanatory stage, a top-down approach was pre-planned, *'proceeding from the general to the particular'* (The Oxford Dictionary of English 1989) to construct multiple meanings of the studied social phenomena. The details of each research method in each stage will be depicted in later sections of this chapter.

4.3.2 Choosing case study as the basis of the research approach

Case study was chosen as the underlying research approach of this study. The term 'approach' was preferred to 'tradition' (Creswell 1994), 'strategy of inquiry' (Denzin & Lincoln 2000; Tesch 1990), 'variety' (Tesch 1990), or 'method' (Morse &

Richards 2002). ‘Approach’ was preferred because the conditions of this study are coherent with Yin’s (2009) justification of employing case study research:

- the research question of this study is being posed as a ‘how’ question,
- there would be either no or little control over events happening in the cases being studied,
- the focus of this research is on a contemporary phenomenon which is the collaboration between SMEs and game experts within some real-time contexts, specifically the formal education setting in the UK, and
- the relationship between the views held by SMEs and game experts will be measured.

4.3.3 Individual participants as the units of analysis

As the focus of this research is to compare opinions and attitudes of participants towards the potentials of games, the use of games and the perceived ideal and usual practices in GBL collaboration, the units of analysis are the individual participants rather than the games, the GBL or the GBL collaboration which they mentioned in the data collection process. Table 4.3 shows the types of participants involved in this research.

Table 4.3: The types of participants involved in each stage of this research

Stage	Purpose	Types of participants	N	Methods
Exploratory	Exploring the potentials of GBL (Tan *et al.* 2008).	Secondary Mathematics Trainee teachers	25	Multi-method approach
	Exploring the educational potentials of GBL (Tan *et al.* 2010).	Practitioners in the commercial game industry	8	Semi-structured interview
	Examining the perceptions of a specific practice of GBL (Tan *et al.* 2009; Tan *et al.* in press).	Six-form students	9	Focus group
		A-Level Biology teacher	1	Focus group & informal chat
Confirmative	Comparing the attitudes of SMEs and game experts to perceptions on teachers who use games in teaching; studios that produce games for use in formal education contexts; and how SMEs and game experts should collaborate to design and develop GBL for use in formal education contexts.	School teachers / tutors	41	Cross-sectional questionnaire survey
		Academic researchers	12	
		Commercial game experts	17	
		Educational game experts	14	
		Undergraduate students who study games	10	
Explanatory	Explaining why respondents perceive the GBL as they did in the survey by examining their conceptions, misconceptions, understandings, misunderstandings and expectations towards the practice, the collaboration, and the people who are related to GBL.	School teachers / former teachers	5	Follow-up semi-structured interview
		Educational strategist/ learning technologists	2	
		Academic or GBL researchers	6	
		Commercial game developers	2	
		Educational game developers	3	
		Undergraduates who study and develop games	4	
		TOTAL	159	

*Some academic researchers developed games and used their games in teaching and research activities, so they are regarded as educational game developers as well.

4.4 Ensuring reliability and validity

Reliability and validity are two prominent criteria for assessing the quality of research, thus ensuring them was a constant action taken throughout the doctoral research journey.

In the social sciences, Bryman (2008) stressed that reliability is crucial to ensure the consistency of the measures which are devised for concepts. These concepts are related to human behaviour, attitudes and perceptions, which may not be directly observable. Thus they need to be defined operationally or to be reduced to directly

observable patterns which are measurable (Krishnan Guru 2005). Therefore, the reliability of a measure refers to the stability and consistency of the instrument which is used in making the concepts measurable. Trustworthiness is a synonym of reliability but used in the contexts of qualitative research (Bryman 2008).

Validity is related to whether an instrument measures what it was intended to measure (Gray 2009). Thus, it is concerned with the integrity of the conclusions of a study (Bryman 2008).Three types of validity were taken into consideration throughout this research: internal validity, external validity and ecological validity.

Internal validity refers to *'the extent to which the instrument measures the concept it was intended to measure and not something else.'* (Krishnan Guru 2005) Three aspects were examined in this research, namely construct, content and criterion-related validity. How these aspects of internal validity related to this research is shown in Table 4.4.

Table 4.4: Types of validity and the corresponding instruments used in this research. (Adapted from Bryman 2008; Krishnan Guru 2005)

Criteria of research quality		Functions
Reliability or trustworthiness		Evaluate the stability and internal consistency of a measure or an instrument. The stability can be examined through: - test-retest method where an instrument is used at two different points in time and the correlation between the responses are compared, and - parallel forms where two forms of the same questionnaire are devised except that the questions are ordered and worded differently in the two forms. The internal consistency can be examined by checking whether the respondents' responses to all the items are consistent.
External validity		Evaluate the generalisability of measuring instrument across persons, settings and time.
Internal validity	Construct	Assesses the extent to which the items included in the instrument covers all the components of the concept being measured based on some underlying theory regarding the concept. Can be established when: - the results obtained by the instrument are highly correlated with the results of an already existing instrument for the concept which is known to have construct validity, and - the responses on two variables that are known to be independent of one another based on theory are in fact uncorrelated.
	Content	Assesses the extent that the items to be measured represent the universe of the concept being measured. Can be verified by getting the opinion of a panel of experts on the relevance of the items.
	Criterion related	Assesses the extent to which an instrument differentiates individuals based on some particular criterion. Can be established when individuals who are known to be different, based on some criterion, respond differently on the test instrument.
Ecological validity		Assesses whether the findings are applicable to research participants' everyday, natural social settings.

The following sub-paragraphs depict how the issues of reliability and validity were addressed to ensure the measures done by every research instrument, and the results generated through those measurements, are as valid and reliable or trustworthy as possible.

4.4.1 Multi-method approach

The multi-method or multiple methods approach was used under a role-playing mode in the first exploratory study (ES1) which aimed to investigate the perceived potential of GBL through the eyes of trainee teachers. Although the multiple data

collection approach was only applied once in ES1, the use of the multiple data analysis approach extended to the explanatory stage of this research.

ES1 was divided into two sessions, in which all participants played the role of SME in the first session and game designer in the second. Five different methods were deployed to gather four kinds of data and to test their suitability and practicality for other studies (see Table 4.5).

Table 4.5: The types of instruments used and the nature of data collected in the first exploratory study

Instruments/methods	Kinds of data	Nature of data
Brainstorming	Perceived potentials of GBL	Qualitative
5W1H Worksheets	Self-justifications of the perceived top ranked potential of GBL	
Six Thinking Hats Worksheets	Self-evaluations: the evaluation of the self-justifications	
Single-page treatment form	Game design treatments	
Post-session feedback questionnaire survey	Responses and comments on the conduct of the study and the use of instruments	Quantitative & qualitative

Apart from the six closed questions about the conduct of game design activity in the second feedback form, all collected data were qualitative. Written text was the only form of qualitative data collected in this study. Although it would be common to express game or GBL ideas through graphical or auditory representations, written text was preferred, to match the choice of data analysis techniques. The collected data were sorted using NVivo (Bryman 2008, p. 569). Three analysis techniques were used to analyse the data: narrative text coding, pattern matching and logical model mapping. These techniques were employed in all qualitative data analyses throughout the doctoral research.

The narrative text coding technique was an adaptation of Creswell's (2008) qualitative process of data analysis. A narrative is a spoken or written account of connected events (The Oxford Dictionary of English 2005). Written accounts were coded to form themes and to describe either the themes or interesting issues mentioned by participants.

The second analysis technique was pattern matching (The Oxford Dictionary of English 2004). Pattern is a form of qualitative finding (Patton 2002); which appears

in a regular and intelligible form or sequence discernible in certain actions or situations, especially one on which the prediction of successive or future events may be based (The Oxford Dictionary of English 2009). In the research, the process of identifying, analysing and interpreting the presence of comparable patterns in perceptions was named as pattern matching. This technique has been used in psychological studies since the 1960s (Campbell 1966), but it was Yin (2009) who transferred the concept to case study research in the 1980s, when he claimed it as *'the most desirable analytic strategy in case study research'* (Hak & Dul 2009).

The third technique used to analyse the qualitative data is called 'logical model mapping'. This technique was inspired by the idea of logical model used in computer database design; as Phelan (2003) explained, *'a logical model is a way to draw your mental roadmap from a problem specification to an entity-based storage system.'* In the preliminary literature review of this doctoral research, key concepts and issues related to GBL were identified and connected to construct a working logical model—the GBL model version 1.1 that imitated the idea used in database design (see Figure 4.6). The GBL model juxtaposes the inputs needed in a linear game production process, which could be acquired from academia, the creative industry and a specific GBL context. Academics who study games for use in educational contexts could define learning objectives at the beginning of the production using a generic ADDIE instructional design approach. Instructional design is *'the systematic approach to the **A**nalysis, **D**esign, **D**evelopment, **I**mplementation, and **E**valuation [ADDIE] of learning materials and activities'* (McGriff 2000). After that, experts in the creative industry could create storylines and plots during the game design and development process, in which the core mechanics are set. This would be followed by determining the artistic direction of the game, which involves interface and graphic design. Once the game is produced, SMEs or teachers could develop the instructor's guide which depicts how the game could be used to provide or facilitate fun and engaging learning experience.

The GBL model was used in a logical model mapping process to identify the gaps of knowledge and skills in three domains of study: academia, the creative industry and GBL context. The term 'mapping' was adopted from Mathematics, where it means 'be associated with or link to' (The Oxford Dictionary of English 2005). The gaps

were identified by comparing the desired roles and responsibilities of subject matter experts (Felicia 2009) and game experts (Rollings & Adams 2003), with the findings drawn from the actual and perceived usual practice of participants.

The use of multiple methods in both data collection and analysis processes was indeed an attempt to enhance the trustworthiness of the overall research outcomes, particularly in the self-justification and the self-evaluation processes. The use of NVivo was another effort made to technically enhance the consistency of the analysis procedure (Bazeley 2003).

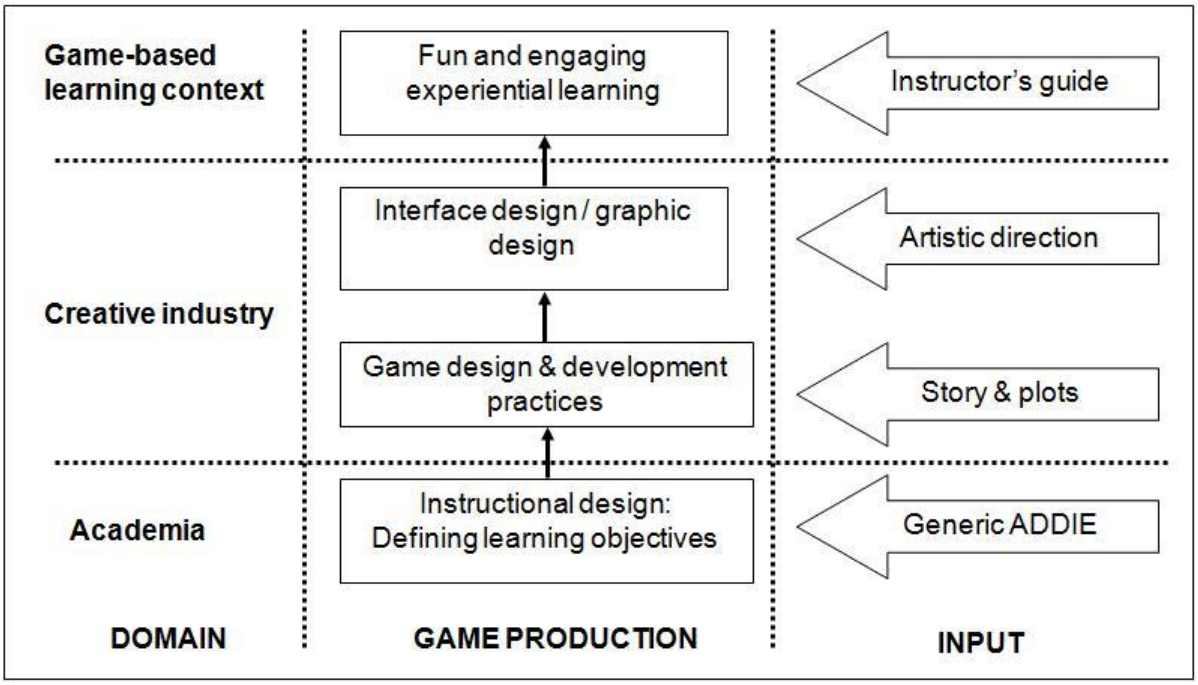


Figure 4.6: GBL model version 1.1, the logical model developed based on the preliminary literature review

In terms of external validity, like all other methods employed in exploratory studies, the multi-method approach was not designed to make any statistical generalisation due to the small number of participants involved in these studies (Lincoln 1985). However, analytic generalisations were made based on the conclusions of those studies. Such generalisations were relatively more intuitive, ideographic and empirical (Lincoln & Guba 1994). The results of these exploratory studies were used to build hypothetical propositions which were tested analytically in both confirmative and explanatory stages.

As for internal validity, the development and the use of the logical data mapping aimed to cover most if not all components of the GBL concept.

In terms of ecological validity, trainee teachers and teachers should be able to apply the findings in their teaching because the research outcomes were context-oriented, which means based on the justification and evaluation by the trainees who completed the PGCE programme.

4.4.2 Semi-structured interview

Semi-structured interview was the method used to collect qualitative data in the second exploratory study (ES2) and follow-up interviews in the explanatory stage. Although the questions used in both stages were alike, the rationales behind those usages were different. The former aimed to explore the extent of GBL concepts and issues through the eyes of experts in the creative industry; while the latter was meant to explicate the reasons why SMEs and game experts agreed or disagreed on the findings of the exploratory studies.

The interview questions were developed based on the preliminary literature review and the findings of ES1. GBL model version 1.1 was also used to establish their internal validity. Some of the questions were reworded into two to three versions used as alternatives to suit the action and reaction of the interviewees during the interview session, hence enhancing the reliability of the data.

To ensure the stability of interviews, a set of identical interview questions was sent to interviewees in advance. When an interview was being carried out, a digital voice recorder was used to capture the actual conversation. Then the recordings were transcribed on a verbatim basis. After that, all transcriptions were sent to interviewees to verify their authenticity. If a transcription needed to be translated to English, interviewees would be requested to check the accuracy of the translation. In the case where interviewees' English language skills were not competent to cross-check the translation, the translated work would be re-translated back to the original language, and sent back to the interviewee for verification. In one case in ES2, a third party translator who possesses a qualification in translation studies was hired to complete the task. The outcomes were then compared and contrasted to generate the most appropriate version of the transcription in English.

In ES1, open-ended demographic profile questions were asked, and the answers received were used to form themes or tags to classify and differentiate interviewees. These tags were then used as the response categories of closed questions asked in the questionnaire survey (QS) of the confirmatory stage. No demographic questions were asked in follow-up interviews because the interviewees had been respondents in QS.

To improve the content validity, the interviewees of ES2 who were game experts, were requested to comment on the relevance and usefulness of the questions they answered at the end of their interview sessions. Their comment was considered in enhancing the internal validity and the ecological validity of this method when it was used in follow-up interviews.

Like the multi-method approach used in ES1, the semi-structured interview was meant to generate analytic generalisations rather than statistical generalisations. However, since ES1 had already gone through a peer-review process before it was published in an international refereed journal paper, the validity and trustworthiness of the method could be seen as justified.

4.4.3 Focus group

A focus group was used in the third exploratory study (ES3), a study aimed to examine the perceptions of nine sixth form students towards the use of a GBL solution in a formal education context. This method was selected to gather a variety of opinions, or more consistent/contradictory voices from the participants in the available time. The focus group in this study took a combination of three forms: a group interview, a group discussion and an exploration of individual views in a group context, in which both interview and discussion happened concurrently (Newby 2010).

Since ES3 was a subset of a research project funded by Becta (Abbot, Townsend, Johnston-Wilder, & Reynolds 2009), the questions used in the focus group were reviewed and verified by two senior educational researchers. Internal and external peer-review was carried throughout the conduct of this study to ensure its trustworthiness and validity before its official publication.

4.4.4 Cross-sectional questionnaire survey

Three GBL issues were chosen for further investigation at the end of the exploratory stage. Each of these issues consists of a list of findings which were the results of analytic generalisation, generated from qualitative data analyses. These findings were treated as hypothetical propositions in the questionnaire design. In other words, each item of the response category was in fact a finding from the exploratory stage.

The questionnaire went through several major and minor revisions before it was finalised and distributed to targeted respondents. Pilot-testing was done with six SMEs: four PGCE tutors at the WIE, a further education teacher/assessor in Chester and a teaching development fellow from Coventry University.

The reliability of the QS was examined at two levels. The internal consistency was assessed by checking whether the respondents' answers to all the items were consistent. If a particular respondent participated in a follow-up interview, the responses in QS were cross-checked with the answers given in the interview. SPSS was used to analyse the data collected in the QS; four types of nonparametric statistical tests—Kolmogorov-Smirnov test, Wilcoxon Signed Rank test, Mann-Whitney U test and Kruskal-Wallis test were run (Siegel & Castellan 1988; Pallant 2007).

Due to the limitation of resources available, a modest sample size of 60 was targeted and 94 responses were collected in QS for practical purposes. Therefore, the ability to generalise is limited. Nevertheless, *'when working with such modest samples, it is the quality of the sample that becomes more important rather than the size.'* (Gray 2009, p. 153) All the responses were carefully evaluated and only those which met the predetermined criteria were tagged as valid.

4.5 Ethical issues

Ethical approval was granted twice, first for ES1 and secondly for all subsequent studies, by WIE (see Appendix I). For each study conducted in this research, an information sheet (see Appendix II) and a consent form (see Appendix III) were created and delivered to each participant before data collection. In the QS, a covering letter was attached to the questionnaire and respondents could decide whether to fill

in the questionnaire or not after reading the letter (see Appendix IV & V). The data collected throughout this study were separated from any document that might reveal the identity of the participants. The computer used for storing participants' background information was password-protected. This was to protect the confidentiality of the data and to keep the data anonymous at all times. Identity codes were substituted for participants' names in the reports, articles and thesis writing (see Table 4.6).

Table 4.6: Identification codes used in this research to substitute participants' names

Studies	Identification codes	Number of participants
ES1	Trainee No.1–Trainee No.25	25
ES2	Interviewee 001 – Interviewee 008	8
ES3	M1–M3; F1–F6	9
QS	SME001–SME045; GX001–GX041	86
Follow-up interviews	SME_A–SME_K; GX_A–GX_K	22
	TOTAL	150

4.6 Beyond mixed methods design: the Spiral Research Model

Apart from the mixed methods design shown as Figure 4.5, an 'evolutive spiral-segregated' case study research model was developed to illustrate the doctoral research as a journey (see Figure 4.7). This model , a.k.a. the spiral research (SR) model, is a synthesis of the adaptation of both Eisenhardt's (1989) process of inducting theory using case studies and Yin's (2003) multiple case studies design model, plus the inspiration gained from Boehm's (1988) spiral model of software process.

4.6.1 Evolutive: temporal focus shift

The SR model is evolutive because temporal focus shifts occurred as the research progressed, which forms a pattern of movements or manoeuvres (The Concise Oxford English Dictionary 2008). The darker areas in Figure 4.7 represent the foci of the research. The initial focus of the model was placed in the central whorls. The focus shifted to the outer whorls by the end of the doctoral research as a result of the definition and redefinition process. This shift of focus was coherent with the exploratory–confirmative–explanatory nature of the mixed methods research design.

An animated version of this model is accessible at http://go.warwick.ac.uk/ep-edrhal/research/design/methods/.

4.6.2 Why spiral-segregated and how are studies linked to each other?

This model follows a six-step generic research process: definition and redefinition, design and development, data collection, analysis, evaluation, and report and conclusion (Creswell 2008). It is a six-whorl spiral, which is segregated by five milestones. Each milestone attainment marks the completion of a standalone study. The milestones are standalone because they are independent and can be published without being seen as a subset of a doctoral research. The spiral-segregated nature of this model not only enabled the accumulation of knowledge, skills and insights along the research journey, but also eased the project management as the research progressed. The status of research in progress could be easily identified by referring to the activity being conducted.

The research process integrates elements of both linear data collection and iterative analysis, which is an attempt to combine advantages of top-down and bottom-up research design. It is linear because the data were only collected at one point in a defined interval of time to meet the requirements set by research fund providers; it is iterative as the formative evaluation and cross-case analyses were carried out throughout the journey to reflect and reflex the research outcomes and the lessons learnt. As a result, one whorl of the spiral is linked to other whorls in two ways: chronological dependence and cross case synthesis / analysis. Analyses were done in each whorl at two levels—data analysis within each standalone study which generated preliminary findings; cross-case analysis between two studies which compared and contrasted their findings.

The findings in a study would eventually determine the modified research aim and outcomes of the subsequent study, thus after a particular hypothetical proposition is tested in one study, it will become the theoretical proposition of the next study, with or without modification. As a result, the data collection procedure and the data analysis strategy might be similar but not identical.

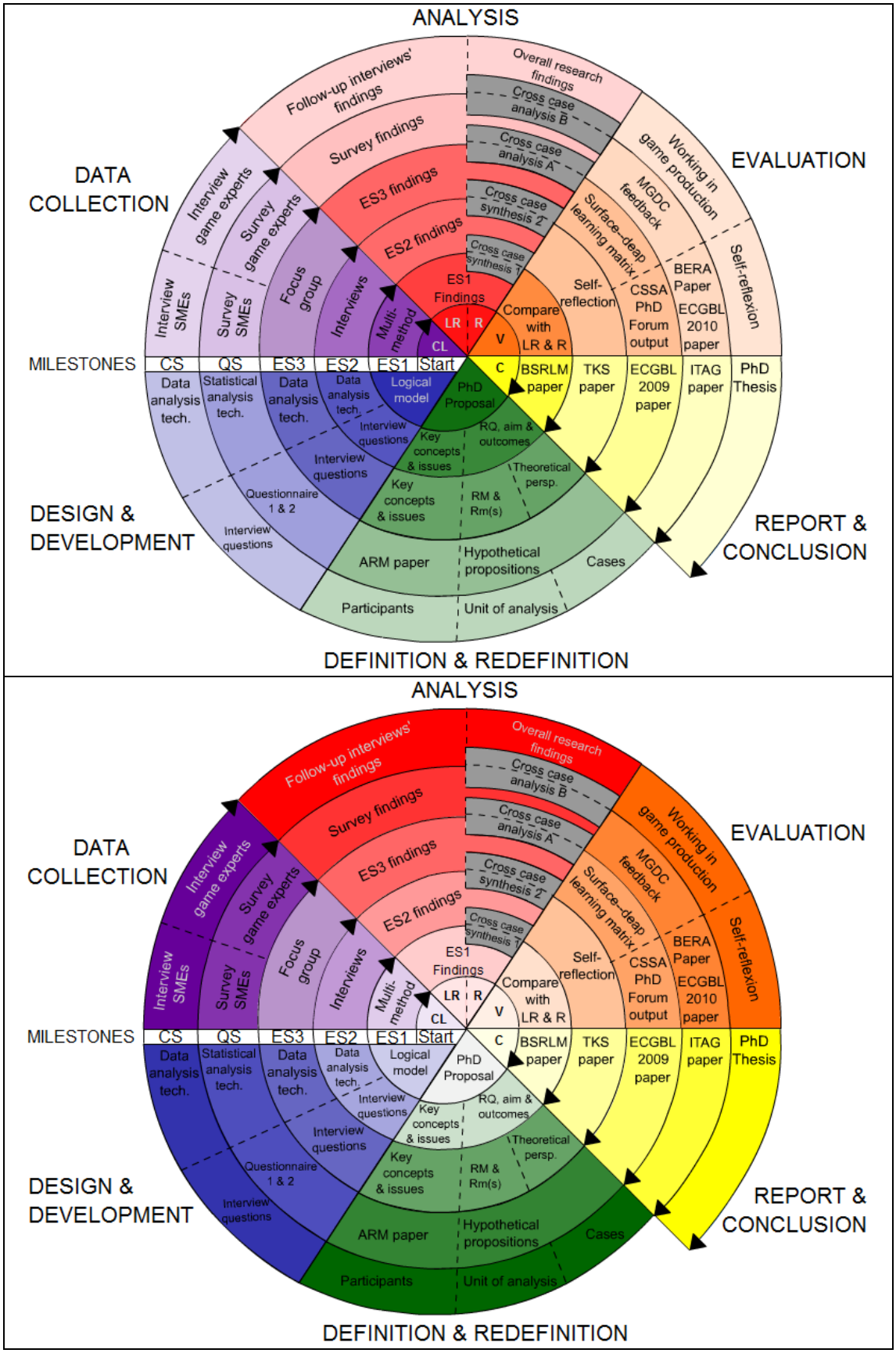


Figure 4.7: Two phases of the spiral research model. The legend of this model is attached to Table 4.7

Table 4.7: The grouping of activities carried out in each whorl under three research stages

Stage	Level	Legend	Description
Preparatory	Whorl 1	START	Started PhD in March 2008.
		CL	Collected literature related to GBL.
		LR	Preliminary literature review.
		R	Reflection on past experience.
		V	Verification of the usefulness of collected literature via reflection.
		C	Classification of literature.
		PhD Proposal	Reviewed and redefined the PhD Proposal.
		Logical model	Developed a GBL model.
Exploratory	Whorls 2–4	ES1, ES2 & ES3	The first, second and third exploratory studies
		Multi-method	Designed and developed data collection methods for use in exploratory studies
		Semi-structured Interviews	
		Focus group	
		ES1, ES2 & ES3 findings	Findings generated based on three exploratory studies.
		Cross-case synthesis 1 & 2	Juxtaposed and combined the findings and lessons learnt
		Compare with LR & R	Comparison of findings, preliminary literature review and reflection.
		Self-reflection	Recognised past experience through introspection.
		Surface–deep learning matrix	Evaluate the findings (teaching and learning outcomes) of exploratory studies using surface-deep learning matrix
		CSSA PhD Forum output	Presented papers in BSRLM Day Conference; the 6th International Conference on Technology, Knowledge & Society (TKS); the 1st PhD Forum of Chinese Students & Scholars Association (CSSA) & the 3rd European Conference on Games Based Learning (ECGBL).
		BSRLM paper	
		TKS paper	
		ECGBL 2009 paper	
		RQ, aim & outcomes	A paper was written for the Advanced Research Methods (ARM) training module, defining and redefining research question (RQ), aim, outcomes, key concepts and issues, theoretical perspective, research methodology (RM), research methods, and hypothetical propositions.
		Key concepts & issues	
		Theoretical perspective	
		RM & Rm(s)	
		Hypothetical propositions	
		ARM paper	
		Interview questions	Designed interview questions, data analysis techniques
		Data analysis tech.	
		Questionnaire 1 & 2	Designed questionnaire and determined statistical analysis techniques to be used in data analysis.
		Statistical analysis tech.	
Confirmative	Whorl 5	QS	Questionnaire surveys
		Survey SMEs &	Collect data through cross-sectional questionnaire surveys.
		Survey game experts	
		Survey findings	Findings generated based on 2 surveys
		Cross-case analysis A	Compared findings of surveys with exploratory studies
		MGDC feedback	Present papers in Malaysia—Glasgow Doctoral Colloquium (MGDC); British Educational Research Association (BERA) conference; and the 4th ECGBL.
		BERA paper	
		ECGBL 2010	
		Cases; Unit of analysis; Participants	Select and define cases, unit of analysis and participants in case studies
		Interview questions	Designed interview questions and data analysis techniques.
		Data analysis tech.	
Explanatory	Whorl 6	CS	Case studies
		Interview SMEs	Collected data through follow-up semi-structured interviews with SMEs and game experts.
		Interview game experts	
		Follow-up interviews' findings	Analysed interview transcriptions to generate findings.
		Cross-case analysis B	Compared and contrasted findings between QS and CS.
		Overall research findings	Review all the findings to generate overall research findings.
		Self-reflexion	Justified and evaluated overall research findings through self-reflexion and meta-reflection.
		Meta-reflect.	
		PhD thesis	Made conclusions and reported research in PhD thesis.

4.6.2.1 Whorl 1: preparatory stage

The beginning months of the doctoral research were focusing on preparatory tasks. Literature related to games, playing, learning, game production, games studies and research design were collected. A preliminary literature review was conducted to understand the background and contexts related to GBL and to identify issues that were considered worth studying at doctoral level. A reflection on past experience was carried out to identify and to analyse prior knowledge, skills and attitudes that might have implicitly constructed the underlying assumptions made in the initial doctoral research plan. The past experiences include learning in formal education (primary, secondary, undergraduate and postgraduate); game-playing while a child, a teenager, an undergraduate and a multimedia specialist; involvement in animation and multimedia productions as a producer, a coordinator and a 3D animator; teaching and training in multimedia courses; instructional systems design; diploma and degree programmes design and development; participation in Malaysia e-learning policy-making; and conducting, leading and evaluating academic research projects. The preliminary literature review and the identified assumptions (mentioned in Section 3.0, p. 44-45) were verified through informal chat and discussion with ex-course mates, ex-colleagues and peers in both academia and the game industry.

Both academic research publications and practitioners' writings on game productions were gathered and classified according to the structure of this research. The initial PhD proposal was reviewed and revised based on the outcomes of the preparatory stage. Key concepts and issues related to GBL were identified and connected to construct the GBL model that imitated the idea used in database design (see Figure 4.6). When the model was used in data analysis, the 'mapping' process revealed the gaps in knowledge and skills in instructional design, in game design and development practices, and in learning delivery.

4.6.2.2 Whorls 2–4: exploratory stage

In the exploratory stage, three exploratory studies were conducted, which involved the design and deployment of three types of data collection instruments, i.e. multi-method, semi-structured interview and focus group. Creswell's (2008) qualitative

process of data analysis was adapted as the core data analysis instrument in all three studies. Next, the findings of these studies were juxtaposed, synthesized and then analysed to integrate with the findings of later stages. Two 'cross-case syntheses' took place in this stage. The cross-case synthesis was a method used to combine the findings of ES1, ES2 and ES3 to form a connected big picture of the perceived potentials of GBL. Three types of identified perceptions—one from trainee teachers (as SMEs), one from practitioners in the creative industry (commercial game experts) and one from sixth-form students—were juxtaposed and integrated as the result of the synthesis. In this context, synthesis is *'the combination of components or elements to form a connected whole,'* which contrasted with analysis, defined as *'detailed examination of the elements or structure of something,'* (The Oxford Dictionary of English 2005) This definition of analysis was adopted in the cross-case analysis of this research, which was a method applied to examine the findings of two phases of studies through juxtaposition and comparison. The outcome of the synthesized findings was compared with the findings of QS in cross-case analysis A.

The findings of the exploratory studies and their meta-findings, or findings yielded from cross-case synthesis, were externalised through participations in forums, workshops and conferences related to GBL either as an inquirer or a presenter. Feedback gathered through the externalisation was recorded in the research diary and treated as normative evaluation measures. These measures shed light on the need to define and redefine key concepts, issues, the research question, the aim, research outcomes, theoretical perspectives, the research methodology, research methods, and hypothetical propositions.

In this research, hypothetical propositions were defined as statements or assertions that express judgements or opinions constructed through the collection of findings in exploratory studies, and served as hypotheses for statistical testing in the questionnaire survey. In other words, the questions asked in the questionnaire survey were actually the findings of exploratory studies, thus justifying the purpose of the naming of the stage that followed.

4.6.2.3 Whorl 5: confirmative stage

In this stage, two waves of cross-sectional questionnaire survey were conducted: the first wave with SMEs and the second with game experts. Apart from capturing the demographic profile of respondents, the questionnaire was intended to collect respondents' attitudes to the findings of exploratory studies. In total, the questionnaire consists of 29 response categories, and each in two situations: ideally, what the best example should be; and usually, what respondents' experience of average situations is. The respondents were requested to indicate whether they agree or not with those response categories in five-point Likert Scales. As mentioned in the previous section, the response categories are in fact the hypothetical propositions formed at the end of the exploratory studies, which were originally the collection of findings.

Two types of statistical data analysis techniques were used in this study, descriptive and inferential. The former was used to describe the characteristics of the sample, including frequency, distribution, mean, median, mode, variance and proportion. The inferential techniques used in this study were nonparametric, because the samples are very small and the data do not meet the strict assumptions of parametric techniques (Pallant 2007).

The findings of the QS were juxtaposed and compared with the results of cross-case synthesis in Cross-case analysis A. Again, formative evaluation was carried out through similar externalisation to that in previous whorls.

The unit of analysis and characteristics of participants of the case studies were defined based on the interest expressed by survey respondents in joining the follow-up interviews. The interview questions used in ES2 were refined for use in CS.

4.6.2.4 Whorl 6: explanatory stage

SMEs and game experts who agreed to join a follow-up study after the survey were interviewed. Each individual was regarded as one unit of analysis of one case study. Documents related to their use and productions of games were collected to support understanding of the underlying experience and background of each individual.

Semi-structured interview and Creswell's (2008) model of analysis were again used and the findings of the multiple case studies were juxtaposed and compared with the findings of the confirmative study in Cross-case analysis B.

4.6.2.5 The thesis

The findings of this research as a whole were drawn from the outcomes of the three cross-case analyses. A self-reflexion, followed by a meta-reflection were carried out to assess the validity and reliability of these findings, while capturing the limitations, the lessons learnt and the afterthoughts of the overall doctoral research journey.

4.7 Using the Spiral Research Model as an alternative to triangulation

According to Gray (2009), triangulation is combining several qualitative methods or combining quantitative and qualitative methods, which aims to allow one method to compensate for the weakness or blind spots of the other, hence strengthening the validity of the overall findings. However, as Flick (2006) suggests, each method remains autonomous, operating side by side with other methods.

Some social science researchers argue that triangulation is the core strength of mixed method design (Gray 2009; Newby 2010). So the purpose of triangulation is to ensure validity, rather than ensuring triangulation through validation, which is a misuse of mixed methods in research.

In triangulation, each method remains autonomous, operating side by side with other methods (Flick 2006), but the focus of the research must be consistent throughout the use of different methods, which was not the case in this research. The use of the SR model overcame the limitation set by triangulation because it allows the focus to shift as the research evolves. Therefore, if adjustment and justification of focus shift were made appropriately, the SR model could be treated as an alternative to triangulation in mixed methods design.

4.8 Summary

This chapter articulates the pragmatic research design of this doctoral research. It reflects collectively the research methods taken in searching for research answers,

and the rationale behind those actions. Research should start with the identification of research questions and aims, followed by defining and redefining key concepts and issues associated with the aim. After that, the strengths and weaknesses of both quantitative and qualitative research methods should be taken into account when determining the nature of a mixed methods research design. The validity and reliability of instruments used along with their inherent ethical considerations should be thoroughly thought through and put into practice. This study attempted to realise the above mentioned strategies by integrating them into the SR model, which was not only developed to represent the overall research journey but also to highlight the temporal focus shift of the research.

CHAPTER 5: FINDINGS OF THE EXPLORATORY STUDIES

5.0 Introduction

In order to gain an overall view of key concepts and issues related to GBL through the eyes of SMEs, game experts and learners, three exploratory studies were carried out between July 2008 and March 2009. While their findings are described in this chapter, the research methods employed in each study were described in the previous chapter.

At this stage of the research, the secondary maths trainee teachers were seen as SMEs; the practitioners in the game industry were regarded as game experts; and the sixth formers were considered as advanced learners (see Section 1.4 in Chapter 1). Such emphasis is noteworthy because more diverse SMEs and game experts were used in later stages, altering not only the coverage of these concepts, but also the possible roles and responsibilities they were expected to play and bear.

5.1 Findings of Exploratory Study 1 (ES1)

This study aimed to examine the perceived potential of GBL through the eyes of 25 secondary mathematics trainee teachers at the end of the PGCE programme. Figure 5.1 depicts how the findings were drawn from this study. The findings of this study are organised into four sections:

- The perceived potential of GBL.
- The self-justification of the perceived potential of GBL.
- The self-evaluation of the justification.
- The gap of knowledge and skills in game design.

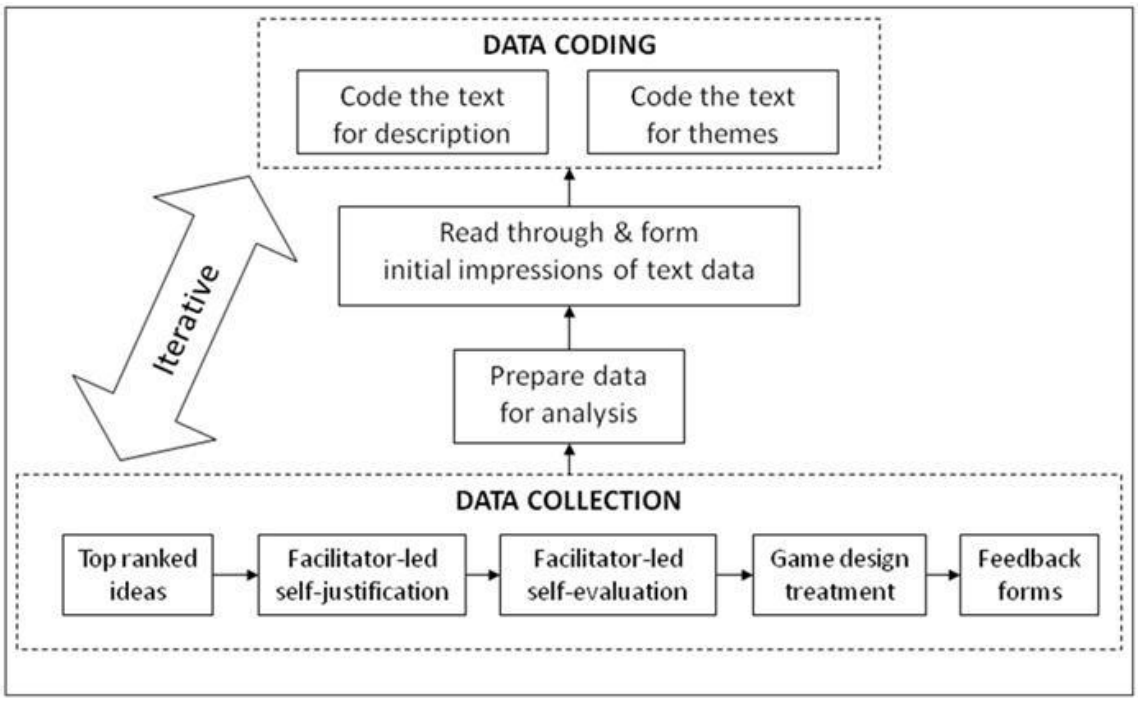


Figure 5.1: Research methods of ES1, adapted from Creswell (2008)

5.1.1 The perceived potential of GBL

While playing the role as SME in a brainstorming session, the trainees were asked to generate as many ideas on GBL as possible for use in their classroom. Then they were instructed to identify the top ranked idea. In five minutes, 25 trainees generated 95 ideas. Table 5.1 shows the differences among the trainees in terms of the number of ideas generated. The measurement of frequency did not adequately explain why they generated those ideas.

Table 5.1: The number of ideas generated by trainees. (Male: female = 48:47)

Number of ideas		1	2	3	5	6	7	8	10	14	Total
Frequency	**Male**	6	2	0	2	1	0	1	0	1	13 people
	Female	5	0	2	1	0	3	0	1	0	12 people
Total ideas		11	4	6	15	6	21	8	10	14	95 ideas

For those trainees who generated more than one idea, they were encouraged to classify the ideas into themes according to their preference. In this optional activity, two trainees classified their ideas into themes (see Table 5.2).

Table 5.2: Themes proposed by Trainee No. 16 and Trainee No. 19

Participant	Themes	Ideas
No. 16	Individual development	Developing Avatar's 'math skills' Online access to MMRPG
	Assessment for learning	Shooting correct answer game
	Group work	Acquisition of mathematical artifacts Maths class leader board Presentation using ICT
No. 19	Rewarding	Reward Carrot Friday Period 6 Small groups taken out of class
	Competing	Teacher vs. pupil Team play–competitive element Weekly competition
	Assessment for learning	Self-assessment Assessment (can they cope)
	Interaction with others	Plenary Engaging kids who find writing difficult Co-operative Dressing up to get into character—engaged.

More than half of the trainees proposed more than one idea, and they were requested to select their top ranked idea. Table 5.3 shows the typology of the 25 top ranked ideas, classified using Bloom's (1956) three domains of educational objectives—a taxonomy that could map the potential of GBL for the attainment of learning outcomes.

Table 5.3: The typology of top ranked ideas grouped under three domains

Trainees' top ranked ideas of GBL	Example of teaching and learning outcomes conjectured by researcher	Domain of learning
Appeal to different types of learners	The teacher will invite different types of learners to become interested in learning maths.	Affective (Attitude)
Team building	The learners will participate in activities in organised group.	
'Why love ring road' rules	The learners will demonstrate appreciation towards maths through real-life example (traffic management)	
Interactive online community school Second Life Circle Time	The learners will discuss issues related to maths in online community or virtual environment The learners will share interests in maths	
Weekly pupil vs teacher competitions English / Drama student shoot 'em up	The teacher will organise the appreciation towards maths through competition.	
Pupils as game testers	The teacher will combine maths learning with game testing	
Simulation: distance / time / speed relationship Simulate real world example of Mathematics Using real life applications Teacher creates maths world	The teacher will describe the relationship among mathematical concepts. The learners will differentiate mathematical concepts in the simulation. The learners will assimilate problems faced in real-life with the simulation of the relationship among mathematical concepts.	Cognitive (Knowledge)
Positive / negative fractions [sic] to obstacle course [of direction on number line]	The learners will define fraction, positive fraction and negative fraction The learners will differentiate positive and negative fractions	
Problem solving	The learners will solve problems [in real life situations]	
Penguin tossing angles velocity	The learners will define velocity The learners will describe the relationship between angle and velocity	
Show relevance of maths	The teacher will demonstrate the relevance of maths [in real life situations]	
Analytical thinking	The learners will analyse mathematical concepts	
Fraction grid game	The learners will define fractions Describe the types of fraction involved in the grid game.	
Developing avatars' maths skills	The learners will develop mathematical skills through the avatar training	Psychomotor (Skills)
Class investigations Use for an investigation activity Investigate Bowland activities in groups	The teacher will use investigation activity as teaching material Trace evidence found through mathematical skills.	
Use Interactive Whiteboard pods	The teacher will use Interactive Whiteboard pods	

Mapping / bearings finding treasure	The learners will use map and bearing	
Choose topics for questions moving through a maze	The teacher will use the maze as a medium to pose questions	

5.1.2 The self-justification of the perceived potential

In general, the trainees could articulate their own perceived potential of GBL. Most of them regard 'fun / entertaining', 'engaging' and 'ease teaching' as the rationale for choosing the top ranked ideas, as shown in Table 5.4. All trainees believed that learners would benefit from the perceived potential of GBL—seven of them included teachers as beneficiaries.

Table 5.4: Rationale justifying the top ranked GBL idea

Rationale	Mentioned	Examples included…
Fun / entertaining	6	Consolidate fractions using in a fun way
Engaging	5	Engaging practical application
Ease teaching	5	Easy to implement
Useful for all ages, ability groups and cultures	4	Involves cross cultures, ages, abilities
Working together	4	Opportunity for whole class to work together
Promote affection toward learning / subject matter	3	Could help pupils to see the beauty of maths.
Beneficial learning	2	Beneficial to learning
As enhancement	2	Goes beyond normal curriculum
e-learning / distance learning	2	They can be in school even if they are [physically] off school
Competition	1	Element of competition and wanting to 'beat the teacher'.
Simulation of real life/ virtual reality	1	Real life interaction, navigation, most entertaining whilst learning.
Interactivity	1	Interactive game

5.1.3 The self-evaluation of the justification

In a guided self-evaluation session using De Bono's (2000) Six Thinking Hats, trainees reviewed their justification based on the nature of thinking of each hat.

5.1.3.1 Objective and evidence-based White Hat: facts and figures

When the trainees put on the White Hat, most of them were able to be realistic by listing facts about possible difficulties they might face. For example, Trainee No. 9 mentioned that, to put GBL into practice, *'will take a lot of organisation, planning*

and need to sort out games and investigation.' Trainee No. 10 echoed that *'[it] requires a moderator to organise…time needed.'* ICT requirements, particularly computer software, hardware and Internet access should be ready for successful implementation (Trainees No. 11, No. 22, No. 23 and No. 25). Some trainees were concerned about the needs, preferences and nature of learners, as one of them put it: '*Pupils love Avatars. Virtual worlds can be exciting and stimulating…Some pupils work better in teams; some pupils take a while to settle into a new environment* (Trainee No. 20).'

5.1.3.2 Critical and judgmental Black Hat versus objective and positive Yellow Hat

Two contradictory questions were used to guide critical thinking and positive thinking: why it will / will not work (see Table 5.5.). Ten key arguments were presented for each type of thinking. The majority of the trainees regarded their ideas as fun, interesting, exciting or engaging—reasons why they would work; however most of them thought their idea would appeal to certain learners only, mainly because of social barriers.

Table 5.5: Self-evaluation of why perceived GBL ideas will work / will not work. Ref = references; S = sources

Black Hat (critical thinking) Why it will not work			**Yellow Hat (positive thinking) Why it will work**		
Arguments	Ref	S	Arguments	Ref	S
Appeals to certain learners only / social barriers	19	11	Fun, interesting, exciting and engaging	18	15
Depends on games' quality	9	8	Effective teaching materials (reusable, updatable, variety)	9	7
Access to software, hardware or Internet	7	6	Autonomous / self-paced / flexible learning	9	7
Technical constraints / monitoring	6	5	Learners' preference / ease learning	8	7
Potential for ICT mishaps / overexcitement	5	5	Subject matter relevance / related to real life	6	6
Return on investment / educational usefulness	5	4	Competitiveness	6	5
Practicality	5	4	Teamwork / social interaction / collaborative learning	4	3
Costly (development / implementation / maintenance)	4	4	Ease teaching (prepare, teach, monitor, etc)	3	3
Requires self-motivation / teacher's motivation	3	3	Assessment (self-assessment, assessment for learning)	3	3
Irrelevant contexts	3	3	Rewards to learners	2	1

5.1.3.3 Subjective and emotional Red Hat: How do I feel about the idea?

The red hat was worn to generate opinion based on positive or negative feeling, or both. Most of the trainees had positive feelings about their perceived ideas, as shown in Table 5.6, while four negative views were collected, as listed below:

- Great idea but needs lots of preparation and effort.
- I think it needs more development and to be made more exciting.
- I'm not really enthused by the idea because driving and cars are not my favourite hobby.
- I'd be dangerously addicted to it.

Table 5.6: Positive words mentioned when the Red Hat was virtually worn

Positive words mentioned	**Examples included**	**Mentioned**
Fun	Games are fun.	4
Like	I like the idea that my idea is education through a medium which pupils enjoy and that is considering Maths in a broader context.	4
Engage	It is something I believe could really help engage disinterested pupils especially with examples of work they want to go into.	3
Work	It works well with lower ability students	3
Good	A strategy / lateral thinking game will stretch them to deal with problem solving skills, which are extremely cross-curricular potential—a good thing!	3
Love	A lot of pupils would love a game like this.	3
Interesting	More interesting way of consolidating work on fractions than doing a test.	3
Enjoy	Would enjoy teaching with this.	3
Great	It's great.	2
Enthuse	I think it will work especially with lower ability sets who need something different to enthuse them.	2

5.1.3.4 Speculative, creative and innovative Green Hat

Most of trainees focused on adding features or inter-platform operability to their game ideas. Three of them suggested getting students involved in the creation of GBL (Trainee No.4, No. 9, and No. 21). Two trainees depicted the roles that

teachers could play—interact with pupils in virtual world using their avatars (Trainee No.16); become the judges for other classes in game competitions and the head teacher could be a guest challenger (Trainee No.19).

5.1.4 The gap of knowledge and skills in game design

All five trainees who participated in the game design activity were very supportive and keen to turn their ideas into GBL practices. Four game design treatments were written, as two trainees preferred to work in pairs (see Table 5.7). The inputs made by the trainees were insufficient to reveal their capabilities for designing and developing GBL. However, the deficiencies and unfamiliarity with game production practices indicated the inability of the trainees to design and develop games.

Table 5.7: Basic information on the game design ideas gathered in this study

Proposed title	Genre	Type	Target audience
The Conqueror of Greece	Role-playing game	Storyline , including task completing and avatar development	KS3
Face off	Co-ordinates / geometry	Reflective action	KS3 / KS4
High Five Fever	Statistical prediction	Predict how many high fives will occur.	-
Crystal Maths	Mathematical history	History counts	-

5.2 Findings of Exploratory Study 2 (ES2)

ES2 was conducted to explore the perceptions of eight game experts from three production studios in Malaysia about issues related to the educational potential of games, the use of games and the ideal GBL collaboration between SMEs and game experts. The findings of this study are organised into four sections:

- The perceived definitions of game, game playing and learning.
- The perceived educational potential of games.
- How games should ideally be used in education.
- How teachers and game experts could collaborate to design and develop games used in education.

5.2.1 The perceived definitions of game, game playing and learning

GBL was a new concept to the interviewees. Instead of asking them to define GBL, their fundamental conceptions of GBL were explored through the perceived definitions of *game*, *game playing* and *learning*. As these terms are the building blocks of the GBL concept, the definitions of the interviewees demonstrate the extent of their existing knowledge and views on the nature, properties, attributes, characteristics and functions of GBL. In what follows, the interviewees are referred to using 3 digit numbers.

In general, game experts related games to fun, entertainment, play, leisure, hobby or fantasy. Interviewee 001 gave a comprehensive definition: a game is software or new media that provides players with a virtual space or presence to release tension. It could be online and globally networked.

Both 001 and 002 saw game playing as a social trend. According to 001, although game playing was seen as something anti-social in the past, it has become a medium for healthy socialising. He classified the medium into three forms: virtual interaction, physical interaction and physical sports. Meanwhile, 003 regarded game playing as experience, a practice for human life which contains winning and losing when there is more than one player. This idea is echoed by 004 as he claimed that playing games enables one to gain and experience satisfaction in the game world through the realisation of things which cannot be done in reality. Both 004 and 008 regarded game playing as a form of acquisition: 004 referred to satisfaction while 008 referred to learning. Besides defining game playing, 001 further classified the meanings into three levels, based on the depth of involvement:

- Playing games as a hobby that is important for balancing work and leisure in life.
- Playing games as a form of mental anchor, which may lead players to addiction.
- Playing games at ‘Otaku’ level, where players live in their own world and have their own ways to accomplishment in life.

As commented by 003, the term learning has *‘a huge scope which covers thought, experience, input and observation.’* In defining learning, three synonymous terms

were suggested: studying, knowing and realisation. Other definitions of learning proposed by the game experts are: information acquisition, a process of fulfilling curiosity or a consequence of curiosity, an action that occurs when one encounters novelty, and something objective-driven which is helpful to one and one's work. Three arguable thoughts about learning were put forward: learning is anything, it is something individual, and it is not reasoning. When associated with games, 008 indicated that learning could be a side outcome of game playing and it occurs when one tries seriously to understand something in games. Only one participant attempted to classify learning: 002 suggested that *'there are two types of learning, one is learning how to know, and the other is learning how to be [in the state] do-not-know.'*

5.2.2 The perceived educational potential of games

The previous section indicates that knowing how the game experts perceive the educational potential of games is the first step to exploring and realising effective GBL practices. The potential of games as perceived by the interviewees was compared with other views in the literature to identify perception gaps, which are crucial in directing the discovery, creation or foundation of common ground for successful GBL collaboration.

Fifty-two ideas were suggested by the eight interviewees as the educational potential of GBL. The difference among interviewees in terms of the number of ideas generated is shown in Table 5.8.

Table 5.8: The number of perceived educational potentials of GBL proposed by interviewees

Interviewee	001	002	003	004	005	006	007	008	**Total**
Number of ideas	16	5	4	7	2	5	4	9	52

The perceived educational potentials of games were grouped into four beneficiaries: learners or learning, teachers or teaching practices, game players, and parents. Twenty themes were generated from the arguments, and half of them are related to learners (refer to Table 5.9).

For learners, the top three potentials of games are knowledge or learning absorbance, enhancing learning performance and easing learning. For teachers, five game experts suggested that games could be used as a teaching tool or resource. Most of the interviewees regarded learners and game players as similar beneficiaries, one reason why they felt it was redundant to repeat similar potentials for game players. Meanwhile, the interviewees thought parents could gain benefits from games through improved parenting and monitoring of children's learning at home.

Table 5.9: Themes of arguments about the educational potential of games, grouped into four beneficiary groups

Beneficiary	Themes of arguments	Reference[a]	Source[b]
Learners	1. Knowledge or learning absorbance	5	2
	2. Enhance learning performance	4	4
	3. Assist learners	3	2
	4. Motivate learners	2	2
	5. Alternative learning method	2	2
	6. Relax or have fun in learning	2	2
	7. Learning in virtual environment	2	2
	8. Change learning attitude	2	1
	9. Enhance memory or understanding	2	1
	10. Education revolution	1	1
Teachers	11. Teaching tool or resource	5	5
	12. Improve teaching	2	2
	13. Teachers' learning	2	2
	14. Relaxing, enjoying, have fun in teaching	2	1
Game players	15. Justified game playing	2	2
	16. Have fun in learning	1	1
	17. Advantage of being experienced gamers	1	1
Parents	18. Children's learning at home	5	4
	19. Parenting	5	3
	20. Change parents' perception of games	2	1

a. The number of times an argument was mentioned
b. The number of interviewees who used the argument

001 emphasised that, as games are not commonly used in education, they should remain as potential media. Therefore, they should be made optional instead of compulsory (003). If parents were required to pay for the games, they should not be burdened financially. Ideally, the games should attract pupils, students or parents to buy voluntarily.

Games should be considered as the media of GBL, not the whole of learning (005). Their effective use is limited to whether they are well executed or not (001). The implementation requires sufficient resources and training, and this is not limited to educational institutions, as game experts might also need to be trained in order to guide teachers in using games.

The content of GBL should include real and physical human interaction (005). Also, multimedia should be used to allow learners to get information without being limited only by texts (001). 001 and 007 advised that games should be carefully used or controlled to avoid addiction. Therefore, the contents of games should be made known and accessible to parents (006).

The production of games, whether serious or leisure, must involve research activities (002). In spite of this, as long as research has been done, the political, cultural or historical truth of games should not be taken too seriously (003). The importance of research in using games in education cannot be overstressed, but 007 urged that as parents could be easily affected by research findings on GBL published by the mass media, such research findings should always be validated in advance.

5.2.3 How games should ideally be used in education

The extent of the interviewees' existing knowledge and views on the ideal use of games in education indicate the degree to which game experts will exploit the potential of GBL. Knowing such perceptions is crucial as it illustrates the boundaries preset by game experts in producing educational games.

5.2.3.1 Rationale of using games

Table 5.10 shows 13 themes of rationales perceived by the interviewees for the use of games in education. Although 003 stated that the use of games in education should be justified by academics, most of the game experts shared their views on why games could be used. 003 argued that games should be seen as readily available fun or course material, which lets learners play and learn concurrently. 004 echoed this perception by stressing three times that games should not be used seriously, instead they should make learners feel relaxed. Other uses of games perceived by the interviewees are:

- a form of discovery learning,
- providing a professional, skills-practice platform,
- initiating learning,
- drawing attention,
- directing focus,
- earning satisfaction,
- making learning easy creatively, and
- creating competition.

However, according to the interviewees, games should not be used to replace humans, especially teachers. In determining the nature of game-based learners, 003 highlighted that games are meant for *'learners who like to play games but [do] not necessarily have much time to learn other things; they are not for people who already like to learn things, then they are forced to play games because nowadays playing e-games itself is a school of knowledge.'*

Table 5.10: Rationale for using games in education (conventions as Table 5.9)

Themes of Arguments	Reference	Source
1. Not serious but relaxing	4	003, 004
2. Not boring but fun and interesting	3	003, 005, 008
3. Discovery learning	1	005
4. Professional skills practice platform	1	002
5. Competition	1	004
6. Earning satisfaction	1	
7. Play and learn	1	003
8. Making learning easy creatively	1	
9. Directing focus	1	
10. Initiating learning	1	
11. Drawing attention	1	
12. Not to replace humans	1	006
13. Selective learners	1	003

5.2.3.2 The best time or place to use games

The views of all interviewees on the best time or place to use games in education can be separated into two levels: the macro level focuses on the readiness of society as a whole to accept GBL or games used in education; the micro level discusses the use of games in schools or classrooms.

Macro Level

By assuming games have yet to be accepted by current education systems in Malaysia, 001 set four requirements for games to fulfil before being used in education. He argued that games could be used after being proved worthy, accepted as a positive or healthy activity, realised as a trend which should be initiated by world leaders of game industry, and seen as having market value by the games industry. 004 added another requirement that was to consider the views of users—both teachers and learners. 008 also thought that Malaysia is not ready for GBL. He proposed to wait until GBL had been proven successful in developed countries.

In contrast, 002 held the view that GBL could be started now because among children gaming is a common phenomenon. However, she suggested to *'start now but implement gradually.'* This view is supported by 003 as he supposed that games need a transitional period in formal education although they could be blended into teaching immediately. 006 also agreed that *'to take the advantage of being a highly achievable target,'* games should be used in education now. Nevertheless, she suggested to start only with private schools or selected schools, especially those in urban areas. To start GBL nationwide, she believed that *'research should be well done, the games should be completed and ready for all associated courses, and the teachers should be trained properly, the differences between urban and rural schools should be minimised.'* She added that GBL could be started with either individuals or families, since it '*should not require the presence of [a] teacher.'*

005 argued that both rural and urban schools should start to adapt GBL at the same time to keep pace with the globalisation of education. 007 supported this view and he

advised to start GBL at primary schools, with slight exposure and proper control at pre-school level. Nonetheless, he conjectured that the success of GBL depends on the degree of parents' participation.

Micro Level

001 stressed that the most ideal time to use games in classrooms is 'when the whole trend and the structure are both established after undergoing various phases or evolution of usage.'

003 suggested that the best time to use GBL should be determined by teachers, ie when the game is recommended or distributed by teachers. However, whether it is bought and played at home or facilitated by teachers in the classrooms, GBL should be made an option. The importance of the teachers' role is also echoed by 002. She inferred that GBL could be used at home only after the students were given guidance in the classrooms, but she was concerned that the teachers should not make students see GBL as a burden. Two specific times for using games were proposed: in the afternoon when students feel most sleepy or after school hours.

007 held a different view, as he argued that when to use games depends on what is being taught. As different kinds of studying require different kinds of methods, for him there was no perfect answer for the best time to use games in teaching.

5.2.4 Perceptions of teachers who use games in teaching

003 praised teachers who use games in teaching as he regarded having fun as being the most effective matter to draw learners' attention. This view was shared by 008 because such teachers were perceived as knowing how to attract learners to have more interest in learning. 005 reaffirmed the praise, seeing such teachers as modern and very adaptive to new instructional practices and methods. They were also seen as courageous, because 006 thought games might still be resisted by the general public nowadays.

007 was sceptical about some teachers who might take advantage of using games to neglect their actual teaching responsibilities. 001 worried about the improper use of games by teachers which could lead learners to addiction. 004 argued that teachers are generally lacking the understanding of the concept behind the use of games in

teaching; thus he suggested that instruction should be given to them for teaching using games.

5.2.5 Perceptions of studios that produce games for use in formal educational contexts

008 gave the only positive view among the game experts about studios that produce games for use in formal educational contexts, in which he considered these games would have a longer shelf life compared to commercial games, because those games will not be outdated easily and they are also reusable and upgradable.

To 002, these studios only produce boring games. 001 echoed this; that the studios' definition of game should be equal to fun or entertaining, rather than serious. 003 added that they should not make the game too serious, because once they have taken the fun away from a game, it cannot be regarded as a game anymore. This leads to 006's concern about the types of games these studios might produce, which possibly look like textbooks—too serious, linear presentation mode and nobody would like to play.

005 presumed that only academics would work in such studios. The studios might be using the latest game production methods, but the content they deal with might be too serious, or they might make the content overly serious. He was concerned about the negative impacts such studios left after producing dull games that discourage learners from GBL.

In rationalising why the studios produce serious games, 004 sympathized with them because they ought to follow strict requirements set by clients. Their main clients, according to 002, are normally government-related organisations or agencies, which are conservative in nature, thus it is difficult for the studios to excel or expand. 007 shared similar view and showed sympathy for these studios as he thought their market would be very small and it would be very challenging for them to survive.

Apart from the limited market, 001 pointed out that the biggest challenge faced by the studios is how to provide sensory stimulus while embedding the learning contents into the game playing process. One possible solution is the idea of 'concealed learning' in which he suggested that the studios should conceal learning

contents and messages to let players learn unconsciously while being engaged in the game playing.

5.2.6 How teachers and game experts can collaborate to design and develop games used in education

The depth of knowledge and views possessed by the interviewees educes their ideal GBL collaboration. It also shows how they would like the perceived educational potential of games and their ideal GBL practices to be realised collaboratively with teachers.

Forty-four arguments about how the interviewees could collaborate with teachers to design and develop games were collected and synthesised into 11 collated arguments (see Table 5.11). The most frequently cited argument states that teachers and game experts need to understand each other's perception of the key concepts and issues associated with GBL. There were three highly cited arguments which relate to the delineation of roles and responsibilities, involvement in GBL evaluation and effective communication. Together with understanding each other's perception, these four aspects are the key success factors for GBL collaboration found in this study. Meanwhile, 008 highlighted that although most people are aware of the need to delineate the roles and responsibilities, those roles and responsibilities might shift over time—a commonly neglected matter in collaboration.

Other issues such as having mutual and non-conflicting objectives, respecting each other's profession, being aware of the trends and latest technologies, and acquiring expertise from other fields are also regarded as important factors by most interviewed game experts (001, 002, 003, 005 & 007).

For instance, to start a GBL collaboration, 003 suggested that *'both teachers and game experts should agree upon a method of collaboration which both of them feel comfortable with.'* If the methods used by the two to reach the objective are not the same, they should at least not be conflicting (003).

One distinctive suggestion given by 008 to solve problems faced in collaboration is to appoint a coordinator who knows about education and game production. 008

recommended that this position is needed to act *'as a bridge that links both teachers and game experts throughout the collaboration.'*

Table 5.11: Collated arguments of the game experts about how teachers and game experts should collaborate to design and develop GBL (conventions as Table 5.9)

Collated Arguments	Frequency	Source
1. They need to understand each other's perception of the key concepts and issues associated with GBL.	8	001, 002, 003, 004, 007
2. The roles and responsibilities of both teachers and game experts must be clearly delineated in three stages of collaboration: pre-production, production and post-production.	7	001, 006, 007, 008
3. GBL evaluation should involve learners, teachers and game experts.	7	003, 004, 005, 007
4. They should communicate with each other effectively.	7	002, 003, 007
5. They should set mutual and not conflicting objectives in determining the direction of pedagogic strategies, design and production methods used in collaboration.	5	003
6. They should respect each other's profession.	4	005, 007
7. They should be aware of the trend and latest technologies in both learning media and game playing.	3	001, 002
8. Experts from other fields such as R&D, computer engineering, IT, management, business and marketing are needed to support the collaboration.	3	001, 003
9. At the pre-production stage, both teachers and game experts should do research.	2	001, 007
10. A coordinator who knows about education and game production is needed to act as a bridge that links both types of expert.	2	008
11. At the implementation stage, teachers should regard games as a teaching tool or material.	1	006

5.3 Findings of Exploratory Study 3 (ES3)

ES3 was carried out under *14–19 Deep Learning with ICT*, a project funded by Becta (Abbot, Townsend, Johnston-Wilder, & Reynolds 2009). The actual focus of this study was deep learning but it was the perceptions of learners towards the use of a commercial e-game in a formal education setting that linked it as part of this doctoral research. Hence the aim was to examine nine sixth form students' perception of their Biology teacher's use of Spore™ in the classroom to promote deep learning. Spore™ is a simulation game which allows a player to control the development of a species in five phases: cell, creature, tribal, civilization and space (Electronic Arts Limited 2009). Deep learning is a form of learning that involves higher level outcomes in cognitive, affective or psychomotor domains of learning (Tan *et al.* in press).

Such use of the game in an upper secondary school was named as 'GBL with a dialogic teaching approach', which is a form of teaching that derived from dialogic education. Wegerif (2006) claimed that the idea of dialogic education emerged from the use of dialogue as a shared enquiry, as a way of writing and as a way of knowing. These characteristics could direct the understanding of the processes and the aims of education (Bakhtin *et al.* 1986).

The findings of this study are organized into six sections, based on the questions asked in the focus group, where the last section compiles extracts that represent the students' experience of GBL and their attributes as deep learners.

5.3.1 Perceptions on how Spore™ is related to biology studies and what the students think they learned from playing Spore™.

The students generally agreed that only the first two phases of the game are related to biology studies. In playing and winning the game, the students applied knowledge of biology gained in the past, particularly when they were in Year 9. Two themes—the concepts of evolution and of a selective framework—were found in their perceptions on how Spore™ is related to biology studies. The framework is a feature designed in the gameplay of Spore™ that allows players to determine the biological properties of a species.

5.3.2 How the students compared GBL and the way they normally approach their studies.

Eleven themes were generated from the transcriptions that depict the perceived advantages of GBL as compared to the way in which the students normally approach their studies. These themes were classified into in four categories: enhanced visualization, easing reinforcement/revision, fun/interest, and knowledge transfer, as shown in Table 5.12.

Table 5.12: Classification of themes based on the perceived advantages of GBL as compared to normal learning approaches

Themes	Typology of themes
1. Interactive visual presentation (diagram) of game playing progress.	Enhanced visualisation
2. Attractive visual presentation (animation)	
3. Assist in visualizing learning experience.	
4. Reinforcement of previous learning experience	Easing reinforcement and revision
5. Ease of revision	
6. Mnemonics for revision	
7. Extend concentration span	
8. Make learning more interesting.	Fun and interesting
9. Fun in GBL enhances effectiveness of learning	
10. Fun in GBL extends learning span	
11. Applying knowledge gained in the past in game playing.	Knowledge transfer

5.3.3 How the students perceived the usefulness of GBL as compared to the way they would normally study.

The most active participant among the sixth-form students, M1, highlighted that Spore™ is not useful for learning biology at A-Level:

> *'it's not as detailed…it's not learning at A-Level standard…I would say it's more useful for Year 9 group and for us, it's just a fun game to play…students [in] Year 9 may are actually gonna be learning from what they are doing…we already know enough about evolution to understand it. I don't think it's that beneficial to A-Level, but as a Year 9 student, as I go home and then I can give feedback in the lesson.'*

He also commented that Spore™ did not have an explicit aim. On the other hand, this mimics the non-directionality of evolution. While playing Spore™, the evolutionary simulation in itself does not require that players have to survive, but implicitly players have to survive in order to continue playing. Among game developers, not having an explicit cost/benefit structure would result in a programme being described as a simulation rather than a simulation game (Prensky 2007). However, within the outside world, a simulation is understood to have implicitly either a good outcome or a bad outcome, although game developers deliberately discount the presence of an implicit outcome and usually design simulations for players to ignore the cost/benefit structure. On the other hand, game developers make the cost/benefit structure explicit for players to progress in simulation games,

hence the game developers' distinction between a simulation and a simulation game (Gredler 1996).

5.3.4 How the students perceived their teacher who used technology-enabled practices in teaching.

According to the feedback given by the teacher over the post-focus group informal chat, the students welcomed the use of GBL in biology lessons. This statement matched the students' perceptions, as they were pleased to have game playing as homework and to have teachers who are open-minded to technology and willing to listen to their suggestions (see Table 5.13).

Table 5.13: Perceptions of teachers who adopt technology-enabled practices

	Transcription	Themes
M1	[He] actually said that our homework which is to go home and play Spore™.	Set game playing as assignment
M2	That's more enjoyable homework.	
M1	…I won't say anything to a teacher worrying about time for games in school curriculum. I'll show them the advantages, I'll explain the advantages if there were any, because I don't know other game, maybe apart from Spore™ allows us, does have enough…educational value. I don't think many games have a massive worthwhile level of it.	Willing to listen to students' suggestion.
M1	…most of the teachers are quite open-minded about trying new things…Our teacher is trying to get us iPods so that we can watch video and listen to the Podcast. I mean this is very open-minded to technology…	Open-minded to technology
M2	Yes. They let us play Spore™ in the first place. I mean a lot of schools wouldn't.	

5.3.5 The perceived educational potential of GBL and other technology-enabled practices.

The students suggested 16 different technology-enabled practices, and most of them involve GBL. The perceived educational potential of these practices are shown in Table 5.14. Transfer of knowledge and skills was regarded as the top perceived potential of these practices.

Table 5.14: Perceived educational potential of technology-enabled practices

Perceived potential	Times mentioned	Examples included…
Transfer of knowledge / skills	13	It's application of logic and knowledge at the same time.
Flexibility in combination	3	…like biology A-Level student add-on or Physics A-Level student add-on…
Challenge and competitiveness	3	Western culture is very about winning and being the best
Mnemonics	2	21st century mnemonics
Rule-oriented	2	The rules of the game should be the rules you are trying to teach them.
Exploration in virtual reality	2	First person shooter based inside human body…
Interactivity in learning	2	It was interactive as well…
Communication tool	1	Like a discussion board, you can talk over.
Cater to the needs of non-game players	1	The BiteSize really needs a lot of passion…some person that plays more video games it's not going to be as interesting
Visualization tool	1	Say like you try to describe a part of a relation in playing the game and then show it on vision [a state of display in the game]
Remedial learning material	1	If someone doesn't understand something…

5.3.6 Extracts of the knowledge, attitude and skills of the students as deep learners

An instrument for categorizing learning outcomes, called surface–deep learning matrix was developed and used to organize the extracted knowledge and skills of the students on deep learning (see Figure 5.2). Six cognitive outcomes, four affective outcomes and two psychomotor outcomes associated with deep learning were drawn out inductively by referring to the meanings of the transcriptions (see Table 5.15).

Learning / Complexity	Cognitive domain (Knowledge)	Affective domain (Attitude)	Psychomotor domain (Skill)
Surface	Knowledge	Receiving phenomena	Perception
	Comprehension	Responding to phenomena	Set
	Application	Valuing	Guided response
Deep			Mechanism
	Analysis	Organisation	Complex overt response
	Synthesis	Internalising values	Adaptation
	Evaluation		Origination

Figure 5.2: Surface–deep learning matrix, adapted for this study (Tan, Johnston-Wilder & Neill *in press*).

Table 5.15: Matching deep learning outcomes and knowledge and skills demonstrated by the students in the focus group discussion

Learning domain	**Level of complexity**	**Learning performance associated with deep learning, in which the students were able…**
Cognitive	Application	To apply knowledge gained in Year 9 into the playing of Spore™
	Analysis	To differentiate the degree of learning in biology between Year 9 and A-Level. To criticize the usefulness of Spore™ in the learning of A-Level biology.
	Synthesis	To construct understanding of game mechanics and relate it with knowledge gained in real life. To propose games and other learning activities that could be used in the learning of biology
	Evaluation	To appraise the quality of games used in facilitating GBL
Affective	Valuing	To demonstrate belief in the value of GBL practices. To differentiate games based on their educational value.
	Organisation	To recognize the need for acquiring pre-requisite knowledge in GBL involving Spore™.
	Internalising values	To influence the teacher to use games in teaching through commitment to active participation in GBL.
Psychomotor	Adaptation	To modify current GBL practice in biology to fit special requirements of other A-Level subjects.
	Origination	To originate a game's features to fit a particular teaching and learning situation.

5.4 Interim discussion and cross-case synthesis

After the completion of three exploratory studies, the characteristics of participants' perceptions along with the implications were juxtaposed, compared and synthesized in order to identify key issues associated with GBL in formal education contexts which were worth further researching. The outcomes of this cross-case synthesis are shown in the following comparisons among SMEs, game experts and deep learners.

5.4.1 Perceived potential of GBL in formal education

The characteristics of three different perceptions of the potential of GBL in formal education collected in exploratory studies were compared in Table 5.16.

In general, the SMEs were aware of the potential of GBL and capable of transforming their subject matter expertise into GBL ideas. Their view on treating the learner as the core beneficiary of GBL is consistent with the idea of GBL being a form of learner-centred learning in this research.

Table 5.16: Comparison of the characteristics of the perceived potential of GBL in formal education

Participants	Characteristics of perceptions
SMEs	The majority of the identified potentials are subject matter specific. The learner was regarded as the core beneficiary of GBL, but some did include teachers. Acknowledged the engaging capability of games and treated it as a measurement scale of learning, hence the notion of 'engagability'.
Game experts	Absence of vision for GBL. The perceived educational potential of games were limited to common-sensical views. Acknowledged the engaging capability of games but regarded it as a threat which could lead to addiction, rather than a form of educational potential.
Deep learners	Appreciated the deployment of GBL in formal education contexts GBL was regarded as a form of technology-enabled learning, which shares similar potential with other forms of technology-enabled learning. Urged for flexibility in combining GBL with other forms of teaching and learning activities.

5.4.1.1 Diverse views of engagement

One of the most popular rationales for using GBL amongst trainees was 'engagement', but the nature of the generated ideas was not as 'engaging' as those described in game production literature, such as in Prensky's (2007) characteristics of games with associated inherent engaging elements, and the list of engaging elements proposed by Quinn and Connor (2005). One of the significant differences is the absence of 'flow' in their ideas, which is a mental state targeted by game designers to achieve in game playing (Prensky 2007). The desire to design a game which could lead players to the attainment of the flow state has directed game experts to see engagement in a game playing as an absolute matter of success or failure (Fullerton *et al.* 2004; Koster 2005). In contrast, the trainees generally regarded learning as an assessable activity, thus they perceived engagement in learning as a measurable scale, either in terms of degree, level or percentage. This finding echoes the attempts of measuring engagement in learning through empirical studies (Dondi & Moretti 2007; O'Brien & Toms 2008; Kearney 2007).

Compared to the perception of SMEs in ES1 and literature in both academic and game production, the game experts of ES2 did not see engagement as having educational potential. In contrast, they regarded addiction as a threat when using games in education. As both engagement and addiction could lead game players to

the flow state, they are indeed two different aspects of the same matter; engagement implies control over one's actions, addiction lack of control.

Such a diverse conception could result in fatal confusions in GBL production and evaluation, since what might be thought as a failed game in the creative industry could be rated as a relatively less engaging game in academia. Further research should focus on bridging or blending the gaps.

5.4.1.2 Fun or serious?

In justifying the rationale for using games in education, the game experts in ES2 shared the same view as the literature in game production, stressing that games should be fun, interesting and relaxing. However, in contrast to the academic literature, game experts assert that GBL should be fun, interesting and relaxing, regardless of the type of education contexts. They insisted that games should not be serious even in formal education contexts. The notion of serious games is seen as opposing the nature of games.

Although the SMEs in ES1 also regard fun and entertaining as the top rationale for using games in teaching, they did not oppose the notion of 'serious games'.

The success deployment of GBL in promoting deep learning among sixth formers in ES3 demonstrated that commercial simulation game titles can be used for GBL in formal education contexts. However, the success or failure of the GBL depends on the seriousness of players' involvement. To acquire a positive attitude, knowledge or skills in the GBL environment, learners ought to be directed or guided to be serious in the game playing process. The deep learning representation shown by students in ES3 could represent the form of seriousness needed to make such GBL successful, which encompasses a combination of attitude, knowledge and skills in deep learning domains. In other words, commercial simulation game titles can become serious games if they are structured to incorporate outcomes in deep learning domains. The GBL with a dialogic teaching approach discussed in ES3 is an example of one such incorporated structure of teaching and learning activities.

5.4.2 Characteristics of teachers who use games in teaching

None of the game experts in ES2 were taught using GBL, therefore their perceptions were merely speculative views. In general, they welcomed teachers' use of games in classrooms but they also remained uncertain about teachers' capability for using games effectively.

Nonetheless, such uncertainty was countered by the identified positive characteristics of the teacher who used Spore™ to promote deep learning in biology lessons. The learners in ES3 were pleased to have an open-minded teacher who valued their GBL suggestions.

A list of instructional activities was generated associating GBL with the dialogic teaching approach carried out by the teacher in ES3, using the surface–deep learning matrix (Table 5.17). The teacher was able to blend surface and deep teaching objectives in GBL deployment. The perceived and identified characteristics of the teacher could be used as a reference for other teachers who intend to begin GBL with a dialogic teaching practice in general, or to teach deep learning using games in specific subjects.

Table 5.17: Classification of instructional activities carried out by the teacher who used Spore™ to promote deep learning

Domain	**Level of complexity**		**Instructional activities associated with GBL with a dialogic teaching approach**
Cognitive	Surface	Knowledge	To recognise the potential of GBL for promoting deep learning among learners.
			To identify a dialogic teaching approach as a potential integrating element of GBL.
		Comprehension	To distinguish the differences between simulations and simulation games when they are used in education contexts.
			To explain to learners how GBL could benefit the learning of subject matter.
		Application (Passive)	To relate the theory of evolution and simulation games in the teaching of biology without causing misconceptions about the theory among learners.
	Deep	(Active)	To apply subject matter expertise and teaching expertise in converting a simulation game into teaching material.
			To modify a lesson plan to accommodate GBL into the original subject syllabus.
		Analysis	To provide prompt remedial guidance to rectify students' misconceptions in a real-time game playing session in the classroom.
			To break down the levels of a simulation game based on the requirement of instructional events.
			To separate GBL with a dialogic teaching approach in the classroom from GBL as homework in order to optimise the limited classroom interaction sessions.
			To troubleshoot a GBL barrier faced by learners by using teaching expertise and subject matter expertise.
		Synthesis	To reconstruct a teaching approach from diverse technology-enabled practices and teaching experience to form a new teaching approach.
			To rearrange conventional teaching activities for the use of GBL with a dialogic teaching approach.
			To summarise the benefits and lessons learnt in using GBL with a dialogic teaching approach.
		Evaluation	To appraise the value of GBL in formal education contexts.
			To select the most suitable simulation game for GBL in the classroom.
			To evaluate GBL ideas proposed by game experts.
			To justify an innovative teaching approach.

Domain	Level of complexity		Instructional activities associated with GBL with a dialogic teaching approach
Affective	Surface	Receiving phenomena	To listen with respect to GBL ideas proposed by game experts.
		Responding to phenomena	To play-test a simulation game suggested by game experts in order to understand the game mechanics or gameplay.
		Valuing (Passive)	To demonstrate belief in the potential of simulation games for use in biology lessons.
	Deep	(Active)	To initiate a lesson plan that can exploit the potential of a selected simulation game.
		Organisation	To explain the role of GBL in promoting deep learning.
			To combine GBL with a dialogic teaching approach efficiently to meet the requirements of the subject syllabus.
			To prioritise time for GBL effectively to meet the needs of the school, learners and self.
		Internalising values	To display teamwork by cooperating with game experts in the use of simulation games in classrooms.
			To value learners' participation in GBL with a dialogic teaching approach for their active involvement.
			To revise judgments and change behaviours in light of new evidence of technology-enabled practices.
Psychomotor	Surface	Perception	To adjust existing teaching practice by comparing subject matter needs in relation to the practicality of GBL.
		Set	To react to game experts' GBL proposals (this is closely related with the 'Responding to phenomena' level of the Affective domain).
			To recognise individual learners' abilities and limitations in participating in GBL.
		Guided response	To imitate existing practices in the use of games or other technology-enabled practices in education.
	Deep	Mechanism	To organise events of instruction using a dialogic teaching approach in a GBL environment.
		Complex overt response	To conduct events of instruction during a GBL with a dialogic teaching approach.
			To manoeuvre game playing activities into a form of homework.
		Adaptation	To modify instruction to meet the needs of learners who are not familiar with game playing.
			To use a simulation game that was not originally intended for learning without jeopardising learning outcomes.
		Origination	To develop a new teaching approach with incorporated GBL and a dialogic teaching approach.

5.4.3 The extent to which the participants in exploratory studies could design and develop games for use in formal educational contexts

Despite having vision on the pedagogical potential in GBL and very positive attitudes in trying to turn the game ideas into GBL practices, the SMEs in ES1 did not have sufficient knowledge and skills to realise their ideas. Under normal circumstances, teachers are trained to be SMEs and teaching experts only, and the training does not include knowledge or skills for game production. Therefore, the SMEs' knowledge and skills are limited to game playing experience and non-electronic game design. Altering existing teacher training programmes to fit in game production knowledge would be unrealistic and counter-effective because game production has been established as a standalone profession in itself.

Meanwhile, although the game experts in ES2 were enthusiastic about the pedagogic issues related to GBL, their apparent lack of vision for GBL became a barrier preventing them exploiting the educational potential of games. Since they were not trained to teach in any subject, their vision of the pedagogical potential in GBL is limited to common sense and reflection of their personal past learning experience in formal education contexts. This could be a result of the detachment between game experts and the academic literature. Being an ex-practitioner in the creative industry, the researcher experienced a similar dilemma and did not see his own lack of vision as a problem before doing research related to GBL. However, the exposure to academic literature and research enlightened the researcher, to realise the importance of those visions in order to make GBL deployment successful. Without such vision, the game experts might still be able to design and develop games for use in formal education but the pedagogical values and practicality of those games would be in question. Therefore, conveying the vision for GBL to game experts and giving them opportunities to realise its importance is crucial in making GBL successful.

Though the learners in ES3 had convinced their teacher to deploy GBL, the decision of whether to use games in teaching or not always remained as the authority of the teacher. Learners might have valuable opinions that could contribute to various aspects of game creation, such as usability, aesthetics and game play, but their lack of subject matter and pedagogical expertise reduce the depth of their involvement in game production. However, their game playing experience with commercial game

titles triggered their high expectations towards GBL experience in formal education contexts. Such expectations could be very useful for them to join the playtesting of games in production.

Table 5.18: Comparison of the capability to design and develop games for use in formal education contexts.

Participants	Design and development capability
SMEs	Lack of knowledge and skills in game design and development. Possess subject matter and teaching expertise. Possess vision on the pedagogical potential in GBL.
Game experts	Lack of vision on the pedagogical potential in GBL. Aware of their incapability to produce effective games for use in formal education without SMEs' support. Possess advanced technical knowledge and skills in game production.
Advanced learners	Possess advanced game playing experience in commercial game titles. Such experience formed the basis of expectation towards the quality of GBL experience. Lack of subject matter and pedagogical expertise. Lack of knowledge and skills in game design and development

Neither SMEs, game experts nor advanced learners can produce games for use in formal education without the contribution or participation of others. The collaboration between SMEs and game experts is crucial to initiate the design and development of games, while advanced learners could be very helpful at the playtesting and quality assurance stage.

5.4.4 Perceived GBL collaboration

Having identified collaboration as a solution, what the collaboration should be like became an immediate issue. The findings on the diverse perceptions held on a common concept like engagement inferred the need to investigate further the nature of the perceptions. One form of investigation is comparing the perception between the expected and the current state of GBL among SMEs, among game experts and between SMEs and game experts.

This need was reinforced by the necessity to clearly define and delineate the roles and responsibilities between SMEs and game experts to ensure successful collaboration. When the game experts in the ES2 described how they might collaborate with SMEs to design and develop GBL, they saw SMEs as client-like, passive members of the collaboration, although the SMEs' involvement could spread

through the collaboration. In this sense, they believed that SMEs' involvement in GBL collaboration should be limited to the analysis process of pre-production and the implementation plus evaluation process of post-production. In other words, they excluded SMEs' involvement in the game design and development process. Figure 5.3 shows the mapping of their views into game production and instructional design processes. The darkened boxes beneath design and development process indicate where game developers think SMEs should have no role.

Game production process	Pre-production		Production	Post-production	
Instructional design process	Analysis	Design	Development	Implementation	Evaluation
Conclusive arguments on how SMEs and games experts should ideally collaborate	1. Understand GBL concepts & each other's views 2. Delineation of roles & responsibilities 5. Set mutual & not conflicting objectives 9. Research			11. Teachers regard games as tool or teaching materials	3. Involve learners, SMEs & game experts
	←----------**Throughout the collaboration**----------→ 4. Communication 6. Respects each other's professionalism. 7. Be alert with the social trend and latest technologies. 8. Gains supports from experts from other fields. 10. Middle person's coordination 5. Selection and maintenance of objectives.				

Figure 5.3: Mapping the game experts' views onto game production and instructional design processes

5.4.5 Hypothetical propositions for the questionnaire survey

Based on the outcomes of cross-case synthesis, the following issues were recognised as important in GBL deployment and collaboration and worth further researching:

- What teachers who use games in teaching should be like.
- What studios that produce games for use in formal education contexts should be like.
- How SMEs and game experts could collaborate to design and develop games for use in formal education contexts.

A list of 29 hypothetical propositions was generated based on the findings of the exploratory studies (Table 5.19). These propositions were converted into response categories in the QS. Two waves of surveys were conducted; the first survey was carried out with SMEs who have experience in either using games in teaching or involving in game production; while the latter was responded to by various types of game experts. The respondents were asked to indicate whether they agree or not with the propositions in two aspects:

- ideally, what the best example would potentially be, and
- usually, what their experience of a typical situation has been.

The purpose of the survey was to confirm or refute statistically the findings in this exploratory stage. The findings of the QS are presented in Chapter 6.

Table 5.19: Identified GBL issues and their associated hypothetical propositions

GBL issues	Hypothetical propositions
Teachers who use games in teaching	1. … must have understood the concept behind using games in teaching. 2. … need to be trained to use games in teaching. 3. … are open-minded to the latest information and communication technology. 4. … are willing to listen to students' suggestions on the use of games in classrooms. 5. … cannot use GBL effectively unless they get involved in games production.
Studios that produce games for use in formal education contexts	1. … produce boring games. 2. … produce games which are not creative. 3. … produce games which are not pedagogically sound. 4. … produce games which do not fit curricular objectives. 5. … experience limitations preventing them making games fun. 6. … constantly face the dilemma of balancing educational elements and gameplay elements. 7. … should let players enjoy playing the games without realising they are learning.
How SMEs and game experts could collaborate to design and develop games for use in formal education contexts.	1. The roles played by both SMEs and game experts in the collaboration have to be clearly defined. 2. The responsibilities held by SMEs and game experts in the collaboration have to be clearly separated. 3. They need to understand each other's job scope. 4. Effective communication is the key factor in successful collaboration. 5. They both need to understand the technical terms used in game production. 6. They both need to understand the pedagogical concepts used in teaching. 7. They both need to understand the concepts used in game-based learning, e.g. simulation, serious game, engagement, etc. 8. They both need to understand the nature of game playing. 9. They should have agreed objectives about the output of GBL collaboration. 10. A coordinator who knows about both education and game production is required in the collaboration. 11. An induction session for teambuilding is essential at the beginning of collaboration. 12. Game experts should determine the production methods used in GBL collaboration. 13. SMEs should determine the contents of GBL. 14. SMEs have to convey 'what and how' teaching is supposed to be to the game experts. 15. Game experts have to explain to SMEs how they inject their own creativity into GBL design and development. 16. SMEs should be involved in the testing of games. 17. Game experts should be involved in the teaching-trials using GBL.

5.5 Summary

This chapter presented the findings of three exploratory studies and the results of cross-case synthesis. First of all, it elaborates what issues of GBL were explored and what was discovered in the series of explorations. This is followed by a depiction of how the research focus switched from studying the perceived potential of GBL to investigating GBL collaboration between SMEs and game experts. Finally, the chapter explains how the nature of this research shifted from exploratory to confirmative. The usefulness of exploratory studies in this doctoral research cannot be overstressed. However, it was the practice of the cross-case synthesis that connected the findings and made their implications meaningful to the research as a unified and cohesive journey.

CHAPTER 6: FINDINGS OF THE CONFIRMATIVE STUDIES

6.0 Introduction

This chapter compares the findings of two surveys, conducted with SMEs and game experts separately, to examine their attitudes to teachers and educational game studios in GBL practices and collaboration. The chapter aims to discuss the evidence whether SMEs and game experts agree or not with the hypothetical propositions stated in the previous chapter (see Table 5.19). A bespoke questionnaire was used in these surveys. Two interim survey reports were produced (Tan 2010b & 2010c) to present the statistical analysis of the results using nonparametric statistical techniques and a provisional interpretation of the results, specifically to educational researchers who study GBL. Once the validity of the research methods used were verified, the results presented in the interim reports were compared and contrasted to produce the findings of the confirmative stage in this thesis.

6.1 Questionnaire surveys

Two surveys were carried out in the UK, first with SMEs and the second with game experts. The purpose of the survey was to explore the attitudes among SMEs and game experts towards three GBL issues: teachers who use games in teaching, studios that produce games for use in formal education, and GBL collaboration between SMEs and game experts. This led to the measurement of the association between the demographic characteristics of the respondents and the attitudes identified. In brief, the four research questions were:

- How many respondents agree or disagree with the exploratory findings?
- Is there a difference in attitude to the perception of GBL between the perceived ideal practice and the usual experience of respondents? If so, is the change significant?
- Is there an association between the respondents' demographic characteristics and their attitude to GBL? If so, is the association significant?

- Is there any attitude difference between SMEs and game experts in their perception of GBL between the perceived ideal practice and the usual experience of respondents? If so, is the difference significant?

6.1.1 The questionnaires

Two questionnaires were employed, one for each survey. Apart from questions related to the demographic profile (see Appendix VI & Appendix VII), identical questions were asked in these questionnaires (see Appendix VIII). The identical part of the questionnaires was designed based on the hypothetical propositions shown in Table 5.19 in the previous chapter. These findings were structured to form 29 response categories in the questionnaires, grouped under three GBL related issues. Respondents' attitudes to these categories was asked in two situations: ideally, what the best example should be, and usually, what respondents' experience of the average situation is. A five-point Likert scale (1. Strongly disagree. 2. Disagree. 3. Neutral. 4. Agree. 5. Strongly agree) was used to measure attitude in the surveys.

A series of pilot-testing of the questionnaires was carried out with six SMEs and four game experts at different phases of the questionnaire development. The questionnaires were revised and improved with reference to the feedback given, before the actual data collection.

6.1.2 The sampling and response rate

After considering the feasibility for this single-man project with a confined funding period, the initial modest target of 30 responses was set in each survey. The population of the first survey (Survey 1) was SMEs in UK formal education who have the experience of using e-games in teaching or involvement in the design and development of e-games, or both. Due to the difficulty faced in identifying respondents that met the criteria to be cases of the population, purposive and convenience samples were used. The survey was conducted on a cross-sectional basis, from 29 July 2009 to 31 January 2010. The questionnaire was distributed through face-to-face meetings, postal mail with a stamped addressed envelope (SAE), and email invitation. The distribution channels and the response rate are shown in Table 6.1. A total of 137 invitation letters or emails were sent to potential respondents, and this figure excluded invitations through advertisements posted in

GBL or serious-games-related forums and newsletters. Cold-mailing or cold-emailing and the posting of advertisements in forums or newsletters yielded no response at all. Nevertheless, the initial modest target of 30 responses was met; 53 returns were collected, but only 45 responses were valid in Survey 1. While there were eight invalid respondents who have neither experience in using nor developing games but voluntarily responded to the survey, some valid respondents withdrew with written notification because they thought they were not fit to respond in this survey. One of the reasons was due to the possible misunderstanding about GBL and other terms related to the use of games in education. For instance, there were academics who did not see the games they used in teaching as games for GBL.

Table 6.1: Questionnaire distribution channels and the corresponding response rate

Survey respondents	Channels	Frequency		Total response	Response rate (%)
		Valid	Invalid		
SMEs (Survey 1)	Academic events	10	1	11/27	41
	Colleague / peer	4	2	6/6	100
	Peer's recommendation	7	0	7/10	70
	PGCE trainee's help	4	3	7/42	17
	Summer School	20	2	22/30	73
	Cold-mailing / cold-emailing	0	0	0/22	0
	Advertisement in forums & newsletter	0	0	0/unknown	0
	Total	45	8	53/137	39
Game experts (Survey 2)	Personalised-emailing	34	0	34/100	34
	Cold-mailing	7	0	7/50	14
	Advertisement in forums & newsletter	0	0	0/unknown	0
	Total	41	0	41/150	27

The population of the second survey (Survey 2) was game experts who have experience in e-games creation either in the UK or in international game production studios elsewhere. The questionnaire was distributed between October 2009 and February 2010 using two channels: cold-mailing or cold-emailing and advertisement in forums joined by game experts. At least 100 personalised emails were sent to members of the International Game Developers Association (IGDA) and the Digital Game Research Association (DiGRA); while 50 standardised mails were posted with a SAE to game developers who attended serious games related seminars and workshops, including the Third ECGBL, the first International Open Workshop on

Intelligent Personalization and Adaptation in Digital Educational Games, National Workshop on Learning in Immersive Worlds, and Microsoft Innovative Teachers Forum. Forty-one game experts responded to the questionnaire and the target of 30 responses was met. Seventeen of the respondents were commercial game experts, 13 were educational game experts, and 11 were indies. All of the indies who responded to the survey were also undergraduates studying game design or programming but who had produced games individually or collaboratively. While all the educational game experts and indies were based in the UK, the commercial game experts were working in international game studios, which might or might not be physically located in the UK.

6.1.3 Demographic profile of respondents

In Survey 1, nine variables associated with the demographic profile of SMEs were examined to identify independent variables which worth using for analysing the dependent variables—the attitudes to GBL issues. Table 6.2 shows the cross tabulation between gender and other demographic characteristics of the SMEs.

There were 35 respondents (78%) who were working in secondary school contexts, including two Local Authority posts (one teaching and learning consultant and one class teacher) and two respondents who chose 'Other' (one class teacher and one GBL initiative leader). The rest were academics working in post-secondary contexts: nine in higher education and one in further education. The majority of respondents (63%) were female, reflecting the majority of respondents in the sample who taught in secondary schools (69%) and higher education (60%). As most of the responding SMEs serve various roles in secondary schools and higher education, much of the following discussion reflects the differences between secondary teachers and academics.

A noteworthy discovery was that 28 of the respondents (62%) across both genders fell in the age range 31–50 and half of them had more than 10 years' teaching experience, contrary to the possible expectation that games might mainly engage younger SMEs. Twenty-two of the teachers (63%) were aged between 31 and 50; while 21 teachers (60%) had 4–15 years experience. Thus, the majority of the

Table 6.2: Demographic profile of valid respondents in Survey 1

Gender			Male	Female	Total
			16	27	43*
Age	21–25		1	2	3
	26–30		3	3	6
	31–40		7	9	16
	41–50		4	8	12
	51–60		1	5	6
Ethnicity	White		15	24	39
	Black		0	1	1
	Asian origin		0	1	1
	Others		1	1	2
Types of working environment (Phase)	Secondary school contexts	Secondary school	9	20	29
		LA Post	2	0	2
		Others	1	1	2
	Post-secondary contexts	Higher education	4	5	9
		Further education	0	1	1
Service length	1 year		4	1	5
	2–3		0	3	3
	4–6		2	6	8
	7–9		1	5	6
	10–15		6	6	12
	16–25		2	4	6
	> 25		0	2	2
Post that reflects SMEs' main responsibility	Class teacher		9	15	24
	Curriculum co-ordinator		0	2	2
	Middle management		1	3	4
	Assistant head teacher		0	1	1
	Teaching & learning consultant		1	0	1
	GBL initiative leader		1	0	1
	Further education teacher		0	1	1
	PGCE tutor		0	1	1
	Lecturer		4	3	7
	Others		0	1	1
Number of games used in an average term	None		3	0	3
	1		1	3	4
	> 1		12	24	36
How long have you been using games? (GBL experience)	Never		2	0	2
	1 year		4	3	7
	2–3 year		1	5	6
	4–6 year		5	9	14
	> 6 years		4	10	14
Number of game developments in which involved (Game production experience)	None		7	20	27
	1		2	3	5
	> 1		7	4	11

*Including two secondary school teachers with unknown gender.

teachers (15 or 43%) had 4–15 years of teaching experience. Seven (out of ten) academics were aged between 31 and 50, and 6 of them had 10–25 years of teaching experience. Most (39) respondents are White; one is Black and two have Asian origin.

Based on the results of examination of demographic characteristics, five independent variables—gender, teaching experience, phase, GBL experience and game production experience—were chosen for analysing the respondents' GBL experience and attitude towards the above mentioned GBL issues.

In Survey 2, the majority of the respondents were male (83%), reflecting the reality of a male-dominated game industry—only 6.6% of the workforce is female (TIGA 2010). Slightly more than half (22) the respondents are 30 years old or below. Apart from ten respondents who have no experience working in game studios, the game experts were grouped into three levels of experience: nine juniors with up to three years experience, ten seniors who had been working between 4 to 9 years, and twelve veterans who joined the game industry at least ten years ago. In terms of responsibilities in game production, 18 of the respondents were holding administrative or managerial positions while 23 of them were mainly focusing on the design and development of games. Half of the respondents possessed at least a Bachelor's degree (21) and this included twelve who also had postgraduate qualifications. The majority of the game experts (34) were White; six have Asian origins. Table 6.3 shows the cross tabulation between gender and other demographic characteristics of the game experts.

After examining the demographic profiles of the game experts, four independent variables—gender, job position type, nature of expertise, and academic qualifications—were chosen for analysing the game experts' attitude towards the above mentioned GBL issues.

Table 6.3: Demographic profile of valid respondents in Survey 2

Gender			Male	Female	Total
			34	7	41
Age	> 21		5	2	7
	21–25		10	0	10
	26–30		3	2	5
	31–40		8	2	10
	4 –50		4	1	5
	> 51		4	0	4
Ethnicity	White		30	4	34
	Asian origin		4	2	6
	Others		1	1	2
Qualification	GCSE or equivalent	Secondary (n = 10)	1	0	1
	A-Level / AS Level		9	1	10
	Diploma		4	3	7
	Bachelor's Degree		8	1	9
	PGCE / PG Diploma	Postgraduate (n = 12)	2	0	2
	Master's		7	2	9
	PhD		1	0	1
	Others		2	0	2
Service length	Never		8	2	10
	1–3		7	2	9
	4–6		3	2	5
	7–9		4	1	5
	10–15		4	0	4
	> 16		8	0	8
Nature of expertise	Indies		9	2	11
	Educational		10	3	13
	Commercial		15	2	17
Post that reflects game experts' main responsibility (Type of Job position)	CEO	Administration & management (n = 18)	4	0	4
	Developer		4	0	4
	Director		4	0	4
	Managing director		1	0	1
	Manager		1	0	1
	Producer		1	0	1
	Consultant		2	0	2
	Recruitment staff		1	0	1
	Indies	Design & development (n = 23)	9	2	11
	Game designer		2	2	4
	ISD		0	1	1
	Artist		2	0	2
	Animator		0	1	1
	Programmer		1	0	1
	Tester		1	0	1
	Research student		1	1	2

6.2 Nonparametric statistical analysis

With the small targeted sample sizes, nonparametric statistical tests were planned and run using SPSS, following the guidelines indicated by Siegel and Castellan (1988). Four nonparametric techniques were applied: Kolmogorov-Smirnov Test, Wilcoxon Signed Rank Test, Mann-Whitney U Test and Kruskal-Wallis Test. One-sample Kolmogorov-Smirnov tests were carried out to check the goodness-of-fit of the sample to a normal distribution. In Survey 1, age category and teaching experience were the only two demographic characteristics that yielded approximations to normal distributions; while in Survey 2, only gender and ethnicity showed normal distributions, thus the choice of using nonparametric statistical techniques instead of parametric techniques was justified (Siegel & Castellan 1988).

Throughout the survey, a comparison was made between respondents' attitudes to what might occur in an *ideal* educational situation, and to what they would *usually* expect. The *ideal* situation is denoted as what the best example would be like *ideally*; while the *usual* situation is regarded as what the experience of average situations would be like *usually*. To avoid confusion between these two specifically defined situations with the common usage of 'ideal', 'usual', 'ideally' and 'usually', terms in italics have these specific meanings in this chapter. Wilcoxon Signed Rank tests were carried out to compare the attitudes in the *ideal* and *usual* conditions. Two levels of attitude comparison were made in this research: the first level compared the differences of attitude of both SMEs and game experts to the *ideal* and *usual* conditions; while the second level compared the differences of attitudes between SMEs and game experts. The types of nonparametric techniques employed in this research were shown in Table 6.4.

Table 6.4: Types of nonparametric statistical analyses conducted in this research

Nonparametric techniques	**Analyses were carried out to identify…**
Kolmogorov-Smirnov Test	…the goodness-of-fit of the sample.
Wilcoxon Signed Rank Test	…differences of attitude to the *ideal* and the *usual*.
Mann-Whitney U Test	…attitude differences related to gender.
	…attitude differences between secondary school SMEs and post-secondary SMEs.
	…attitude differences between SMEs who had experience in game production and those who had none.
	…attitude differences between game experts who held administrative / managerial positions and those who held positions in game design or development.
	…attitude differences between SMEs and game experts.
Kruskal-Wallis Test	…attitude differences among different age categories.
	…attitude differences among SMEs who had different lengths of teaching experience.
	…attitude differences among SMEs who had different lengths of GBL experience.
	…attitude differences among game experts who had different academic qualifications.
	…attitude differences between indies, educational game experts and commercial game experts.

6.3 Attitude to teachers who use games in teaching

Teachers who use games in teaching were denoted as 'GBL teachers' in this chapter. The questionnaire consists of five hypothetical propositions about respondents' attitude to GBL teachers, in which two were about the characteristics of GBL teachers and the rest were regarding characteristics of effective GBL teachers.

6.3.1 GBL teachers *per se*

The majority of the respondents held positive attitudes to teachers who use games in teaching (see Table 6.5). Both the SMEs and the game experts regarded the *ideal* GBL teachers as open-minded to the latest ICT and willing to listen to students' suggestions on the use of games in the classrooms. However, Wilcoxon Signed Rank tests show that the positive attitudes of the SMEs and the game experts reduced significantly from 'Agree' in the *ideal* situation to 'Neutral' in the *usual* situation ($p < .001$). The reduction of positive attitudes may reflect the respondents' uncertainty about their usual GBL experience in teaching. In fact, a respondent (SME047) who did not respond to questions in this section in the questionnaire commented that, *'I don't really have an extensive enough knowledge on games to be able to answer this*

section.' Another respondent (SME034) also found answering the questions difficult, particularly for the *usual* experience, because *'if there is an obvious educational purpose to the game, I think teachers will be convinced of the benefit and be able to use it irrespective of their own knowledge and competence with ICT.'* This indicated a need for conducting follow-up interviews to further investigate the reasons behind respondents' state of uncertainty about the *usual*.

Table 6.5: Respondents' attitudes towards teachers who use games in teaching (GX: game experts; SA: strongly agree; A: agree; N: neutral; D: disagree; SD: strongly disagree; d: direction of significance; ↓: reduction, r = effect size)

Teachers who use games in teaching			**Attitude**					**Mode**	**Md**	***p***	***z***	***d***	***r***
			SA	**A**	**N**	**D**	**SD**						
…are open-minded to the latest ICT.	SMEs	Ideally	18	24	3	0	0	A	A	<.001	-4.175	↓	.52
		Usually	3	24	11	7	0	A	N				
	GX	Ideally	18	19	4	0	0	A	A	<.001	-4.311	↓	.45
		Usually	5	15	14	7	0	A	N				
…are willing to listen to students' suggestions for the use of games in classrooms.	SMEs	Ideally	17	23	5	0	0	A	A	<.001	-4.470	↓	.47
		Usually	3	16	14	12	0	A	N				
	GX	Ideally	11	18	10	2	0	A	A	<.001	-3.873	↓	.43
		Usually	3	12	17	7	2	N	N				

6.3.2 Characteristics of effective GBL teachers

In terms of requirements for effective GBL teachers, the respondents believed that *ideally* the teachers need to be trained and must have understood the concepts behind games usage; these were regarded as more relevant than involvement in game production (see Table 6.6). However, the view of both the SMEs and game experts changed significantly to uncertainty (p <.001, Md = Neutral) when they referred to what their *usual* experience was like.

SMEs and game experts believe that involvement in game production is not a determinant factor for effective GBL practice. However, a Mann-Whitney U test revealed a significant difference in distribution of attitudes between SMEs and game experts, despite a tied median score (Md = Disagree, U = 674.5, z = -2.281, p = .023, r = .25). This difference was caused by the fact that half of the SMEs strongly disagreed with the statement, while the majority of the game experts disagreed with it. A further analysis revealed that despite a tied median score (Md = Disagree), SMEs in secondary schools were more likely to strongly disagree (17 of 35) with the

usefulness of getting involved in game production—presumably because it would distract from their teaching duties; while post-secondary SMEs with a greater orientation to research and development tended merely to disagree (6 out of 10, U = 106, z = -2.005, *p* = .045, *r* = .3).

Table 6.6: Respondents' attitudes towards the requirements for effective GBL teachers

Teachers who use games in teaching			Attitude					Mode	Md	*p*	*z*	*d*	*r*
			SA	A	N	D	SD						
…need to be trained to use games in teaching.	SMEs	Ideally	19	13	8	4	0	SA	A	<.001	-4.802	↓	.51
		Usually	2	15	12	12	0	A	N				
	GX	Ideally	14	17	5	4	1	A	A	<.001	-3.712	↓	.41
		Usually	3	12	15	11	0	N	N				
…must have understood the concepts behind using games in teaching.	SMEs	Ideally	24	14	3	1	0	SA	SA	<.001	-4.957	↓	.53
		Usually	4	16	13	11	0	A	N				
	GX	Ideally	19	20	2	0	0	A	A	<.001	-4.762	↓	.53
		Usually	3	14	16	8	0	N	N				
…cannot use GBL effectively unless they get involved in game production.	SMEs	Ideally	2	4	4	17	18	SD	D	.244	-1.165	-	.12
		Usually	1	2	6	18	18	SD/D	D				
	GX	Ideally	2	5	5	21	8	D	D	.976	-.03	-	.00
		Usually	1	4	9	20	7	D	D				

6.4 Attitude to studios that produce games for use in formal educational contexts

Studios that produce games for use in formal educational contexts are regarded as 'educational game studios' or 'serious games studios' as contrasted to 'commercial game studios' in this thesis. Thus, the games produced by educational game studios are seen as educational games. In the questionnaire, three questions were asked about the educational studios and four questions related to the educational games.

6.4.1 The games produced by educational game studios

As shown in Table 6.7, the majority of the respondents disagreed with all four negative propositions about games produced for use in formal education, but the results of Wilcoxon Signed Rank tests indicated that the attitude differences between the *ideal* and the *usual* conditions were statistically significant.

The respondents in both surveys opposed the proposition that bespoke educational games are not pedagogically sound, but they were uncertain (Md = Neutral) whether this was the *usual* situation or not (SME: *p* = .001; GX: *p* = <.001). A further

analysis among the SMEs revealed a significant difference; SMEs who had used games in teaching for 4 to 6 years (14 out of 43) were in doubt (Md = Neutral) whether the games should be pedagogically sound or not, as opposed to other SMEs who either 'Strongly disagreed' or 'Disagreed', (X^2 (4, n = 43) = 10.236, p = .037). In fact, this reflects the voice of some contemporary SMEs who regard 'pedagogically sound' as an unnecessary feature for games use in education. Such perceptions might be shaped by the trend of GBL practices in schools which adopted games on the Nintendo Wii (released since November 2006) that were not specifically designed for education.

Table 6.7: Respondents' attitudes to the games produced by educational game studios (↑: increment)

Studios that produce games for formal education contexts			**Attitude**					**Mode**	**Md**	***p***	***z***	***d***	***r***
			SA	**A**	**N**	**D**	**SD**						
…produce games which are not pedagogically sound.	SMEs	Ideally	2	6	8	11	16	SD	D	.001	-3.528	↑	.38
		Usually	3	12	16	9	3	N	N				
	GX	Ideally	0	3	11	13	14	SD	D	<.001	-3.713	↑	.41
		Usually	2	6	22	7	4	N	N				
…produce games which do not fit curricular objectives.	SMEs	Ideally	5	5	7	16	10	D	D	<.001	-3.359	↑	.36
		Usually	3	17	11	10	2	A	N				
	GX	Ideally	0	7	11	17	6	D	D	.003	-2.954	↑	.33
		Usually	2	10	18	9	2	N	N				
…produce boring games.	SMEs	Ideally	0	3	9	15	16	SD	D	<.001	-4.278	↑	.46
		Usually	0	17	13	10	3	A	N				
	GX	Ideally	1	5	4	19	12	D	D	<.001	-4.310	↑	.48
		Usually	2	23	7	8	1	A	A				
…produce games which are not creative.	SMEs	Ideally	0	3	8	16	16	SD	D	<.001	-4.241	↑	.46
		Usually	3	11	14	12	3	N	N				
	GX	Ideally	1	5	3	19	13	D	D	<.001	-4.384	↑	.48
		Usually	2	20	10	7	2	A	A				

Another uncertainty of attitude was revealed when the respondents were not sure whether educational games *usually* fit curricular objectives or not (Md = Neutral), although they believed that should *ideally* be the case (SME: p <.001; GX: p =.003). Further analysis in Survey 2 indicated that game experts who possessed postgraduate qualifications admitted (n = 13, Md = Agree) that games produced for use in formal educational contexts *usually* do not fit curricular objectives, while other respondents were either neutral (Secondary and Diploma) or disagreed (Bachelor's degree), (X^2 [3, n = 39] = 12.426, p = .006). Noticeably those experts who did not receive postgraduate education were not able to state whether educational games fit curricular objectives or not in the *usual* practice.

Although the respondents felt that educational games were not boring and uncreative in the *ideal* situation, the SMEs' attitude changed from 'Disagree' to 'Neutral' in the *usual* situation (p <.001), while the game experts' attitude reversed from 'Disagree' to 'Agree' (p <.001).

Perhaps the change in attitudes about the characteristics of educational games indicates that although the SMEs knew how educational games **could** be pedagogically sound and fit curricular objectives, they do not know how to produce games that **are** creative and interesting; while the game experts knew how to produce **creative** and interesting games, but they do not know how to produce games which are **pedagogically** sound and fit curricular objectives. These differences clearly show that both types of experts were only certain about aspects of educational games related directly to their field of expertise; hence the need for collaboration rather than independent production.

6.4.2 The studios that produce educational games

The majority of the SMEs were uncertain (Mode = Neutral) in both the *ideal* and in the *usual* conditions about the issues that prevent educational game studios from making games fun. Nearly half (10 out of 19) of SMEs who disagreed that there would be problems in the *ideal* situations admitted that the studios actually face such limitations. This led to more SMEs recognising that was *usually* the case, and the difference of attitude between the two conditions was indeed statistically significant (p =.008). Compared to the SMEs, the game experts held a clearer stance, as they believed that *ideally*, the game studios should not experience limitations that would prevent them from making games fun (Md = Disagree), but they confessed that was the *usual* situation in educational games production (p =.001, Md = Agree).

A Mann-Whitney U test revealed a significant difference in this attitude—to the *usual* condition—between game experts (Md = Agree) and SMEs (Md = Neutral; U = 606.5, z = -2.583, p = .01, r = .28). The lack of awareness amongst SMEs of the aspiration of educational game studios to make games fun could prompt a potential conflict in cooperative GBL practices that involve both types of experts, because the emphasis on making games fun is often at the expense of educational context or vice versa.

However, in issues related to educational elements, the SMEs did recognise the present production challenges. The majority of the SMEs and the game experts agreed that educational game studios constantly face the dilemma of balancing educational elements and gameplay elements. However, only among the game experts was there a recognition that the problem was more serious in the *usual* than the *ideal* situation (p = .023). This difference echoed the statistically significant difference in awareness of this dilemma in the *usual* condition, revealed through a Mann-Whitney U test, (U = 670.5, z = -2.002, p = .043, r = .22), in which the median score of game experts was 'Agree' but the SMEs scored 'Neutral'. In fact, this difference reinforces the lack of awareness among SMEs of problems faced by educational game studios.

Table 6.8: Respondents' attitudes to studios that produce educational games

Studios that produce games for formal education contexts			**Attitude**					**Mode**	**Md**	***p***	***z***	***d***	***r***
			SA	**A**	**N**	**D**	**SD**						
…experience limitations preventing them making games fun.	SMEs	Ideally	1	8	15	14	5	N	N	.008	-2.633	↑	.28
		Usually	2	13	19	7	2	N	N				
	GX	Ideally	3	13	4	15	6	D	D	.001	-3.479	↑	.38
		Usually	8	18	9	6	0	A	A				
…constantly face the dilemma of balancing educational elements and gameplay elements.	SMEs	Ideally	6	16	10	7	4	A	A	.095	-1.671	-	.18
		Usually	7	21	9	4	2	A	A				
	GX	Ideally	10	14	7	9	1	A	A	.023	-2.281	↑	.25
		Usually	14	19	4	3	1	A	A				

6.4.3 Stealth learning in GBL

Stealth learning is a type of GBL where the *'players enjoy themselves while doing it and realise that they have learned after.'* (Prensky 2001, p. 96) The majority of the respondents held positive attitudes in the *ideal* situation (SME: Mode = Agree; GX: Mode = Strongly agree) about the use of stealth learning in GBL—studios should let players enjoy playing the game without realising they are learning. However, the game experts were uncertain whether this was true in the *usual* case. The mastery of stealth learning in GBL construction requires the knowledge and skills to make both the learning and playing objectives implicit. While game experts were certain about the benefits of engaging players through stealth learning, they might be incapable of justifying whether implicit learning is beneficial to formal education or not. On the other hand, most of the SMEs agreed in both the *ideal* and the *usual* conditions about

the use of implicit learning outcomes in games, and this could be seen as a permission given to game experts to embed implicit learning outcomes into game playing.

Despite a tied median score (MD = Neutral), comparison between the SMEs and the game experts yielded a significant difference in the *usual* situation, (U = 644.5, *z* = -2.215, *p* = .027, *r* = .24). Both types of experts became uncertain about stealth learning, and the change of attitude was more significant for the game experts (*p* =.007), as compared to the SMEs (*p* =.032). Perhaps, their heavily technical reliance on game experts to merge stealth learning and GBL in practice had caused the SMEs to hesitate about whether this idea is practical in game production or not.

Table 6.9: Respondents' attitudes to stealth learning in GBL

Studios that produce games for formal education contexts			**Attitude**					**Mode**	**Md**	***p***	***z***	***d***	***r***
			SA	**A**	**N**	**D**	**SD**						
…should let players enjoy playing the game without realising they are learning.	SMEs	Ideally	14	17	3	8	1	A	A	.032	-2.146	↓	.27
		Usually	3	18	15	6	1	A	N				
	GX	Ideally	14	12	4	8	3	SA	A	.007	-2.688	↓	.30
		Usually	2	11	12	11	5	N	N				

Further analysis in Survey 1 revealed that SMEs in secondary school contexts were more likely to agree with stealth learning (Md = Agree, n = 33) in the *usual* situation, as all (n = 10) the post-secondary SMEs were neutral about its necessity in practice (U = 90.5, *z* = -2.281, *p* = .023, *r* = .35). Besides, a significant difference was found in the same proposition in relation to experience; SMEs who had 7–15 years teaching experience agreed (Md = Agree) when others scored either 'Disagree' or 'Neutral', (X^2 [6, n = 42] = 15.022, *p* = .02). Thus 7 to 15 years of teaching experience could be the comfort range for practising GBL with implicit learning objectives in the classrooms.

Meanwhile, a significant difference in the attitude to stealth learning in *the ideal* situation was revealed between game experts who worked in administration / management (Md = Neutral or Agree, n = 18) and those who worked in game design and development (Md = Agree, n = 23; U = 131.5, z = -2.06, *p* = .039, *r* = .32). The administration or management group seems to have less confidence in placing implicit learning outcomes in educational games.

6.5 Attitude to GBL collaboration: comparing SMEs and game experts

Seventeen questions were asked in the questionnaire regarding how SMEs and game experts could collaborate to design and develop games for use in formal educational contexts. In other words, these were GBL issues related to collaboration between SMEs and game experts. Among these questions, four questions were about successful factors of GBL collaboration, five were matters that both SMEs and game experts need to understand in GBL collaboration and eight were issues concerning the roles and responsibilities in GBL collaboration. A comparison was made between respondents' attitudes to what might occur *ideally*, and to what they would *usually* expect.

6.5.1 The factors in successful GBL collaboration

The SMEs supported all four factors of successful GBL collaboration proposed in the survey; the game experts agreed with three of them (see Table 6.10). Both groups of experts stressed the importance of effective communication, agreed objectives and the appointment of a coordinator who knows about education and game production in the *ideal* collaboration, but their positive attitude decreased from 'Agree' to 'Neutral' in *usual* practice (p <.001).

Table 6.10: Respondents' attitudes to the factors of successful GBL collaboration

Factors of successful collaboration			Attitude					Mode	Md	*p*	*z*	*d*	*r*
			SA	A	N	D	SD						
Effective communication is the key factor in successful collaboration.	SMEs	Ideally	11	16	10	7	1	A	A	<.001	-4.462	↓	.40
		Usually	4	7	17	14	3	N	N				
	GX	Ideally	25	14	2	0	0	SA	SA	<.001	-4.481	↓	.49
		Usually	8	14	14	5	0	A/N	A				
They should have agreed objectives about the output of GBL collaboration.	SMEs	Ideally	20	18	4	1	1	SA	A	<.001	-4.467	↓	.48
		Usually	5	14	18	5	2	N	N				
	GX	Ideally	13	15	9	4	0	A	A	<.001	-4.041	↓	.47
		Usually	3	6	17	15	0	N	N				
A coordinator who knows about both education and game production is required.	SMEs	Ideally	15	14	12	3	1	SA	A	<.001	-3.934	↓	.42
		Usually	6	6	23	9	1	N	N				
	GX	Ideally	13	15	9	4	0	A	A	<.001	-4.297	↓	.47
		Usually	3	6	17	15	0	N	N				
An induction session for teambuilding is essential at the beginning of collaboration.	SMEs	Ideally	16	10	15	3	1	SA	A	<.001	-3.825	↓	.41
		Usually	6	7	22	6	3	N	N				
	GX	Ideally	4	12	13	9	3	N	N	.157	-1.14	-	.16
		Usually	0	10	19	10	2	N	N				

SMEs agreed (Md = Agree) that *ideally*, an induction session for teambuilding is essential at the beginning of collaboration, but the game experts were uncertain (Md = Neutral) about its essentiality. This difference between the two groups of experts was significant (U = 609.5, z = -2.801, p = .005, r = .3). The game experts also remained uncertain in *usual* practice, while there was a significant attitude reduction among the SMEs (p <.001). Perhaps the concept of 'induction' was unfamiliar in the game industry; as indicated by Adams (2010, p. 51) many game development teams have started to *'implement a project management process called "Scrum"* (see Section 9.2.1 for an example of actual practice in game production), *which is a term borrowed from the sport of rugby.'* The difference identified between these two practices was in itself an indication of the importance of a teambuilding induction session. A further analysis in Survey 2 discovered that significant gender differences among game experts contributed to the divergent views between SMEs and game experts. Female game experts agreed with the importance of the induction session *ideally* and *usually*, but the males were neutral about this idea (*ideally*: p = .013, U = 50, r =.39; *usually*: p =.038, U = 54, r =.38).

Among the game experts, females (n = 7) generally felt more positive than males (n = 34). Female experts believed that *usually* effective communication is the key factor in successful collaboration, but the males were neutral about this statement (p =.037, U = 61.5, r =.33). Both males and females were positive about having agreed objectives towards the output of GBL collaboration, but the females had stronger feelings. Their median scores in *ideal* and in *usual* conditions were 'Strongly agree' and 'Agree', while the males scored 'Agree' and 'Neutral' (*ideally*: p = .036, U = 62.5, r =.33; *usually*: p =.034, U = 62, r =.33).

Although the majority of respondents in both surveys were uncertain (Mode and Md = Neutral) about the need of appointing a coordinator in *usual* practice, a significant attitude difference was discovered across the three different types of game experts (indies, n = 11; educational, n = 13; commercial, n = 17; X^2 [2, n = 41] = 5.977, p = .05), where educational game experts opposed the requirement (Md = Disagree), while the others chose to be 'neutral'. The opposition to the appointment of a coordinator in collaboration by the educational game experts might have impaired the communication between SMEs or teachers and the game experts, in turn causing

educational game studios to produce games that were not pedagogically sound or fitting curricular objectives *usually*, though further investigation would be needed to justify this conclusion

6.5.2 The types of mutual understanding needed

As shown in Table 6.11, the respondents held positive views (Md = Agree) about the need for five types of mutual understandings in the *ideal* collaboration, but their enthusiasm decreased significantly relating to the *usual* circumstances relating to four of those understandings, for which they were neutral *in practice* on whether or not both game experts and SMEs understood each other's job scope (p <.001), the technical terms used in game production (SME: p <.001; GX: p =.004), the pedagogical concepts used in teaching (SME: p <.001; GX: p =.002), and the nature of game playing (p <.001). Both type of experts changed their overall attitude because they themselves were lacking the understanding of those aspects of collaboration, despite being aware of its importance.

Although the respondents consistently held positive attitudes to the need for understanding the concepts used in GBL both in *ideal* and in *usual practice*, their belief decreased significantly (p <.001) from *ideal* to *usual*. This could reflect their lack of opportunity to understand those concepts *usually* despite recognising the importance of such knowledge. Among the game experts, those who have at least a Bachelor's degree stressed the need to understand the concepts used in GBL in *usual* practice, but others were neutral to this proposition, (X^2 [3, n = 39] = 9.905, p = .019). This might be an indication of the lack of vision of the importance of GBL concepts in collaboration among experts who only had secondary academic qualifications.

A gender comparison among SMEs indicated that, *in usual practice*, women stressed more strongly that SMEs and game experts need to understand each other's job scope, despite the tied median score (Md = Neutral) for both males (n = 16) and females (n = 27; U = 137.5, z = -2.15, p = .032, r = .33). This stronger women's voice was echoed among game experts in the *ideal* condition, as females (n = 7) held stronger positive feelings (Md = Strongly agree) than males (Md = Agree, n = 34) to the same need, (U = 65, z = -2.097, p = .036, r = .33).

Males SMEs (Md = Disagree or Neutral) held a more negative attitude to the need to understand the nature of game playing *usually* than females (Md = Neutral; U = 116, z = -2.623, p = .009, r = .4); probably they thought they knew games enough to collaborate with game experts, since recent statistics show that there were more male game players than female game players on all types of platforms (ESA 2010). The same statistics may also explain why male game experts (Md = Neutral) were unsure about the need to understand the nature of game playing in *usual* practice, while the females (Md = Agree) regarded that as necessary, (U = 58, z = -2.214, p =.027, r =.35). The game experts who held design or development positions (Md = Agree) stressed the need to understand the nature of game playing in the *usual* situation, while the experts in the administration / management group were neutral, or perhaps uncertain about the necessity of this, (U = 123.5, z = -2.297, p = .022, r = .36). This result was consistent with the gender differences because the administration / management group who responded to the questionnaire was all-male.

Female SMEs felt more positive *usually* to the need for understanding the pedagogical concepts used in teaching, (U = 141.5, z = -2.003, p = .045, r = .31), and the median scores were identical as well (Md = Neutral). Meanwhile, a higher proportion of SMEs who have no game production experience (11 out of 29) were positive to the need to understand the pedagogical concepts in GBL collaboration compared to those who had experience (1 out of 16; U = 117.5, z = -2.64, p = .008, r = .4), despite having a tied median score (Md = Neutral) between the two groups.

While significant differences were found in *usual* practice among the SMEs, there were dissimilarities between the game experts regarding the need in the *ideal condition* to understand pedagogical concepts. Both commercial (n = 17) and educational (n = 13) game experts (Md = Agree) agreed with this need, while the indies were uncertain (Md = Neutral, n = 11; X^2 [2, n = 41] = 9.746, p = .008); probably being independent developers limits their opportunities to be involved in collaborative game production, particularly those involving educational elements. In terms of academic qualifications, game experts (Md = Agree) who possessed at least a diploma qualification stressed the mutual need for understanding the pedagogical concepts, while those who have secondary or equivalent qualification were less certain (Md = Agree or Neutral), (X^2 [3, n = 39] = 8.381, p = .039). The value of

understanding the pedagogical concepts was less appreciated among experts who have only completed secondary education.

Table 6.11: Respondents' attitudes to the types of need in mutual understanding

SMEs and game experts need to understand			Attitude					Mode	Md	*p*	*z*	*d*	*r*
			SA	A	N	D	SD						
…each other's job scope.	SMEs	Ideally	16	21	7	0	1	A	A	<.001	-4.549	↓	.48
		Usually	2	14	22	6	1	N	N				
	GX	Ideally	15	22	4	0	0	A	A	<.001	-4.786	↓	.53
		Usually	4	12	18	7	0	N	N				
… the technical terms used in game production.	SMEs	Ideally	11	16	10	7	1	A	A	<.001	-3.826	↓	.40
		Usually	4	7	17	14	3	N	N				
	GX	Ideally	10	11	6	12	2	D	A	.004	-2.901	↓	.32
		Usually	1	8	17	14	1	N	N				
… the pedagogical concepts used in teaching.	SMEs	Ideally	20	22	2	1	0	A	A	<.001	-4.869	↓	.51
		Usually	8	4	21	12	0	N	N				
	GX	Ideally	13	18	6	3	1	A	A	.002	-3.149	↓	.35
		Usually	3	14	17	7	0	N	N				
… the nature of game playing.	SMEs	Ideally	12	22	7	2	2	A	A	<.001	-4.051	↓	.43
		Usually	7	8	18	10	2	N	N				
	GX	Ideally	15	23	2	1	0	A	A	<.001	-4.175	↓	.46
		Usually	6	13	15	7	0	N	N				
… the concepts used in GBL.	SMEs	Ideally	16	21	6	2	0	A	SA	<.001	-4.515	↓	.48
		Usually	6	9	21	8	1	N	A				
	GX	Ideally	9	22	7	3	0	A	A	<.001	-3.539	↓	.39
		Usually	3	14	14	5	0	A/N	A				

6.5.3 The roles and responsibilities in GBL collaboration

In issues related to roles and responsibilities in collaboration, the majority of the respondents agreed that *ideally* the roles played by both game experts and SMEs have to be clearly defined (see Table 6.12). However, the respondents were uncertain in *ideal* and in *usual* conditions whether the responsibilities in collaboration need to be clearly defined or not. The discrepancy between the agreed role delineation and the uncertainty about responsibilities could be a result of the lack of the understanding of the practice of roles and responsibilities delineation in GBL collaboration, because when a role is clearly defined, the responsibilities of playing the role would need to be listed to justify the need for the particular role in the collaboration. The evidence of this lack of understanding is that the *ideal* collaboration as perceived by the respondents would be blending clearly defined roles among SMEs and game experts, leading to blended or joint responsibilities

instead of separated ones, despite having no clear knowledge of what the *usual* situation is like in GBL collaboration (Mode and Md = Neutral).

Apart from the issue related to the delineation of roles and responsibilities, the respondents agreed with all the roles and responsibilities proposed for game experts and SMEs in the survey, even though the positive attitudes shown in both surveys decreased significantly in *usual* practice. Despite being uncertain about what the collaboration in *usual* practice is like (Mode = Neutral), the respondents asserted that the roles played by game experts should include determining the production methods (SMEs: p =.005; GX: p =.012), explaining how creativity is injected in production (SMEs: p <.001; GX: p =.001), and participating in the teaching-trials using GBL (SMEs: p <.001; GX: p <.001); while SMEs' roles should cover determining the contents of GBL (SMEs: p <.001; GX: p =.003), explaining 'what and how' teaching is supposed to be like (SMEs: p <.001; GX: p =.037), and involvement in the testing of games (SMEs: p <.001; GX: p <.001).

A comparison between the two groups of experts revealed a significant attitude difference in the necessity for SMEs to convey 'what and how' teaching is supposed to be like to game experts *ideally*, (U = 631.5, z = -2.428, p = .015, r = .24). Despite a tied median score (Md = Agree), 39 SMEs (91%) held a positive view of the proposition, but there were only 23 game experts (56%) who shared this positive view. In fact, almost half of the game experts were either unsure or disagreed about the need to learn 'what and how' teaching is supposed to be like from SMEs.

In issues related to formative evaluation, three groups of SMEs—those who had 2–3 years, 4–6 years and 16–25 years teaching experience—felt strongly (Md = Strongly agree) that *ideally*, game experts should be involved in teaching-trials using GBL, as compared to other SMEs (Md = 'Strongly agree' or 'Agree'; X^2 [6, n = 42] = 18.75, p = .005). These results matched the previous findings, showing that SMEs who were not in the comfort range for GBL practice preferred to have explicit objectives in GBL collaboration and have game experts' direct involvement in GBL practices.

Table 6.12: Respondents' attitudes to the roles and responsibilities in collaboration

Roles and responsibilities in collaboration			Attitude					Mode	Md	*p*	*z*	*d*	*r*
			SA	A	N	D	SD						
The roles played by both SMEs and game experts have to be clearly defined.	SMEs	Ideally	16	19	8	2	0	A	A	<.001	-4.542	↓	.48
		Usually	3	10	23	8	1	N	N				
	GX	Ideally	11	18	9	3	0	A	A	<.001	-3.540	↓	..3 9
		Usually	1	14	19	6	1	N	N				
The responsibilities held by SMEs and game experts have to be clearly defined.	SMEs	Ideally	7	12	8	16	2	D	N	.039	-2.069	↓	.22
		Usually	0	9	23	10	3	N	N				
	GX	Ideally	4	11	13	11	2	N	N	.533	-.623	-	.07
		Usually	2	10	23	6	0	N	N				
Game experts should determine the production methods.	SMEs	Ideally	8	21	13	1	1	A	A	.005	-2.822	↓	.30
		Usually	4	15	21	3	1	N	N				
	GX	Ideally	7	16	15	3	0	A	A	.012	-2.517	↓	.28
		Usually	2	12	22	5	0	N	N				
Game experts have to explain to SMEs how they inject their own creativity in GBL design and development.	SMEs	Ideally	10	22	9	2	0	A	A	<.001	-3.850	↓	.42
		Usually	4	9	25	5	0	N	N				
	GX	Ideally	9	17	12	2	1	A	A	.001	-3.285	↓	.36
		Usually	1	15	20	4	1	N	N				
Game experts should be involved in the teach-trials using GBL.	SMEs	Ideally	20	18	4	1	0	SA	A	<.001	-4.376	↓	.47
		Usually	5	11	18	8	1	N	N				
	GX	Ideally	20	14	6	1	0	SA	A	<.001	-4.092	↓	.45
		Usually	5	13	19	3	1	N	N				
SMEs should determine the contents of GBL.	SMEs	Ideally	11	18	9	5	1	A	A	<.001	-4.121	↓	.44
		Usually	1	8	26	7	2	N	N				
	GX	Ideally	2	24	12	3	0	A	A	.003	-2.996	↓	.33
		Usually	2	12	20	7	0	N	N				
SMEs have to convey 'what and how' teaching is supposed to be to the game experts.	SMEs	Ideally	10	29	3	1	0	A	A	<.001	-4.540	↓	.50
		Usually	4	12	23	4	0	N	N				
	GX	Ideally	9	14	11	6	1	A	A	.037	-2.080	↓	.23
		Usually	0	17	18	4	2	N	N				
SMEs should be involved in the testing of games.	SMEs	Ideally	27	14	3	0	0	SA	SA	<.001	-4.809	↓	.51
		Usually	4	13	20	5	2	N	N				
	GX	Ideally	22	17	2	0	0	SA	SA	<.001	-4.280	↓	.47
		Usually	7	14	15	5	0	N	A				

6.6 Interim discussion and cross-case analysis

Upon the completion of the surveys, the findings in the confirmative studies and the exploratory studies were juxtaposed and compared for two reasons: first, to confirm or refute the 29 hypothetical propositions analysed in this chapter, and then to identify the latent gaps in understanding that required further exploration and explanation in this research. In turn, this cross-case analysis as elaborated in Chapter 4, set the ground for the top-down data analysis in the next stage of research.

Table 6.13 presents the overall modes of attitudes gathered in Survey 1 and Survey 2, in which the figures represent the number of questions in each section with a mode at that level. Since the GBL issues studied were in fact the findings in exploratory studies, the meta-modes of respondents in both the *ideal* or the *usual* cases represent the general attitudes held by the majority of respondents towards those findings.

Table 6.13: The overall mode of the respondents' attitudes to the GBL issues studied

GBL issues studied			**Mode of Attitudes**					**Meta-mode**
			SA	**A**	**N**	**D**	**SD**	
Section 1: Teachers who use games in teaching	SMEs	Ideally	2	2	0	0	1	SA/A
		Usually	0	4	0	1	0	A
	GX	Ideally	0	4	0	1	0	A
		Usually	0	1	3	1	0	N
Section 2: Studios that produce games for use in formal educational contexts	SMEs	Ideally	0	2	1	1	3	SD
		Usually	0	4	3	0	0	A
	GX	Ideally	1	1	0	4	1	D
		Usually	0	4	3	0	0	A
Section 3: How SMEs and game experts could collaborate to design and develop games for use in formal education contexts.	SMEs	Ideally	5	11	0	1	0	A
		Usually	0	0	17	0	0	N
	GX	Ideally	3	11	2	1	0	A
		Usually	0	2	15	0	0	N
Total views	SMEs	Ideally	7	15	1	2	4	A
		Usually	0	8	20	1	0	N
	GX	Ideally	4	16	2	6	1	A
		Usually	0	7	21	1	0	N

In total, twenty-two propositions (Ideally: Strongly agree = 7 and Agree = 15) were supported by the SMEs in Survey 1 under *ideal* conditions of which only eight (Usually: Agree = 8) were confirmed in their *usual* experience. They opposed six propositions (Ideally: Disagree = 2 and Strongly disagree = 4) in the *ideal* situation and one (Usually: Disagree = 1) in the *usual*, while leaving the remaining propositions uncertain (Ideally: Neutral = 1; Usually: Neutral = 20). In the second survey, the game experts supported twenty propositions (Ideally: Strongly agree = 4 and Agree = 16) in the *ideal* condition but seven (Usually: Agree = 7) in *usual* practice. Seven propositions (Ideally: Disagree = 6 and Strongly disagree = 1) were rejected by them in the *ideal* condition and one (Usually: Disagree = 1) in *usual* practice, while they were neutral about the rest of the propositions (Ideally: Neutral = 2; Usually: Neutral = 21). In conclusion, the SMEs and the game experts shared a fairly similar pattern of attitudes with the findings of exploratory studies, as the meta-mode in the *ideal* was 'Agree', but the majority of the respondents were

uncertain whether or not the conditions were *usually* the case (Meta-mode = N). In general, the change in attitudes to GBL issues between these two conditions indicated a lacuna in knowledge that is worth further study.

Regarding the first GBL issue, although the changes of attitude among the SME were statistically significant between the *ideal* and the *usual*, the direction of attitude remained constant. The SMEs agreed with the same four propositions and disagreed with one identical proposition about teachers who use games in teaching. However, in the case of Survey 2, the game experts rejected one proposition in both the *ideal* and the *usual*, but shifted view about three out of four propositions they had supported in the *ideal* when considering the *usual* experience. In other words, the SMEs held more affirmative attitudes than the game experts on GBL issues related to teachers who use games in teaching. Both sets of experts shared similar expectations about GBL teachers, but the lack of collaborative GBL practices had probably left game experts in uncertainty when referring to what their experience of GBL teachers was like.

In the GBL issues related to educational game studios and the games produced by these studios, both the experts shared a similar change of attitude, where they disagreed with all four negative features of educational games in the *ideal* but admitted that *usually* some were actually the case. As mentioned above, the uncertainty of both types of experts about issues beyond their professional knowledge and understanding, justifies the need for collaboration instead of independent production.

If GBL practices were going to involve the use of bespoke educational games—which should ideally be the case—both the SMEs and game experts **must** collaborate to design and develop games specifically for use in educational contexts. Alternatively, GBL teachers could either learn to be ‘deep-teachers’, like the specific GBL teacher depicted in Section 5.4.2. Or else, they might have to rely heavily on serendipities or learn-based gaming, an approach used by commercial game experts to employ ‘learning’ as a marketing strategy to increase the sale of commercial games.

In cases where SMEs chose to collaborate with educational game experts, they ought to understand the limitations and challenges faced by the game experts in realising the aspiration of making games fun and creative. If the SMEs were aware of the dilemma encountered by the game experts in balancing educational elements and gameplay elements, SMEs could initiate the collaboration by proposing pedagogical ideas to game experts, and then provide sufficient liberty to the game experts to convert the pedagogical ideas into game ideas. One pragmatic approach revealed in this research was informing the game experts explicitly about the SMEs' acknowledgement of the value of implicit learning objectives in GBL practices.

Issues related to GBL collaboration were indeed complicated, and both the groups of experts recognised this complexity unequivocally. The general patterns of their attitudes and attitude changes to issues of collaboration were quite similar because the meta-modes were identical in the *ideal* and in the *usual*: the majority of the SMEs held positive attitudes to nearly all propositions in the ideal condition but they neither agreed nor disagreed with all the propositions in *usual* practice; the game experts were just slightly more certain than the SMEs when responding to the same set of questions. This in fact indicates a call for realistic GBL collaboration solutions, which could extend the positive attitudes of both types of experts in the *ideal* conditions to working together in actual practice.

6.7 Targeted themes of analysis for follow-up interviews

Respondents in both Survey 1 and Survey 2 who were interested in participating in the follow-up interview were invited to answer a list of selected questions asked in previous exploratory studies. The data collected in the previous studies were analysed and interpreted for generating the hypothetical propositions used in the survey. The revision of the questions was tailored to guide respondents who became interviewees to think and reflect on what they had said or had not said in the survey. Based on the outcomes of cross-case analysis, the following issues were identified as essential to explain the pattern of attitudes and the attitude change discovered in the confirmative studies:

- How do SMEs and game experts see the games used in education?

- How do SMEs and game experts see GBL teachers?
- How do SMEs and game experts see educational game studios?
- How do SMEs and game experts see GBL collaboration?

A list of nine themes was structured under three issues—benefits of GBL, GBL practice in formal educational contexts and GBL collaboration between SMEs and game experts—based on the findings of the confirmative studies (Table 6.14). These themes were used as the placeholders to sort and analyse interview data in the explanatory study. Two batches of interviews were accomplished; the first batch was carried out with SMEs while the second was conducted with game experts. The interviewees were those who either responded or intended to respond to either one of the questionnaire surveys. The findings of the explanatory study are presented in Chapter 7.

Table 6.14: The structure of GBL themes for top-down analysis and their associated GBL issues

GBL issues	Analysis of data needed in the explanatory stage
Benefits of GBL	1. The benefits of GBL for teachers 2. The benefits of GBL for game experts
GBL practice in formal educational contexts	3. The challenges faced in GBL practice 4. The positive GBL experience 5. The perceived ideal GBL practice
GBL collaboration between SMEs and game experts	6. The problems faced in the *usual* GBL collaboration 7. The positive *usual* GBL collaboration experience 8. The roles and responsibilities of SMEs and game experts in GBL collaboration 9. The perceived *ideal* GBL collaboration

6.8 Summary

This chapter described the surveys of two major groups of participants in this research—the SMEs and the game experts. The results of the questionnaire surveys were synthesized to construct the findings for the confirmative stage of this research. In turn, the findings were compared with those in the exploratory studies, hence the cross-case analysis, from which a structure of GBL themes was developed for the data analysis described in the next chapter. The confirmative studies played an essential role in this doctoral research. Nevertheless, it was the conduct of cross-case analysis that linked the findings between the exploratory stage and the confirmative

stage, and subsequently revealed significant inferences and lacunae of knowledge that furthered the exploration in this doctoral journey.

CHAPTER 7: FINDINGS OF THE EXPLANATORY STUDY

7.0 Introduction

This chapter reports on an explanatory study carried out to investigate the rationale of the attitude and attitude changes among the SMEs and the game experts on three GBL issues studied in the surveys presented in the previous chapter; twenty-two semi-structured interviews were carried out with survey respondents on a voluntary basis.

7.1 Semi-structured interviews

Twenty two interviewees participated in this stage of research, each representing a unit of analysis (see Table 7.1). All interviewees were recruited through the questionnaire surveys; only 17 of the responses were valid and contributed to the findings at the confirmative stage of this research. Of those who were excluded, SME_E and SME_H did not see themselves as valid survey respondents because they had no experience in using games in teaching or involving in game production, but they offered to contribute to this research since the nature of their expertise relates to the use of games in education. The questionnaire return of SME_G was technically invalid because SME_G said he never used games in teaching when responding to the questionnaire. However, the comments SME_G wrote in the questionnaire revealed that he actually used games in teaching when he was a secondary Science teacher. SME_J was the academic supervisor of GX_C in GBL projects, and he joined the interview session arranged for GX_C.

7.1.1 Demographic profile

In terms of interview contexts, sixteen interviews were conducted in the higher education context, four in the game industry and two at secondary schools. However, four participants in higher education had experience teaching in schools, and three of them were actually teacher trainers during the interview. In fact, SME_C particularly chose to play the role as a former secondary Maths teacher rather than a teacher trainer or doctoral researcher in the interview. The delineation of role held during interview with SMEs (SME_A to SME_K) and game experts (GX_A to GX_K) set the basis for perception comparison in this study.

The GBL researchers (SME_I and SME_J) and the GBL doctoral researchers (SME_K, GX_A and GX_B) played dual roles in this study, holding a rather ambiguous stance in between academia and game industry. For pragmatic reasons, GBL researchers were defined as researchers whose daily operation at work was directly related to research on GBL rather than producing games. The researchers were discriminated as either SMEs or game experts instead of hybrid, depending on the nature of the research they conduct.

Table 7.1: Demographic profile of interviewees (GX: game experts)

Identity	Context of interview	Gender	Role held during interview	Concurrent roles
SME_A	Secondary school	Male	Geography teacher	ICT coordinator; Master's student
SME_B	Higher education	Female	Former secondary Maths teacher	Teacher trainer; doctoral researcher
SME_C	Higher education	Male	Teacher trainer	Former secondary Maths teacher; doctoral researcher
SME_D	Higher education	Female	Teacher trainer	Former secondary Science teacher; Educational researcher
SME_E	Secondary school	Female	Educational strategist	N/A
SME_F	Higher education	Male	Learning technologist	Student experience design specialist; e-learning advisor; doctoral researcher in learning spaces
SME_G	Higher education	Male	Technology-enabled learning researcher	Former secondary Science teacher; assistant professor in educational enquiry
SME_H	Higher education	Female	Pre-school education researcher	N/A
SME_I	Higher education	Male	GBL researcher	Senior lecturer in computer games; educational game designer
SME_J	Higher education	Male	GBL researcher	Principal lecturer in game development and simulation.
SME_K	Higher education	Male	GBL doctoral researcher	Lecturer in e-learning; e-learning project manager
GX_A	Higher education	Male	GBL doctoral researcher	N/A
GX_B	Higher education	Female	GBL doctoral researcher	N/A
GX_C	Higher education	Female	Level designer for educational games	Undergraduate student researcher in GBL
GX_D	Game industry	Male	Founder and CEO of a game studio	Founder and former chief technical officer of another game studio
GX_E	Game industry	Female	Instructional system design manager	Former research manager of an educational game studio
GX_F	Game industry	Female	Game designer	Current game technical artist of a university R&D project
GX_G	Game industry	Male	Senior game artist	Former art director; former 3D animator
GX_H	Higher education	Male	Former president of a game design society	Computer science doctoral researcher ; indie
GX_I	Higher education	Female	President of a game design society	Undergraduate computer science student; indie
GX_J	Higher education	Male	Executive member of a game design society	Undergraduate mathematics student; indie
GX_K	Higher education	Male	Indie	Undergraduate computer science student

7.1.2 Interview methods

As shown in Table 7.2, three interview methods—face-to-face, email and telephone were deployed to suit the preference and convenience of the interviewees. SME_J and GX were interviewed concurrently; while interview with GX_B was started with emailing and followed by a face-to-face discussion.

Table 7.2: Types of interview methods deployed in this study

Interview methods	Interviewees	Count
Face-to-face	SME_A, SME_B, SME_C, SME_D, SEM_F, SME_G, SME_J, GX_B, GX_C[a], GX_D, GX_H, GX_J	12
Email	SME_H, GX_B[b], GX_E, GX_F, GX_G, GX_I, GX_K	7
Telephone	SME_E, SME_I, SME_K, GX_A	4

7.1.3 Top-down analysis approach

The set of interview questions used in this study was a revised version of the set used in ES2. The follow-up interviews focused on gathering participants' perceptions towards games, GBL and people involved in GBL, in which the following questions were asked:

- How do you see people who produce games? Why?
- How do you see teachers who use games in teaching? Why?
- How do you see studios that produce educational games? Why?
- How do you see games used in education?
- What are the potentials of GBL? Why?
- How could game experts and teachers be benefited by GBL?
- How would you want GBL practice to be like?
- How should teachers (as SMEs) and game experts ideally collaborate to design and develop games for use in education?
- What are the possible roles and responsibilities of teachers and game experts in game production?

Other questions related to GBL were also asked primarily as ice-breaking cues that prompted interviewees to talk about their GBL practice and experience. As a result, instead of structuring the findings based on the above mentioned list, three themes were used as the predetermined categories—a top-down analysis approach:

- Benefits of GBL.
- GBL practice in formal educational contexts.
- GBL collaboration between SMEs and game experts.

7.2 The benefits of GBL

The interviewees were asked to describe the benefits they gained or they thought SMEs and game experts would gain from GBL practice. In contrast to the perceived potentials found in exploratory studies (see Chapter 5), the benefits of GBL were mainly based on interviewees' experience rather than imagination.

7.2.1 The benefits of GBL for teachers

After an iterative analysis process, the benefits of GBL for teachers as perceived by interviewees were identified and grouped under two themes and nine categories (see Table 7.3). Compared to SMEs, a higher proportion of game experts (SMEs: 5; GX: 9) were interested in issues related to teachers' benefits, and they also generated relatively more views on teachers' benefits (SMEs: 12; GX: 20).

Table 7.3: Perceived GBL benefits for teachers in on-the-job training and support

Benefits of GBL for teachers		SMEs (n = 11)		Game experts (n = 11)	
		f	Source	*f*	Source
On-the-job training and support	Motivational training	1	SME_B	2	GX_D, GX_F
	Pedagogical training	2	SME_E, SME_G	2	GX_B, GX_D
	ICT training and support	0	-	3	GX_A, GX_G, GX_K
Teaching and learning interaction	Lesson planning	3	SME_G, SME_K	1	GX_A
	Engaging learners	1	SME_B	4	GX_J, GX_H, GX_I, GX_J
	Fun and motivation in learning	1	SME_K	2	GX_I, GX_J
	Efficient and personalised feedback	2	SME_C	2	GX_D
	Eliciting and assessing learners' performance	1	SME_K	3	GX_D, GX_H
	Promoting social interaction among learners	1	SME_K	1	GX_H
	TOTAL	12	5 sources	20	9 sources

7.2.1.1 On-the-job training and support

In this explanatory study, three categories of benefits—motivational training, pedagogical training, and ICT training and support, were found to be related to on-the-job training and support.

In terms of motivational training, SME_B, GX_D and GX_F believed that GBL could enhance the morale of teachers. GX_D asserted that GBL should be seen as a complement rather than replacement to existing teaching and learning approaches. This could probably comfort some teachers who feel challenged or even threatened by the technology-enabled teaching approaches, which include GBL. In fact, GBL could make teaching easier because games should be something that players just pick up and play naturally (GX_F). In this sense, teachers are motivated to use games in teaching (SME_B).

Although game playing should be intuitive in nature, teaching through GBL requires dedicated pedagogical training (SME_E). Undergoing such training would enable teachers to acquire *'another resource and toolkit which they can use when it is appropriate,'* (SME_E) in which GBL becomes another teaching tool to use (GX_B). This in turn *'improves teachers' repertoire of teaching strategies'* (SME_E).

GX_D saw GBL as the technology of the generations that are coming. Therefore once teachers adopted GBL, they gained a new method to communicate with the younger generations (GX_A), and subsequently became capable of finding a common language and preference in games or GBL with their students (GX_K), promoting positive interaction between teachers and students.

Nonetheless, GBL should always be seen as one tool among many (GX_D) which teachers could adopt (SME_G), rather than a compulsory teaching method to fit teachers to the trend of ICT used in education. GX_J witnessed an unpleasant scenario where his mother, a school teacher, was facing pressure from the authority to use games in teaching. In such circumstances, the teachers might be de-motivated.

7.2.1.2 Teaching and learning interaction

Six themes were formed based on interviewees' propositions on teaching and learning interaction. In terms of timeframe, the interaction can be further divided into pre-session, during the session and post-session interactions.

Pre-session

Planning in advance is essential for GBL sessions, and this could be incorporated into teachers' lesson plans. The planning task involves linking specific learning theories with GBL, such as theories that support learner-centred learning. According to SME_K, GBL provides useful experiential learning experiences for learners. Such learning experience is where teachers can enrich by placing elements of scaffolding (SME_K). Besides, GBL allows more delivery of information in a session (GX_A), because teachers are given *'the opportunity to create a very explicit link for students to add some kind of independence in learning'* (SME_G).

During the GBL session

GBL has motivational effects (SME_K), mainly because it lets learners have fun in learning (GX_I & GX_J). When the learners are having fun, they become more engaged in learning (GX_H). Therefore, GBL can engage learners (SME_B & GX_J). The engagement can maintain a longer attention span on the tasks set to learners (GX_I), since GBL can hold the interest of learning longer (GX_A).

When multiplayer games aka games that involve more than two players were chosen by teachers, GBL could promote social interaction among learners, because the play session can get students to work together, to interact with each other and eventually to learn collectively (GX_H). One example given by SME_K is called 'springboarding discussion', in which GBL becomes a medium that prompts participation of learners in discussion (Fletcher 2006).

One key benefit of GBL is its efficient and personalised feedback. The forms of feedback include instant feedback based on the action—reaction between learners and the gameplay (SME_C); and automated debriefing at the end of game based on the overall individual performance (GX_D). Besides, by analysing the results presented automatically in the debriefing, teachers can get constant feedback on

students' performance over a specific or predetermined time (GX_D). This in turn allows teachers to have a more overarching view of the students' progress along the learning session, making GBL an useful assessment tool for tracking learning progress automatically (GX_D). With the support of such feedback mechanism, *'teachers can go around and help pupils a lot more than they would otherwise be able to do'* (SME_C). More importantly, the feedback given by teachers, accompanied by the automated debriefing, would become more individualised (SME_C & GX_D).

Another way of eliciting learners' performance is through *'post-learning critical reflection,'* (SME_K) in which GBL facilitates students to talk about their learning experience and the lessons learnt (GX_H).

7.2.2 The benefits of GBL for game experts

After an iterative analysis process, six types of GBL benefits for game experts as perceived by interviewees were identified (see Table 7.4). Twenty interviewees (10 SMEs & 10 game experts) indicated 30 benefits (SME: 17; GX: 13).

Table 7.4: Perceived GBL benefits for game experts. (*f*: frequency)

Benefits of GBL for game experts	SMEs		Game experts	
	f	Source	*f*	Source
Financial benefit; business opportunity	6	SME_A, SME_D, SME_E, SME_G, SME_J, SME_K	4	GX_A, GX_D, GX_I, GX_K
New market; new domain of game	3	SME_A, SME_G, SME_I	3	GX_A, GX_B, GX_D
Social contribution; motivation to produce educational games	3	SME_D, SME_G, SME_K	2	GX_F, GX_G
Learning opportunity	2	SME_F, SME_J	2	GX_I, GX_J
Job opportunity	1	SME_C	0	-
Research and development	1	SME_K	0	-
No specific benefit	1	SME_B	2	GX_C, GX_H
TOTAL	17	10 sources	13	10 sources

7.2.2.1 Financial benefit and business opportunities

The most mentioned benefit of GBL for game experts was financial or monetary related—half of the interviewees who answered this question highlighted this as the prime benefit for game experts. However, despite being seen as a potential business opportunity by teachers and academics, GBL was indeed not an attractive source of revenue in the eyes of game experts themselves. In other words, the SMEs thought

game experts will make money but the game experts did not think so themselves. If game experts' main concern in game production is to earn money, producing educational games would definitely be not their top priority. SME_K believed that commercial game experts would be quite cynical about the benefits of GBL, because *'doing things for the world of education is possibly something they tried before but without success, while they are probably quite happy with the business model that they have already.'* SME_K illustrated the success in the sale of *Call of Duty: Modern Warfare 2*, which he reckoned that would *'make Hollywood jealous'*:

> *'Spending a lot of money developing very high quality products and then shipping a lot of copies, millions [sic] millions of copies for quite a high price.'*

Another commercial games business model is the casual games market, which aims to *'sell for a relatively small amount of money but sell a lot.'* (SME_K) Money is the main concern for game developers, but financial benefit is not the driving force behind joining educational game making. Conversely, it may be because some game experts intend to be 'money-making machines' for the publishers (GX_J), that they feel reluctant to produce games for use in education.

7.2.2.2 New markets and new domains of games

GBL is an added market for commercial game studios where they can provide services (SME_A). However, GBL could be a new market for commercial game studios, but to educational game developers, this is the only market they have. After being told that there were actually game studios whose key business was developing educational games, SME_A admitted that *'there is an area there for them.'* SME_G also showed no initial vision about educational game experts. Like SME_A, GBL was seen as a potential expansion of the current *'quite well-defined and rival market'* for commercial game developers.

In contrast to SMEs and educational researchers, all GBL researchers understood that GBL would be a diversion for the game industry. SME_I particularly stressed that the market for educational game developers is very different from the one for

commercial games, and the experiences of developing each of these games are very different, herewith the explanation:

> *'At the moment they (commercial game studios) are focusing on particular types or on particular genres in trying to develop games for their entertainment market. The GBL market is a different environment altogether because you might have different people, different ages, different background, different cultures and you have to accommodate them within the same game. Because you can't use different types of games for the same activity, within one learning environment…possibly you could if it's an online thing, but if you have a sort of class-based, or in a more wider sense, class-based learning environment then you have to use the same game.'*

In other words, while commercial game developers have liberty to develop various types or genres of games for a specific demographic group of players, educational game studios have to cater for the need of learners with different demographic profiles in a single educational game, particularly for one classroom-based learning session. Although SME_I believed that currently this is the challenge faced by educational game experts, he hoped that this problem can be overcome, in that the game experts could achieve the same learning outcome through multiple genres or types of games. According to him, if this does become reality, a new sub-section of the game industry would take form.

To existing educational game experts, GBL is a new area for all game experts to develop a new form of games that has not existed before (GX_D). Being the CEO of an educational game studio, GX_D respected people who are also producing games for use in education. To GX_D, producing bespoke educational games was something that had not been done before;

> *'it is a new medium and its boundaries are being explored, therefore it is quite a new and innovative area to be involved with.'*

7.2.2.3 Social contribution and motivation to produce educational games

SME_D thought that apart from financial reward, GBL would be rewarding to game experts when they know what they were designing was useful, had a purpose and

met the needs of the learners and the teachers. This was indeed the case for both the game experts (GX_F and GX_G) who produce commercial games. GX_F had a very positive view towards people like her who produce games, because she believed that the games they produced can bring happiness to players. This kind of happiness should span across all types of games—GX_F could not understand why many of the educational game studios produced boring games for education. In fact, game experts enjoy the games they produce during both the production and the playing. GX_F insisted that creating a game that even the creator would not want to play himself or herself just does not make sense. In contrast to GX_F, GX_G had a positive view of educational game studios, because GX_G perceived them as *'believers in GBL that can bring educational benefits to the society.'* GX_G saw game experts as people who are *'passionate about engaging the development of the games they have enjoyed playing in the past.'* To GX_F, it would be an honour to contribute to social well-being through the professional knowledge and skills gained in both academia when he was a student and the game industry now as a game expert.

Working in the contexts of researching games for use in education, SME_G supposed that some educational game studios did see a broader purpose to what they are doing than simply making money, i.e. they might feel that producing educational games is the right thing to do and not just something they are doing to make money. However, SME_G admitted that most of the commercial game experts were not as motivated as GX_F in term of producing games for use in education. SME_G supposed that game experts might see GBL as an additional selling point, in which the educators could persuade commercial game experts by saying, *'well, if you build this into your game, it's going to able to sell more'*. Depressingly, this implied that only commercial game experts can create good educational games, so to have good educational games available, educators ought to persuade the game experts to produce games for GBL practices. Worse, SME_G doubted the usefulness of this persuasion:

> *'I am also not sure how persuasive that would be because it would have a very short term span plus I would guess, selling games on their learning or educational benefits is less attractive than selling other features of the games*

which students might be interested in. So it's much more difficult to identify benefits with game experts bearing in mind that competitive consumer-driven world which they work.'

SME_K also thought that commercial game experts need to be persuaded. Successful GBL practices are needed to reassure these experts that *'there will be an economic benefit for them in which they can achieve the type of profit they need from getting involved.'* In other words, GBL could be some sort of motivation for commercial game experts to start producing educational games, but again like SME_G, SME_K suspected the impact of persuasion because:

'it's hard for them to get into schools or getting audience[s] with those who control the funding for various different sectors of education. Probably they will find the door a bit more open when it comes to going to people in corporate training. Even in the corporate training, there is a lack of appreciation [of] just how incredibly expensive [it is] to produce a high quality game.'

7.2.2.4 Learning opportunities

Being a National Teaching Award fellow in higher education, SME_F argued that game experts have a lot to learn from education because they have yet to realise the potential of what they do; they can learn those potentials and make simpler or more sophisticated games that would benefit players. However, when SME_F attempted to justify why he thinks game experts still have not realised the potential of games, he admitted that his perception could be just prospect and prejudice, since he rarely used games in teaching despite being able to develop software independently or in a team—so knowledge in game or software development might not contribute much to the knowledge of GBL practices.

Based on the knowledge of software development, SME_F explained that game experts *'tend to be too inward looking, focus too much on the technology but not cognitive, educational, or social issues.'* Nevertheless, SME_F had a vision that this is changing, because he noticed the change in mass media advertising trends,

highlighting the features of games in social networking activities, such as a game for War Child Charity on Facebook (http://www.warchild.org.uk/).

Meanwhile, based on experience in teaching and researching computer game design, SME_J identified two distinctive types of people who produce games: the game companies and the individual. The former type includes experts who generally work in game studios; while the latter is typically, as described vividly by SME_J, *'teenagers or researchers who buy a game and make some modifications.'* These two types of game experts should be seen separately, because the game companies type is culturally commercial, but the individual experts are enjoying and having fun; as SME_J said, *'we don't have to do it, we choose to do it.'* To teenagers for example, hacking or cracking games is fun, *'it is learning how to code, learning how to program* (SME_J).'

The definition of GBL adapted in this thesis was enriched by both GX_I and GX_J because they saw GBL from insiders' perspectives. GX_I supposed that *'game experts could learn in a different way from other learners using GBL.'* She shared her GBL experience after joining the game design society which she led as the president between 2010 and 2011:

> *'I have always been trying to learn more about games and how they work. It is quite difficult for me now not to analyse games as I play them, think about how I would improve them and what were good design choices. Therefore whilst we can benefit from GBL we are liable to try to learn more about the games than the learning.'*

GX_J reinforced the idea of learning in a different way from other GBL learners because he believed that as game programmer, his learning experiences were indeed game-based or even game-dependent by nature. GX_J further explained the importance of 'game-based' learning to game experts:

> *'Understanding ideas like that [how players learn e.g. abstract skills] will help game developers to develop better games, because they understand the psychology of what's going on. So developing games with the objective of*

learning something would probably teach you a lot about how people play your games…'

Therefore the core benefit of GBL to game experts is actually 'game-based' learning experience rather than the notion of game-based learning used in this thesis. In this particular case of 'game-based' learning, the third extended definition of GBL is still applicable (see Section 2.6).

7.2.2.5 Job opportunities

SME_C was the only interviewee who mentioned GBL can offer more job opportunities to game experts. The individual game expert, rather than the studios they work in, would need more attention in issues associated with GBL. It is a pity that the game industry is always seen as a pool of jobs instead of career opportunities. The difference between job and career would determine the attitude of game experts who work in the game industry. For example, SME_B quit a programming job and began her career as a school teacher years ago, because she saw programming as 'just a job' instead of a career. At heart, passion is always a key to sustaining a professional in the creative industry. Therefore, SME_B respected those who have chosen to produce games for a career, and expected them to like and enjoy the challenge of doing it well, pushing the software to its limits, to try to achieve what they want to do in the game industry.

In fact, getting a job in the game industry is very difficult in itself. According to GX_A, the game industry is saturated at the moment, and there are thousands of budding game designers, testers, coders. These budding game experts include people who play games—the gamers, whom in the eyes of GX_A, are as analytical and creative as people who produce games. The difference between these people, according to GX_A, is that *'people who produced games are actually lucky enough to have found room in the industry,'* while others are not. GX_A asserted that a gamer and a game producer are exactly the same person; the only difference is that one makes money from it, and one does not and yet pays a lot of money for it. Based on this argument, GX_A expanded the scope of 'game experts' to include advanced game players who are capable of creating games. Interestingly, while GX_A expanded the scope of 'game experts', SME_E did the opposite by excluding game

developers, because she said, *'game developers are business people,'* rather than people who know how to create games.

7.2.2.6 Research and development

SME_K asserted that game experts could gain benefits from the findings of GBL research conducted by academics, in which the experts could refer to and improve either the games or the production process. From a pedagogical point of view, there are problems and issues of games and game production where advice and principles provided in academic research are of great value to them. The world of game playing is very much Darwinian-oriented, as SME_K explained,

> *'the game that can't be learned quite quickly don't [sic] get played, and the game that don't [sic] get played don't get bossed [sic]. They basically don't succeed. I suppose in that way, it evolves to this [sic] very clever ways of doing things…maybe the worlds of education and psychology have something to offer them in terms of how they might do this special game [game for use in education].'*

7.3 GBL practice in formal educational contexts

This section presents explanatory propositions for the findings of the surveys reported in Chapter 6, specifically on issues associated with GBL practice (the use of e-games) in formal educational contexts. Three aspects of the practice were discussed:

- challenges faced in GBL practice,
- positive GBL experience, and
- the ideal GBL practice.

7.3.1 Challenges faced in GBL practice

According to Bridger (2003), the optimal use of technology relies on *'an appropriate system of work organisation that itself determines the social organisation of the workforce and the relations and inter-dependencies between individuals,'* which is applicable to the GBL collaboration between SMEs and game experts. Three issues

were taken into consideration in understanding the effectiveness of collaboration, i.e. fitting the job to the worker, fitting the worker to the job, and fitting the worker to the work. The socio-technical system introduced by Trist and Bamforth (1951) was adopted in this research to classify the challenges faced in GBL practice. Table 7.5 presents how 15 themes of the challenges were grouped under the following three components of the system:

- Technical factors: equipment, materials, processes and the environment.
- Social factors: the relationships among the workers and their attitudes to the work and their co-workers.
- Economic factors: how efficiency of the system is measured, with emphasis on productivity.

Table 7.5: Classification challenges faced in GBL practice (Ref = the count of references in Appendix IX; NB: One source could mention more than one aspect of a single issue)

Type of challenge	Themes of challenges	Frequency of the identified challenges			
		SMEs (n = 11)		Game experts (n = 11)	
		Ref	Source	Ref	Source
Social	1. Lack of confidence	6	SME_A, SME_D, SME_E, SME_K	0	-
	2. Negative views on games	3	SME_A, SME_B	1	GX_K
	3. Accountability culture of education	1	SME_G	0	-
Economic	4. Trivial usage	3	SME_B, SME_C, SME_H	1	GX_J
	5. Lack good educational games	2	SME_B, SME_C	1	GX_J
	6. Inconsistent quality	1	SME_B, SME_C	0	-
	7. Accountability of off-the-shelf commercial games	1	SME_K	1	GX_C
	8. Learners' readiness	2	SME_F, SME_G	0	-
	9. Time constraints	1	SME_A	0	-
Technical	10. Disjointed with formal education system	2	SME_A	1	GX_A
	11. Lack of support	2	SME_B,	0	-
	12. Restriction to approved teaching methods	1	SME_G	1	GX_J
	13. Teachers' lack of understanding about games	1	SME_D	0	-
	14. Stagnation of educational game design and development	0	-	1	GX_H
	15. Online security for minors	0	-	1	GX_J
	TOTAL	**26**	**9**	**8**	**5**

Fifteen challenges of GBL practices were revealed through follow-up interviews: three social, six economic and six technical challenges. SMEs were more concerned about this issue compared to game experts, as the challenges faced in GBL practices were most frequently mentioned by SMEs (SME: 26; GX: 8).

7.3.1.1 The social challenges

The most frequent mentioned challenge was the lack of confidence among teachers. In a project SME_A organised in school, the GBL approach did not work with certain teachers, particularly those seniors who felt anxious about failure. The reason behind the fear of failure was that these teachers found using a new teaching approach very difficult (SME_A). SME_D admitted that for her to use games in schools, she would need to feel very confident of the purpose of what it is achieving. As a teacher trainer, SME_D noticed that there is a big lack of confidence at the moment, not only in some of the teachers—what the games do, how to use games - but also whether or not teachers should be using games with children in their free time. SME_E echoed this as she needed to see the effects of GBL on learning first before using any games. In fact, this leads to an irony: how could teachers see GBL happening in school without doing it themselves? However, as more successful incidences of GBL practices were reported to teachers, hopefully teachers would gain confidence and start using games in teaching.

SME_K had a different reason for having less confidence in GBL. As an experienced e-learning project manager, he had constantly witnessed cycles of the promise then the failure of the then new learning technologies. Thus he was quite sceptical about the promise of GBL and he saw it as a form of renewed interest in edutainment, which had previously failed. To SME_K, the failure of edutainment was due to the use of an instructional design approach in game design and development. Therefore, to avoid repeating the same mistake, SME_K suggested that investigations should be carried out to find out exactly how learning takes place when people play games. Then, based on the evidence, the learning could be amended to meet educational purposes without affecting the game playing.

The second frequently mentioned challenge was negative views on games. According to SME_A, games used to be very anti-social as *'it took up time [when] people would be out and playing football, or doing their homework.'* He personally saw games as a distraction, which is a way to get away from other matters; but it is the nature of those 'matters' that could direct the positive or negative use of games. Another type of negative views on games was associated with the lack of vision among teachers, as some teachers, such as SME_B, did not see learning in certain games. GX_K supported this view as he mentioned that many people see games used in education as educational games dedicated to children, which was not actually the case.

Meanwhile, SME_G highlighted an important social challenge faced by many teachers in schools: the current accountability culture of education, particularly in the UK. It is a concern because people will want to know the exact educational benefits of GBL, the specific rationale of using games to enhance students' learning. This created a problem when the concern was interpreted as *'learning needs to be serious and students need to be serious; while having fun, [or] enjoying themselves is distraction.'* SME_G had heard quotes like *'I don't care how much fun students are having, I just need to know how important the learning is.'* The implication of such views was that if students are having fun, then they are not learning—an illogical deduction which SME_G regarded as absolutely appalling.

7.3.1.2 The economic challenges

Three out of six economic challenges were related to the quality of games used in education: lack of good educational games, inconsistent quality, and accountability of off-the-shelf commercial games. SME_C considered that there were not many good educational games. As high quality games were scarce, the chances of low quality games being used were higher because those who are not teachers or SMEs might not be able to differentiate games according to their pedagogic quality. For example, non-SMEs might think that they are doing mathematics, therefore they are learning mathematics. That seemed to be a good thing but it might not be; they are different (SME_B).

GX_J had negative personal GBL experience when he was studying for GCSE O-Level. He believed that the negative experience was a result of the poor use and lack of readily available educational games. Therefore GX_J suggested that GBL practices should be deployed after researching on how they could fit into curricular objectives.

SME_B and SME_C worried about the inconsistent quality of games used in education. Some of the games were well thought through, in which students are learning while playing games; some of them are played for fun but students are actually having learning benefits; some of them are quite not so well thought through; other games like racing games, have a learning aspect too, but that is not obvious, most people would completely oblivious to that (SME_B), despite the potential of stealth learning (see Section 6.4.3).

While SME_B acknowledged the educational benefits of certain off-the-shelf commercial games, SME_K and GX_C doubted the games' accountability. SME_K saw the success of using those games in classrooms as serendipity because these games were meant for entertainment rather than education. To him, the benefits of off-the-shelf games were claimed by teachers or GBL researchers rather than game experts who produced the games. SME_K further challenged the effectiveness of using games like *Brain Training* in schools, because some if not most of the game design and educational presumptions underlying those games, especially those related to transfer of learning from game playing to educational contexts were indeed unknown—a trade secret owned by the game company exclusively. However, he admitted that some strategy or tactical games like *Civilization, Total War Rome, War Empire* or even *Call of Duty: Modern Warfare* have educational potentials, because of the amount of learning contained in those games is tremendous. He concluded that:

> *'Maybe there isn't that very sharp distinction. That [distinction] is in terms of who produced that game, but not in terms of games as either purely entertainment or purely learning. I suppose one thing you could say the games that are purely learning tend to not [be] entertaining; but the games that are entertaining are quite often educational.'*

In the case where good educational games were selected, there was an issue of trivial usage. SME_B and SME_H saw incidences where games were used only to keep pupils busy or occupied. Another form of trivial usage was what SME_C did: using games to convince students to answer questions which they would not otherwise do.

Sometimes, the trivial use of games portrayed a negative image of GBL. In the only GBL experience GX_J remembered at secondary level, his teacher used the BBC Bite Size website, which he saw as merely a form of revision guide that was not fun. He claimed that it was actually a lot easier just to read the revision guides then going through the so-called GBL.

Learners' readiness is another challenge faced by teachers, as there were always be students who did not possess the ability for learning through computers (SME_G). However, probably for economic reasons, academics just assumed all students had the physical and perceptual skills which met the entry requirements of any GBL practice (SME_F & SME_G). In fact, for those students who are less confidence in the use of computers, less interest in games, or less expertise in game playing, GBL is a big challenge. One solution to this problem is to provide additional resources to support and prepare students for GBL. Nonetheless, this would delay the deployment, and lead teachers to face another economic challenge—time constraint (SME_A), because time is always the key barrier for them to explore new teaching methods.

7.3.1.3 The technical challenges

GBL had been seen as being disconnected from the formal education system, especially its limited link to formal examinations (SME_A). As a result, GX_A was rather conservative about how games could be used in the classrooms, in which he regarded GBL as motivator and alternative information presenter.

Perhaps, some teachers were forced to be conservative because they are restricted to using approved teaching methods in the classrooms (SME_G & GX_J). SME_G explained:

> *'Bringing games into [the] classroom means stepping outside the structure to do something different from the norm, and this require[s] the particular teacher to be an extremely brave person, one who would be very confident in*

teaching ability. Regardless of the success or failure of the GBL practice, there will be people who come along and criticize the teacher either for it did not work or for not using the adopted, approved method. Consequently, the fun and creativity of GBL practices will be squeezed.'

Under such circumstances, what teachers had to follow is what is in the curriculum, which always means enabling children to pass exams (GX_J). Some GBL teachers might try to impose the exact curricular objectives into games, but this would be very difficult because it constrains game design and it ignores the fact that games in themselves are learning experiences (GX_J). These experiences, according to GX_J, allow players to learn transferrable abstract skills like pattern recognition through hand-eye coordination.

The lack of understanding about games among teachers also caused the stagnation of educational game design and development. When GX_H was a pupil, the games he played in school focused on educational objectives, which he regarded as serving their purposes. However, he thought that was due to the fact that computer games were not as readily available as they are now. Also, it was more unusual to own a computer and be able to play games at home, whereas now all children are used to playing all kinds of games. Therefore, if nowadays children would sit down and play one of the educational games that GX_H used to play as a child, then they would say at the first scene, *'this is [a] really rubbish game. It's nothing like anything I play at home.'* GX_H did not describe the educational games he played as a child as being fun, except for the fact that it was fun at the time to be allowed to use a computer. So when he got to play the educational games, *'being allowed on the computer was as fun as the game itself.'* Whereas now because the act of being allowed on the computer is not exciting anymore, educational games need to be more fun to make up for that and keep people interested.

The lack of support, both technical and financial support, was a critical challenge to those involved in GBL practice. Educational game studios need technical support from SMEs to produce good quality games; while schools need financial support to make good educational games accessible for teachers who need it (SME_B). *'The price of those games is more expensive, that is why the schools are reluctant to buy it*

because they can't afford it, though they knew they need the games,' explained SME_B.

Like other usages of web-based applications in formal educational contexts, online security for minors had become a serious challenge to GBL. Misconduct and misbehaviours in social networking websites such as Facebook had left a negative impact on GBL that was linked to VLEs (SME_D). This phenomenon had caused teachers to be a lot more cautious when interacting with children through virtual environments.

7.3.2 Positive GBL experience

Five factors of positive GBL practice were identified and grouped using a socio-technical system approach, as shown in Table 7.6. Seven out of eleven interviews of each group of experts included positive GBL experience, and SMEs suggested more incidences that reflected positive experiences compared to game experts (SMEs: 14; GX: 9).

Table 7.6: Classification factors of positive GBL practice (Ref = the count of references in Appendix X)

Type of factors	Themes of positive factors	Frequency of the identified factors			
		SMEs (n = 11)		Game experts (n = 11)	
		Ref	Source	Ref	Source
Technical	1. Flexibility in practice	5	SME_G, SME_I, SME_K	4	GX_B, GX_D, GX_E, GX_K
	2. The use of media-rich resources	1	SME_C	2	GX_C, GX_I
Social	3. Positive attitude to new teaching methods	3	SME_A, SME_D	1	GX_J
	4. Trendy learning strategies	2	SME_D, SME_J	1	GX_I
Economic	5. Maturation of GBL systems	3	SME_A, SME_D	1	GX_J
	TOTAL	**14**	**7**	**9**	**7**

7.3.2.1 The technical factors

The most frequent mentioned factor of positive GBL experience was flexibility, wherein a variety of different practices were illustrated by interviewees. SME_G described two of them: GBL as classroom learning activity using bespoke educational games and GBL as a space where students extended what they do at home in school through game playing clubs or societies. Different game selection

criteria were used to ensure their success, including interactivity type, elements of competition, etc (SME_G).

The flexibility of GBL was also reflected in the creation of a learning environment that replicates a real-life situation, where learners *'can develop their own understanding or their own critical appraisal of the situation'* by interacting with elements in the game world (SME_I). According to SME_I, this should not be just letting them playing in the world but also requiring them to respond to what they had experienced, hence reflective learning. Then, the reflection on GBL could be used as a stimulus for further discussion among learners in the physical world (GX_B).

Both GX_D and GX_E believed that games can be used in any area of education with learners of any age groups, as long as the games were produced appropriately. GX_D argued that certain areas are naturally suitable for games, and he gave an example that was related to collaborative learning. GX_D had developed several games with GX_E which were meant for solving problems in team building, in which the games structured a space that allows every team member to have equal rights and chances in collaborative activities. One interesting phenomenon GX_D found was that although there would always be someone who did not play as much as or as well as others in a team, this was not a barrier to team cohesion because players who were better at games would naturally help others, and this did not stop any team member from contributing ideas or efforts in problem-solving. One example of such games that teaches problem-solving in business management is *Imperialism* (GX_K).

GBL is also flexible when integrating with pedagogic principles, as shown in three examples of integration described by SME_K. Traditional learning often splits the learning process and the assessment process, but this is not the case in games as players are constantly being assessed, i.e. it is 100% constant continuous formative assessment. *'If you are not any good, you will get killed or somebody will tell you, depending on the kind of games that you are playing, and that's a great principle,'* said SME_K. In another example, SME_K explained that game designers commonly used a behaviourist approach called the 'fading principle' where players get the maximum amount of support initially and the amount of support faded out gradually.

Games also offer players dynamic difficulty in which the challenge is uniquely matched to individual players' capacity to deliver on the challenge. This feature, which has its theoretical foundation in Csikszentmihalyi's (1991) concept of flow, was seen as very interesting educationally by SME_K.

The second technical factor identified through the interviews was related to the use of media-rich resources in GBL. Both SME_C and GX_C pointed out that children tend to response positively to multimedia content. GX_I shared her GBL experience in playing an archaeologist game in school over ten years ago, in which she could still clearly remember the pictures used, but she did not remember much of what was said in the lesson—an indication of the importance of visual content in GBL.

7.3.2.2 The social factors

Positive attitude to new teaching methods had contributed to the success of GBL practice. The negative image portrayed by the mass media about games made people to be more willing to try GBL (GX_J). Also, the positive view of games allowed GBL to be more accessible than before (SME_D). Nonetheless, developing positive attitudes, particularly among school teachers, has always been a challenging but possible task. SME_A shared his experience of overcoming the challenge by referring to an ICT project he led:

> *'…all of sudden every student got a computer. Well, they are there, no more exercise book…How you are going to teach them now? …one of the things that came out was that, don't be afraid to fail, just try it. That's what I have been doing. I have done it and this is my second year. Last year we didn't use even one exercise book, only used one textbook, but how you create the lesson and that is interesting because it makes you think…to those who succeeded, they did not mind failure in trying [a] new teaching approach, because even if it failed, they learned something positive from it.'*

Apart from persuading teachers not to be afraid of failure, SME_A also employed students as the sounding board:

> *'I am very clear to the students, say 'let's try it!' If they (the new approaches) didn't work, they'll say, 'ok, it's fine.' And they are very happy to give you*

feedback. They are always very honest: Do you like doing that? Yes? No? What do you like? What didn't you like?'

In terms of developing learners' positive attitude, packaging GBL as a form of trendy learning strategy was proven by some interviewees as an effective method. SME_J believed that education should be congruent with life, and GBL meets the expectation of nowaday's digital natives who see computer games as part of their life. One of the trendy learning styles is allowing ownership, where learners could own components of games such as avatars (SME_D). In fact, the ownership of avatars in games had moved GBL beyond other forms of simulation such as those offered through virtual learning environments (VLEs), linking learners' life at home and in school (SME_D). GX_I depicted another trendy learning strategy which she saw as 'the greatest potential of GBL'—adding memorable tags to particular learning content. To her, learning in classrooms is very repetitive and it would be easier to learn when learners attach feelings or images to specific topics as tags.

7.3.2.3 The economic factor

The maturation of GBL systems was the only economic factor discovered. Starting with Nintendo DS Lite, SME_A saw more and more GBL activities, indicating the readiness of GBL to be adopted by the wider teacher population. SME_D supported this proposition because she witnessed the recruitment of new generation teachers who would embrace GBL with ease. Existing technology-enabled teaching and learning approaches like VLEs were also becoming more established, while better quality games are becoming more widely distributed (SME_D). Certainly, this was promised by the fact that accessibility to computers would no longer be an issue among children and people are more used to game playing (GX_J).

7.3.3 The ideal GBL practice

The key to ideal GBL practice is having the ideal games (SME_A, SME_B & SME_C). In the eyes of SME_B, the ideal games are those which *'have been really thought through;'* and the thinking should be based on learners' point of view (GX_B), hence learner-centred learning. However, SME_B admitted that good games are expensive and take time to produce—the reason why she thought they do not exist.

Sometimes the ideal games could be very simple, such as a game called *Mathletic*, in which SME_C saw his students playing and competing with students from other countries in solving arithmetic:

> *'For the week we did it, it became a huge craze over school, and the whole school was getting involved. Because they wanted to beat other people in the school or they wanted to beat other people in other countries.'*

Having the ideal games is essential, but how the games are used is probably crucial (SME_A). SME_A suggested that the first thing is to convince the teachers that the games could be used; then the second thing is to show the games' benefits.

Meanwhile, GX_E and GX_H regarded the ideal GBL as stealth learning, in which educational activities were turned into either games that learners feel are fun (GX_E) or tasks that learners see like a reward (GX_H). However, GBL should not be made compulsory; rather it should be delivered as a form of advice to play games (GX_K). GX_K insisted that only when someone is not pushed to do something, will the person will find it enjoyable and definitely learn new things quickly.

7.4 Lessons learnt from the *usual* GBL collaboration

When the interviewees were asked to depict their past experiences in the *usual* GBL collaboration to design and develop games for use in formal education, most of them elaborated the problems and challenges they faced. However one SME (SME_C) and three game experts (GX_C, GX_D & GX_D) also included their positive experiences.

7.4.1 Problems faced in GBL collaboration

Similar to section 7.3.1, the problems faced in GBL collaboration were classified into social, technical and economic categories. Table 7.7 shows how thirteen problems were grouped under these categories.

Nearly all SMEs (except SME_G & SME_H) mentioned at least one problem when referring to their past GBL collaboration experience; while only five out of eleven game experts pointed out problems they faced in collaboration. Six of the themes

were problems related to social factors of collaboration, while five were technical and two were economic problems.

Table 7.7: Classification of problems faced in GBL collaboration. (Ref = the count of references in Appendix XI)

Type of problem	Themes of problem	Frequency of the identified problems			
		SMEs (n = 11)		Game experts (n = 11)	
		Ref	Source	Ref	Source
Social	1. Unclear roles and responsibilities	1	SME_B	1	GX_D
	2. Dependence on publishers	1	SME_J	1	GX_C
	3. Need for cross-disciplinary checking	0	-	1	GX_J
	4. Language barrier	0	-	1	GX_C
	5. Teachers' scepticism	1	SME_F	0	-
	6. Unnecessary governmental involvement	0	-	1	GX_C
Technical	7. Lack of understanding about games	1	SME_A	1	GX_H
	8. Lack of understanding about education	1	SME_I	1	GX_C
	9. Subject matter boundary	1	SME_E	0	-
	10. Limited expertise	1	SME_D	0	-
	11. Absence of collaboration mechanism	1	SME_K	0	-
Economic	12. Time constraints	2	SME_E, SME_F	0	-
	13. Discrepancy of expected quality	2	SME_B, SME_C	1	GX_K
	TOTAL	**13**	**9**	**8**	**5**

7.4.1.1 The social problems

When explaining why games were poorly produced, GX_J highlighted the need for cross-disciplinary checking, because a game expert can become very isolated during programming, and a specific learning objective might be ignored unintentionally. However, while cross-disciplinary checking is essential, involving multiple types of experts in game production evoked another problem—unclear roles and responsibilities. In the experience of SME_B, game designers attempted to be the pedagogic experts by rationalising how learning happens; while SMEs tried to take over the roles of game designers and justified how games work through common-sensical thinking. This had resulted in games whose potentials were not thoroughly exploited. Educational game expert, GX_D also faced similar problems:

> *'It's always difficult defining that kind of roles and boundaries, and certainly when you [have] got a game designer, instructional designer (ID), SMEs, it's very difficult… obviously the SMEs and ID haven't necessarily got the technical expertise required to sort of engage at that point in the process. So all they can do there is providing feedback based on the games being developed.'*

The problem with roles and responsibilities delineation could also be a result of the language barrier that exists in cross-disciplinary collaboration. Having experience working with school teachers, GX_C admitted that it is very difficult for game experts to keep away from using technical terms which teachers do not understand. In the case when teachers felt alienated, they might hold *'a sort of critical, wise stance'* and become sceptical about the collaboration (SME_F).

Sometimes, the problems faced by SMEs and game experts in collaboration involved other parties, particularly the publishers and the policy makers. In the joint interview session, both SME_J and GX_C stressed the dependency issue of game developers on publishers. According to SME_J, it is normally the publishers who define the games by responding to government policies and the curricula. So when the policies remain unchanged, the publishers will not do anything which is not in the curriculum. The situation became complicated when the government got involved in game production—a situation described by GX_C as unnecessary. The game publishers do not take the needs of schools and teachers into consideration in funding game production; while teachers do not take the initiative to inform the publishers what is required in teaching (GX_C). As a result, games produced under such a kind of collaboration did not meet the needs of actual teaching in schools.

7.4.1.2 The technical problems

Lack of understanding about games and education was the key technical problem highlighted by interviewees (SME_A, SME_I, GX_C & GX_H). Being an ICT coordinator who had been actively promoting the use of games in his school for the past five years, SME_A had seen many attempts at GBL *'fallen flat on the face'* due to the fact that *'the students had gone bored with them very quickly.'* SME_A saw this as a result of teachers using non-challenging games, e.g. 'fill-in-the-gap games'

or games with easy goals. Thus understanding the educational potentials of games and being able to turn the potentials into engaging GBL practices are important to teachers or SMEs and game experts. Nonetheless, GX_H bewailed that *'there are always going to be instances where a teacher wants to teach something, and thinks games probably help here, but going out and producing a software package or a full game that does not necessarily make sense.'*

In contrast, game experts generally do not understand learning theories (GX_C). In game production, it is difficult for game experts to grasp the requirements of teaching (SME_I). Relying purely on game experts alone to master pedagogic knowledge is not reasonable, although GX_D claimed that he had learnt a lot about teaching and learning through educational game productions. The experience of SME_I indicated that it is highly unlikely to find game experts who have good teaching experience and can combine the abilities of teaching and game development in helping the whole production team to collaborate.

As an educational strategist who provided guidance and advice to teachers in a school funded by United Church Schools Trust in England, SME_5 said that *'secondary teachers are overly bound in their subject matter which hinders the generic, transferability and cross-curricular nature of learning.'* Therefore, these teachers need inputs from game experts through collaborative production to explore the potentials of games beyond existing subject matter boundaries.

Based on the experiences of working as a secondary science teacher and a teacher trainer, SME_D argued that teachers have limited research-based evidence and understanding of common misconceptions made by learners. If they participated in the collaboration, they might not be able to justify or even identify the best content for GBL. Moreover, the curriculum is changing quite drastically and assessment is changing hugely at the moment. In fact, SME_D was aware that some teachers she knew did realise their deficiency, and she provided an example of such insecurity:

> *'You teach something, a concept, when a child is 12, what are their concepts that is underpinning? So it can't just be a game for Year 8 digestion; it needs to be a game for Year 8 digestion with a very secured understanding of what comes after. And then, that's quite hard, that is hard.'*

So SME_D doubted the fitness and effectiveness of having teachers to play the role of SMEs in GBL collaboration. In her view, SMEs who participate in the educational game production should *'understand the pedagogy a little bit beyond the classroom to explain to the games people.'*

The absence of a collaboration mechanism was regarded by SME_K as the key challenge faced in educational game production. Such mechanism is essential for sharing a vision on how SMEs and game experts should work together, because *'SMEs typically do not understand how to make compelling games; game experts often do not understand the nature of the subject or how learning is achieved to create the game that put learning across* (SME_K).'

7.4.1.3 The economic problems

The discrepancy of expected quality in relation to educational games occurred across two different professions, as a former secondary mathematics teacher, SME_C described:

> *'...in one example we had with those matching activities involving graphs, where pupils have to connect the equations to the graphs. We'd drawn all the graphs and sent them off. But the game designer didn't know what were the important features, so they hadn't drawn the line precisely, just roughly, instead of going to the points they needed to go to. They look similar but to mathematicians, they weren't the same.'*

The quality of games was reduced in specific aspects of design and development because the experts placed their personal priorities on top of professional judgments in decision making (SME_B). In the example mentioned, the designer might focus on the aesthetics of materials used in games, while the teacher was concerned about the precision of information presented in the games. As game experts and teachers may not understand each other's requirements, they ended up producing a poor game (GX_K).

Another economic related problem is the time constraint. Working with teachers in schools is challenging in itself because it is often extremely difficult for teachers to find additional time to be involved in research or development (SME_E). The

constraint of time also pressured game experts; time is a commercially linked profit generation factor in production. As a result, *'the programming team were hidden away in the office, never really getting enough time with the end users'* (SME_F).

7.4.2 Positive *usual* experience

Four positive GBL collaboration accounts were gathered in this study, one from SME and three from educational game experts.

7.4.2.1 Collaboration between a mathematics teacher and a game designer

Before commencing his doctoral study, SME_C had experience working with a game designer to produce games for use in secondary mathematics. He played the SME role and came up with an idea, and then discussed the idea with a game designer. In the first meeting, he tried to explain the idea as best as possible to the game designer who then said what was possible and what was not possible. When describing the first meeting, he said:

> *'…it helped if there's some overlap, so I've got some programming experience, not a lot, but I've used things like Flash for example, so we were able to chew up quite happily about object and areas to click that kind of thing. But having the ready idea, they then go away create something and go back to me.'*

During the game production, the game designer produced a prototype based on the agreed idea and presented the prototype to the teacher. SME_C evaluated the prototype and indicated aspects that worked and features which did not fit the original aim. Based on the feedback, the designer produced another prototype for evaluation. They repeated the interactions till the end of the production.

The success story illustrated by SME_C was a result of mutual understanding between SMEs and game experts, which in turn laid the foundation for effective communication throughout the collaboration. In fact, the technical knowledge held by SME_C about game programming had a significant influence on the success.

7.4.2.2 Collaboration between a game level designer and primary literacy teachers

GX_C was involved in a year-long research project to develop what she denoted as educational immersive environments for a primary school in Worcester, UK. The EIEs were built specifically for the Primary School Literacy Education, based on constructivist and experiential learning theories. The outcomes of the project received positive and encouraging feedback from teachers through a questionnaire survey and the pupils who played the game were highly motivated and engaged (Moore & Price 2009).

When GX_C was asked to reflect on her collaboration experience, she highlighted that the self-awareness of understanding the learning process and learning outcomes was essential:

> *'in the work that I do, I spent a lot of time studying learning theories, how children learn and also what the teachers meant by different technical terms, literacy. You know I have to go and actually learn what they meant by that. So I have an idea when they were talking…when I was talking to the teachers, I'd kept away from technical terms. Also I have to learn, what they meant by their technical terms, the teaching terms…I think that is something very important as well, for the communication to be effective.'*

Indeed, her efforts put in understanding the theories of learning and the 'language' of teachers played an important part in the achievement she gained in the collaboration.

7.4.2.3 Success stories of a CEO

As a successful entrepreneur, GX_D founded two game production studios in Dundee, Scotland. In the first studio, he led the studio as the chief technical officer (CTO) for seven years; and then he became the chief executive officer (CEO) of the second studio in 2009. The former provided GBL solutions and technologies for organisations in both educational and non-educational settings; while the latter focused on learn-based gaming R&D for commercial games.

The key success factor, according to GX_D, is effective communication, i.e. making sure members of the production team understand each others' tasks. During the

design stage, it is important that the game production team, the SMEs and the instructional designer keep things at high level so that the tasks can be understood. By high level, what GX_D meant was there should be no technical terms or knowledge involved in the communication. The high level communication should be retained until the condition where the contents—both the learning and game playing were integrated, as he explained:

> *'…as things go on with the development, where the contents become integrated, what I tended to find is that the developers become very familiar with the subject area and the SMEs become a lot more familiar with games, and the constraints and things, how they are produced.'*

7.4.2.4 Insights of an instructional system design manager

GX_E worked with GX_D as a research manager in Dundee, and then she became the instructional system design manager of a studio located in Coventry. The core business of the studio was serious games and immersive simulations production, where bespoke GBL solutions were designed and developed for clients like Coca-Cola UK, Shell UK, Hewlett-Packard Development Company, 3M, etc. Based on previous collaboration experience, GX_E described the following:

> *'The best way to collaboration would be for the SMEs to have an idea / concept of what they want students to learn or gain from the experience. At this point it is good practice to discuss this with the game experts to see how this could be approached and whether all ideas / concepts are achievable etc. If a decision to go ahead is reached then ideally, as game experts aren't SME's in the area, teachers would create the content to pass to the game experts to integrate. While the content is being created, development for the game could be started.'*

In educational or serious games production, the role played by the instructional designer could be seen as a 'bridge' that links SMEs and game experts. As an ISD manager, SME_E carried the responsibility to translate the contents provided by teachers or SMEs into design documents which were comprehensible by game experts. To achieve this end, she also needed to 'speak' the language used in

production. After years of working in game studios, she accumulated sufficient knowledge and skills to be seen as a game expert. However, such a role is not common in commercial game studios, because many in the game industry believe that 'the purchase and use of games is discretionary (Isbister & Schaffer 2008),' thus nobody has to learn how to play a game to accomplish tasks or missions assigned to players as part of the gameplay (Pagulayan, Keeker, Fuller, Wixon & Romero 2007), therefore the need for ISD in production was commonly ignored.

7.4.2.5 Teachers as game experts

According to GX_D, one effective way of teaching a particular subject is through developing a game for the subject, where game making tools are provided to students. The students produce their own games about the subject and through that game making process they learn the subject. In this case, the teachers played dual roles as SMEs and game experts, or else the GBL practice would not be practical because the teachers need to teach the subject matter knowledge and the game design skills concurrently or at least sequentially.

Coincidentally, SME_F deployed a similar GBL approach when he covered several Year 8 lessons in a comprehensive secondary school. The students were instructed to create a game of events, consequences, rules and goals. Apart from having to master the subject matter knowledge, the students had to think about creating rules, creating scenarios, creating connections between rules, and most importantly they have to think about time—how things change over time; how a set of events at one time may make things possible or impossible. SME_F regarded this as a valuable way for students to think about and understand events, time, consequences and alike, while enjoying the GBL experience.

7.5 The ideal GBL collaboration

Among the interviewees, five game experts (GX_B, GX_D, GX_F, GX_G & GX_H) explicitly acknowledged the need for collaboration in producing educational games. GX_D particularly stressed that the collaboration *'has to be in all stages of development, from the sort of initial idea all the way through the sort of deploying the game on a wider scale.'*

7.5.1 Effective communication: the key success factor

Matching the findings in the surveys (see Section 6.5.1), the interviewees generally admitted that effective communication is the key success factor for GBL collaboration. Table 7.8 shows three themes of effective communication between SMEs and game experts formed by the interviewees' suggestions, which are pre-production, production and throughout collaboration.

Table 7.8: Themes of suggestions related to effective communication in GBL collaboration

Themes of suggestions		SMEs		Game experts	
		f	Source	*f*	Source
1. Effective pre-production communication	Suggestions to SMEs	2	SME_B, SME_E	7	GX_A, GX_C, GX_E, GX_H, GX_I, GX_J
	Suggestions to game experts	0	-	3	GX_A, GX_E, GX_J
2. Effective communication during production	Suggestions to SMEs	4	SME_A, SME_C, SME_D, SME_G	1	GX_B
	Suggestions to game experts	2	SME_B, SME_K	1	GX_D
3. Effective communication throughout a collaboration	Suggestions to SMEs	4	SME_C, SME_F, SME_I, SME_J	5	GX_C, GX_D, GX_J, GX_K
	Suggestions to game experts	3	SME_B, SME_C	6	GX_C, GX_H, GX_J, GX_K

7.5.1.1 Pre-production communication

In general, the interviewees expected SMEs to be more proactive than at present in the pre-production communication. During the pre-production meetings, SMEs should inform game experts about the big picture, the scope and the constraints of being teachers nowadays (SME_E), including how and what the teachers have to cover at work besides teaching (GX_A & GX_J); how and what the learners have to learn (GX_J); and when the game is needed (GX_H). If SMEs were the ones who proposed game ideas, they should negotiate with game experts on issues of turning the pedagogical idea into game format in the conceptual stage (SME_B) and ensure the information they provide is clear and sufficient for further exploration and production (GX_A & GX_I). Apart from dealing with game experts, SMEs should also inform the game publishers about the requirements of GBL (GX_C).

While none of the interviewed SMEs gave any suggestion on how game experts should communicate effectively in the pre-production process, the interviewed game

experts provided three recommendations. The game experts were expected to understand the teachers' desires and ambition (GX_A & GX_J), in order to offer the best solution to teachers' problems (GX_A). One key message that game experts should deliver to teachers and SMEs is the feasibility or practicality of particular game ideas (GX_E).

7.5.1.2 Communication in game production

During the game production, SMEs should discuss with game experts about issues regarding the details of specific curriculum and learning contents covered in GBL (SME_G); the tendency for learners' misconceptions in learning and how GBL could be used to counter the problem (SME_G); the rationale behind expected learners' behaviours and experience in GBL (SME_A & GX_B); and the choice of particular game features (SME_C).

SME_B expected game experts to base their arguments in discussion on a game design point of view, rather than individual preconceptions about learning or education. On such basis, the game experts should keep their communication with SMEs at high level (GX_D) and assist the SMEs in understanding how successful games were developed (SME_K).

7.5.1.3 Communication throughout a collaboration

To ensure the effectiveness of communication throughout GBL collaboration, both the SMEs and game experts should acknowledge the presence of mutual ground for conversation and exploration (SME_C). Knowledge about education and games should be exchanged (GX_K) and ideas could be bounced to each other through discussion (GX_J), without the use of technical terminology (GX_C).

SME_J suggested that SMEs should drive the collaboration, and SME_I echoed as he believed that this could *'help the game experts in moving to the right direction.'* However, the SMEs should always keep subject matter relevant details at an appropriate level for game experts to understand (GX_D).

A pair of interesting suggestions was identified in this study: GX_F thought SMEs should be free and open with their interpretations in the collaboration; while SME_F

opposed openness and yet suggested that teachers or SMEs should take a critical stance in the collaboration.

Meanwhile, game experts were advised not to prioritise their personal views (SME_B), specifically prejudices held about education and educational games. They should get informed by the teachers (GX_C) and constantly negotiate with SMEs on GBL issues (SME_C).

Interestingly, GX_H proposed to get GBL researchers, particularly academics who study games, to act as the middle ground or communication point for both teachers and game experts to collaborate. He argued that game experts should be able to get constant input from teachers through the GBL researcher who knows about both education and games, implying that the researcher should act as the coordinator in game production. This argument explained the reason why SMEs and game experts agreed that a coordinator is required to make GBL collaboration successful (see Section 6.5.1).

7.5.2 The reason for mutual understanding

Mutual understanding was found as a significant factor for successful GBL collaboration in Section 6.5.2. Through the interviews, four themes of the reasons for mutual understanding were formed: games, players / learners, trends and policies, and being understanding to each other (see Table 7.9).

Table 7.9: Themes of suggestions on the needs for mutual understandings in GBL collaboration

Themes of suggestions		SMEs		Game experts	
		f	Source	*f*	Source
1. Understanding of games and GBL	Among SMEs	6	SME_A, SME_I, SME_K,	1	GX_J
	Among game experts	0	-	0	-
2. Understanding of players / learners	Among SMEs	5	SME_A, SME_E, SME_I	2	GX_J, GX_K
	Among game experts	7	SME_A, SME_D, SME_F, SME_I, SME_K	2	GX_A, GX_J
3. Understanding of trends and policies	Among SMEs	3	SME_I, SME_J, SME_K	0	-
	Among game experts	5	SME_D, SME_J	0	-
4. Being understanding to each other		10	SME_B, SME_D, SME_G, SME_J, SME_K	5	GC_B, GX_D, GX_H

7.5.2.1 Understanding games and GBL

While no interviewee thought game experts need further study about games, it was suggested SMEs need to understand games and GBL from a teaching point of view. SME_I advised that SMEs should identify teaching elements of games by experimenting with games in their personal learning environment. He argued that personal learning experience through GBL is necessary for SMEs to adapt themselves to GBL issues in teaching. SME_K echoed the argument by suggesting SMEs should explore how games facilitate learning when people play them for entertainment purposes. Through this process, they should be able to identify the problem of learning in GBL themselves (SME_A). Also, they could realise that not everything they can imagine is possible in GBL practice (GX_J).

7.5.2.2 Understanding players / learners

Although GX_J expected SMEs to have known *'how children's mind works a bit more than game experts,'* teachers and SMEs were suggested to need understanding of players and learners in the contexts of GBL. By understanding players or learners in GBL, SMEs should be able to reason why learners in classrooms *'get bored very quickly in certain games.'* (SME_A) SME_A argued that game players *'need to be challenged and pushed in GBL.'* The best way to understand learners and players, according to SME_I, is to be enthusiastic and experienced game players themselves. This experience leads SMEs to identify generic, transferable and cross-curricular skills that learners need to learn (SME_E), which should include what a future learner can learn through GBL (GX_K).

On the other hand, game experts need to understand learners because they should consider what a learner needs to learn and understand in the classrooms (SME_A). This could be achieved by immersing themselves in the classrooms and working with learners (SME_D, SME_F & SME_I). Such exposure would allow game experts to understand what they can and cannot do when designing games for formal educational contexts (SME_D). They should be able to expand what they found on learning in the GBL collaboration (SME_K), by linking their knowledge about game playing, to identify what learners will find most fun in GBL (GX_J). They could also

bring new perceptions about the skills that learners need but were not taught in the classrooms (SME_E).

7.5.2.3 Understanding trends and policies

Despite none of the interviewed game experts being aware of the necessity of understanding the link between trends in game playing and the current government policies, four interviewed SMEs acknowledge the need and the importance of understanding the issues. SMEs should know some of the key issues in gaming (SME_I) while game experts should be familiar with the change of government policies (SME_D). Once the trends and policies were understood, SMEs and game experts could work together to change government policies (SME_J).

SME_J asserted that the SMEs need to know issues and trends in game playing because the SMEs have to convince the game industry of the effectiveness of the GBL approach. The failure of edutainment, courseware or other game-like applications in educational practices over the years had decreased the interest of the game industry in investing in making bespoke games for use in the classrooms. As a result, to start collaborating with the game industry is to firstly demonstrate business opportunities in education to game experts. This, according to SME_J, could be achieved by showing as many successful case studies as possible.

As for game experts, they ought to be sensitive to the changing trends and needs in education (SME_D). This would allow them to start GBL collaboration (SME_J) by exploiting the potential of GBL in accordance to the trend of personalised education in practice now (SME_D).

7.5.2.4 Being understanding to each other

Some interviewees thought that SMEs and game experts should be understanding to each other in GBL collaboration. Positive attitudes were seen as the rationale behind successful game production and implementation of GBL in formal education. SME_B stressed that both SMEs and game experts should let each other 'do their own jobs' by not interfering with each other in doing their jobs. SME_D supported the view and warned game experts not to step into teachers' roles. As for SMEs to get the best of the game experts in the collaboration, SME_D alerted that *'SMEs*

should be aware that game experts will not necessarily understand children's needs and level of literacy.' Meanwhile, GX_H pleaded with SMEs to realise that game experts are fundamentally *'making games instead of teaching.'* Therefore, teachers and SMEs should be considerate with game experts during the collaboration. Such empathy should be expressed along with SMEs' strengths to cover game experts' weaknesses (SME_K).

On the other hand, SME_D wished game experts could appreciate some of the challenges facing the teachers. On the basis of such appreciation, the game experts should be more responsive to teachers' needs; acknowledge teachers' role as the driver of the collaboration (SME_J); and see teachers as contributors in the design process (GX_B). Particularly, SME_K expected game experts to complement SMEs rather than take precedence in the collaboration.

GX_D regards teachers in collaboration as stakeholders. Having such thoughts in mind, he suggested that game experts should:

- explain to the stakeholders about game, gameplay mechanics and things that work well in games,
- direct the stakeholders to examples of games that are similar to the proposed concept, and
- encourage the stakeholders to play more games.

7.5.3 Roles and responsibilities delineation

In the confirmative studies, the positive attitude of survey respondents reduced significantly from their expectations in the ideal condition as most of them became uncertain when referring to their actual GBL practices (see Section 6.5.3). To examine how this change of attitude happened, the perception of interviewees was grouped into four themes, based on the chronological order of GBL collaboration: idea incubation, art style and architecture, educational contents, and evaluation and quality assurance. Table 7.10 shows the frequencies of views interviewees gave in each theme.

Table 7.10: Themes of roles and responsibilities delineation between SMEs and game experts

Themes of roles and responsibilities delineation		SMEs		Game experts	
		f	Source	*f*	Source
1. Idea incubation	By SMEs	3	SME_A, SME_C	4	GX_A, GX_E, GX_I
	By game experts	8	SME_B, SME_C, SME_E, SME_G, SME_J	5	GX_B, GX_D, GX_E, GX_J
2. Art style and architecture design and development	By SMEs	5	SME_B, SME_G, SME_I, SME_K	3	GX_B, GX_H
	By game experts	5	SME_C, SME_E, SME_G, SME_K	9	GX_A, GX_B, GX_E, GX_H, GX_J
3. Educational contents design and development	By SMEs	14	SME_A, SME_B, SME_C, SME_D, SME_E, SME_G, SME_I	11	GX_A_GX_B, GX_C, GX_E, GX_F, GX_G, GX_H, GX_J
	By game experts	0	-	0	-
4. Evaluation and quality assurance	By SMEs	3	SME_G, SME_I, SME_J	7	GX_A, GX_D, GX_E, GX_H, GX_J
	By game experts	7	SME_A, SME_F, SME_G, SME_J	2	GX_A, GX_B, GX_E, GX_G, GX_I, GX_J, GX_K

7.5.3.1 Idea incubation

SME_C suggested that both SMEs and game experts should generate game ideas, but SME_A and GX_E asserted that the collaboration should be started by the SMEs rather than game experts with SMEs proposing the pedagogical idea. If the game idea was proposed by SMEs, they should have a clear idea of what they would like to achieve but be flexible on the game itself (GX_I); while the game experts were expected to take responsibilities to:

- enquire of SMEs to understand the idea (SME_C),
- assess the feasibility, quality and practicality of the idea (SME_C, SME_E & SME_J),
- negotiate with teachers or SMEs through discussion on issues regarding how to turn the pedagogical idea into game format (SME_B),
- inform SMEs what is possible with games, what can and cannot be done, what could and could not be achieved (SME_C, SME_E, SME_G, SME_J & GX_E), and

- explain how the SMEs' ideas could be approached (GX_E).

Although game experts ought to always take teachers' game design ideas into consideration (GX_B), they should avoid being confined by SMEs' limited vision of what games can do in GBL (SME_B & SME_E). In other words, they have to bring in imagination (SME_E) and show things or new ways of teaching which teachers cannot think of (SME_J).

Alternatively, if the game idea was created by game experts, they need to check their idea with teachers, pupils and production fund providers (GX_D). In this case, SMEs were expected to judge the level and sufficiency of subject knowledge of game experts who proposed game ideas (SME_C). After that, the SMEs should inquire about the options of games which are available for GBL practices, and then indicate their preferred game option and offer to work with game experts in refining the game option (GX_A).

7.5.3.2 Art style and game architecture design and development

Art style and game architecture are the core scopes of game experts' roles and responsibilities, because the experts were expected to know the following:

- How to produce engaging games (GX_B).
- How to merge the learning elements with engaging gameplay (GX_B).
- How games work i.e. what is feasible and what people playing games find fun (GX_J).
- The best method to disguise the knowledge into the interface where students actually engage with the game (GX_A).

With such knowledge, they should be the professionals who determine the interface design (SME_C) and what should be implemented in the final design (GX_B), or in a word they have to create the game (GX_E). In the GBL collaboration, they ought to be involved in the planning stage (GX_E). During this stage, their role would be technological experts (SME_E & SME_G). Being technological experts means they should inform SMEs how skills and knowledge in the curriculum could be achieved

via game design (SME_G), based on research into existing successful entertainment games (SME_K). However, GX_H reminded game experts to always be aware that they are making games, which are not necessarily teaching.

Although the art style and game architecture are the job scope of game experts, SMEs could also be seen as contributors to the design process (GX_B), as long as the SMEs do not pretend to be game experts and convey their personal priorities and viewpoints on game design from this claimed role (SME_B). Apart from trying to understanding the game development process (SME_G), SMEs should play just the advisory role rather than getting involved in the production (GX_H). Thus the input provided by SMEs at the design stage would be advice or suggestions, rather than decisions (GX_H). Nonetheless, knowing how games will be built into the programme of study is important at this stage (SME_G), because this would allow the SMEs to augment the learning from 'playing for entertainment purposes' to 'playing for educational purposes' (SME_K).

In the case where SMEs were technically competent, SME_K suggested that game experts could 'transfer more control to SMEs via middleware solutions, which can abridge the technical aspects of game design and development, making modification of games possible among SMEs.' One premise for this to happen is that the game ought to be made modifiable by the game experts.

7.5.3.3 Educational contents design and development

When the game experts start to develop the game, SMEs should be creating the educational contents (GX_E). Most interviewees (seven of eleven SMEs and eight of eleven game experts) agreed that designing and developing educational contents are the core responsibilities of SMEs. The rationales behind this view are:

- SMEs understand how the curriculum works (SME_A),
- SMEs understand learning and learning processes (GX_C),
- SMEs understand the subject, what students need to learn and how they should be learning (SME_G), and

- SMEs have looked at the curriculum and mastered it themselves (SME_D).

The experts are expected to be both subject experts and teaching or pedagogical experts (SME_E, SME_G & GX_B). According to GX_A, they should acquire control in the collaboration in these aspects of game production. The specific responsibilities covered by these roles include:

- identifying areas of the subject which are possibly dull and reveal those areas to game experts (SME_D),
- identifying common misconceptions in the subject among learners (SME_D),
- identifying content and skills for the game to support learning development (GX_B), and
- ensuring the content is relevant to what the students need to learn (SME_A).

However, the SMEs should avoid being bound with their subject matter (SME_E). Instead they should combine their teaching experience and GBL experience (SME_I). This implies that the SMEs should balance the students' needs in game playing and the curricular mechanism (SME_A). From the perspective of GX_J, this means balancing game playing elements and learning objectives attainment.

In the cases where SMEs were not teachers, the SMEs need to *'gather teachers' input to ensure that the game reflects the syllabus, particularly what students should be learning'* (GX_H). In other words, SMEs should consult teachers for the content and skills the game should have in supporting the development of learning (SME_C & GX_B). However, SME_D expected the SMEs to *'understand the pedagogy and the science of learning a little bit beyond the classroom.'*

While GX_E assumed that SMEs' involvement should focus on the planning stage and the content creation, GX_A and GX_F wished to expand the collaboration, to allow SMEs to design the games by fulfilling specific learning objectives. The reason for this suggestion is that GX_F believed that SMEs know how to produce

educational games based on the learning documents provided by teachers, which could be hard for game experts to understand without 'translation' into non-pedagogical language.

7.5.3.4 Evaluation and quality assurance

The game quality assurance and testing are traditionally set within the job scope of game experts (GX_E). In playtesting particularly, they must ensure games retain the characteristics of being relevant, fun and enjoyable, and have challenges (SME_A, GX_G, GX_J & GX_K). When games were used in formal educational settings, teachers or SMEs should be involved in the playtesting of the games (SME_J & GX_J), if they have time (GX_E). Game experts should also get pupils or students to test the games (SME_F, SME_J, GX_A & GX_B), but GX_A recommended that the learners should join the testing after the teachers. SME_I echoed this and insisted that teachers should be the first 'learner' in any educational game developed. They ought to try the trial version of games in their own classroom and then evaluate the games to provide feedback to the game experts (SME_G). The core of the feedback would be an indication of whether or not the pupils will find the game fun while learning (GX_J). To ensure that SMEs are well-guided, GX_A proposed a procedure for game experts to get teachers' involvement in playtesting:

- Develop some prototypes.
- Look for teachers in testing the game before it is actually given to students to test.
- Present the prototypes to teachers.
- Guide teachers in playtesting i.e. feedback mechanism, post-session feedback, game score sheet, etc.

Game experts should develop games based on the findings of teachers' testing in the classrooms (SME_G). This is true if they are working for teachers, where they have to adjust the game when necessary throughout the development (GX_I). Conversely, if the game experts could determine who to work with, SME_F encouraged game experts to get as close to the learners as possible, getting the learners to understand

and to help in developing and testing prototypes iteratively and rapidly—diminishing teachers' role in the collaboration. Nonetheless, the game produced without teachers' involvement will be lacking pedagogical value unless the game experts are also authorised SMEs.

7.5.4 Roles and responsibilities beyond SMEs and game experts

SME_D proposed to involve educational researchers in the collaboration, having them contribute in explaining common misconceptions made by learners in a particular subject. The educational researchers could also indicate how progression in learning happens, to both teachers and game experts. This proposition is consistent with the need for a coordinator—a role to be played by educational researchers, revealed in previous chapter (see Section 6.5.1).

SME_J did not regard teachers as SMEs, rather he saw teachers as the users of GBL approaches in classrooms, while the SMEs participate in game design and development. Therefore the ideal GBL collaboration, based on this delineation, should involve teachers, SMEs and game experts. SME_J also mentioned the influence of the publisher and the government in the collaboration as well, where the publishers define games; while the government describes what the National Strategy is. GX_C suggested that the publishers should go into schools and ask the teachers what they want before defining games. This argument was reinforced by SME_F who asserted that GBL collaboration is a joint effort of students, schools and game experts.

7.5.5 Steps and sequences in collaboration

7.5.5.1 SMEs' preferences

SME_J thought that the collaboration ought to be initiated by the game experts, showing the teachers what the game can do, and then listening to the needs of the teachers. Then, the teachers should be driving the direction, while the game experts have to be responsive to the drivers. If the GBL practices were started in the state education system, teachers and game experts work together to change government

policies; or else they can go to the private education system, which includes public schools, and Montessori or Steiner, according to SME_J.

In contrast, SME_B suggested that GBL collaboration should start with the teacher having thought through the pedagogical idea, and then negotiation between teachers and game experts through discussion, in which both the experts play equally important parts. SME_G supported the idea of having teachers to begin the work, but he expected the SMEs to be teaching enthusiasts who know about games. The SMEs could approach game experts whom they know of, to express their willingness to adapt certain games in teaching (SME_G). The overlapping knowledge in both fields enables them to identify educational potentials of games and potential edits that could be made to games for educational purposes.

No matter who starts the collaboration, SME_G stressed that the initial concept needs to be right, where the educational benefits of the particular GBL should be identified. Based on this identification of benefits, the aspiration of both parties is set within a framework, where SMEs indicate what needs to be addressed and what kind of knowledge and skills students need to learn; while game experts present the mechanisms and strategies in games that can be used as a learning supporter. This initial concept stage could be a testing bed for exploring the rationale of further collaboration. After that, the relationship between them should be extended. The focus would be matching the rules and the process of game design with the initial idea and learning objectives.

Instead of arguing who should start the work first, SME_K proposed both SMEs and game experts should examine existing games to understand what kind of learning the games facilitate when people play them for entertainment purposes. After that, both of these experts can augment the learning in their collaboration. They can initiate the collaboration by making interesting mods (modifications) of existing games, rather than the huge expense of producing new games. SME_K advised that *'no-one should take precedence in the collaboration; rather they should complement each other.'*

7.5.5.2 Game experts' preferences

GX_E advocated that:

> *'…the best way to collaborate would be for the SME to have an idea of what they want students to learn from the experience. At this point it is a good practice to discuss this with the game experts to see how this could be approached and whether all ideas are achievable. If a decision to go ahead is reached then ideally, teachers would create the content to pass to the game experts to integrate. While the content is being created, development for the game could be started.'*

GX_I shared a similar idea as she believed that it is best if the teachers have a clear idea of what they would like to achieve but are flexible on the game itself. Then they should give as much information as possible to the game design team right at the start of the project so that more ideas can be put forward and explored earlier on. As for the other side of communication and development, the game experts need to update the teachers with the latest prototype throughout development to get feedback and adjust when necessary.

GX_A argued that SMEs and game experts should both be almost equal in the collaboration, where teachers could start the collaboration by informing what they intend to teach and then seeking available options from game experts. After that, the game experts should develop some prototypes and present various options of GBL methods to the teacher. After the teacher determines the preferred option, they could offer to work together with game experts to refine the proposal. The teachers are responsible for making it clear to the game experts, *'what a game has to teach, up to specific learning goals of the game.'* This would allow game experts to proceed to game design, fulfilling those learning objectives. Next, the game experts should ask teachers to test the developed materials; which leads to the collection of teachers' feedback for game refinement, before presenting the games to students.

GX_C and GX_D saw GBL collaboration as an iterative process. GX_D highlighted that iterative development is an effective collaboration, where a prototype is built *'quite quickly and cheaply, and trying that out and getting feedback before going on*

to [the] developers for a larger version.' Practically, when a game developer has an idea for a game, they need to check that idea out with teachers and pupils, as well as the people who are funding the games (GX_D). GX_D argued that ensuring the iteration involves not only the fund provider, but also the end-users of the games, is crucial:

> *'I think there are a lot of problems why educational games aren't effective, because the developers are only sort of trying to please people that are funding the game as opposed to people who are going to be using it.'*

GX_H suggested that if there is a game expert who is trying to develop a game, it is important to get teachers to join the collaboration or to get GBL researchers to act as the coordinator between the teachers and the game experts. This ensures constant input from teachers can be delivered to game production. Otherwise, if a teacher wants a game, the teacher needs to talk to game experts or GBL researchers. There were also some very basic game production tools that *'teachers could use to put something together'* (GX_H). After starting the collaboration, GX_H recommended that:

> *'you need to have a kind of frequent prototyping system so that you have your design, you have your prototyping, show it to a group of teachers, and then you go away to have a bit more, show it again. So they get to see a product that is evolving….without getting too involved in the actual production.'*

GX_J recommended that teachers and game experts have to collaborate right in the beginning, i.e. the idea stage. In design stage, the teachers and the game experts need to bounce ideas to each other through discussion. Teachers need to indicate what they want children to learn; while game experts should tell teachers the fun factors of games. In terms of the development stage, teachers need to be involved through playtesting the game at various stages.

7.6 Summary

This chapter organised the findings of 22 follow-up interviews, which were conducted to uncover the reasons behind selected results of the statistical analysis in Chapter 6. Three GBL issues were addressed: the benefits of GBL for teachers and

game experts, the GBL practice in formal educational contexts, and the GBL collaboration between SMEs and game experts. The explanatory propositions juxtaposed in this chapter marked the completion of the data analysis in this doctoral research, and consequently laid the ground for compiling the guidelines for GBL practice and constructing the model of GBL collaboration, which are presented in the next chapter.

CHAPTER 8: DISCUSSION

8.0 Introduction

This chapter describes how the overall findings addressed the research questions, offering explanations and suggestions which complemented or contrasted with existing literature. The explanations and suggestions were based on the interim discussion sections presented in Chapter 5 & 6 and the insights derived from the findings of Chapter 7. In other words, the chapter intends to propose some suggestions which could contribute to the advancement of knowledge in the field of GBL.

This research examined the perceptions and attitudes of SMEs and game experts to GBL in formal educational contexts. Three forms of inquiry method—exploratory, confirmative and explanatory—were deployed sequentially to achieve the research aim. The focus of the research shifted chronologically, in accordance with the knowledge accumulated about concepts and issues associated with GBL over time. Therefore, the structure of this chapter is organised with reference to the temporal focus shift, in which reflection, reflexion and meta-reflection of the doctoral research journey were interwoven to consolidate the segregated studies as one.

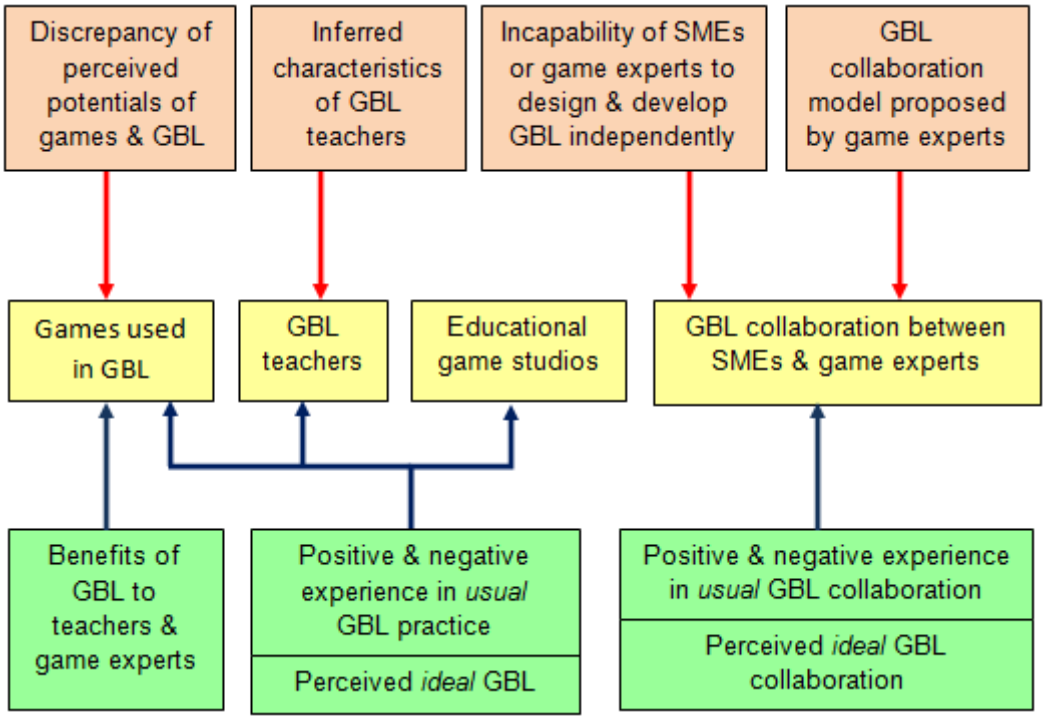
With the completion of the explanatory study based on follow-up interviews, a cross-case analysis was carried out to examine the interrelationship between the findings of the explanatory study and propositions claimed in the exploratory studies and confirmative surveys of this doctoral research. The following section illustrates the results of the cross-case analysis and synthesis.

8.1 Results of cross-case analysis and synthesis

This section shows the issues investigated in this research, and how they relate to each other. In general, two types of relationship—heuristic and illuminative—were identified. The heuristic relationship, represented by red arrows in Figure 8.1, showed how the findings of exploratory studies informed and guided the investigation of attitude between SMEs and game experts through questionnaire surveys. On the other hand, the illuminative relationship, denoted as blue arrows, revealed how the findings of follow-up interviews shed light on the reasoning

underlying attitudes and attitude changes among SMEs and game experts in the surveys. The interrelationship recognised between all the major findings led to the overall cross-case synthesis in this doctoral research. Based on the results of the analysis—synthesis processes, five overarching themes of GBL issues were formulated, which will be discussed in turn below:

- the gaps in and between the perceived potentials and recognised benefits of GBL,
- the characteristics of GBL teachers,
- the rubrics of ideal GBL practice,
- the dilemmas of educational game studios and experts, and
- the pressing need for GBL collaboration model(s).



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	Findings of exploratory studies
	Scope of attitude and attitude change investigation in questionnaire surveys
	Issues of interest in follow-up interviews
→	Heuristic relationship
→	Illuminative relationship

Figure 8.1: Interrelationship of the scope of findings in different stages of this doctoral research

8.2 The gaps in and between the perceived potentials and recognised benefits of GBL

At the beginning of this research, the preliminary literature review revealed contradictory voices between academic research publications and game experts' writings on game production, particularly on the potential of games used in education. While the idea of 'serious games' gradually replaced the unfavourable 'edutainment' in academia (Sawyer & Smith 2008), game experts insisted in their writing that *fun* is essentially the engaging factor which could determine the success and failure of games in the consumer market. Due to this differentiation between academia and the game industry, conflicts occurred when experts from one field needed to rely on experts in the other field to produce games for use in formal education. To investigate the nature of the differentiation and the conflicts that followed, three segregated studies were carried out to explore the perceived potentials of GBL through the eyes of learners, SMEs and game experts.

In fact, the educational potentials of games have been identified and recognised both by researchers who study games (e.g. Egenfeldt-Nielsen 2007; Ke & Grabowski 2007) and by game experts who produce games (e.g. Koster 2005), from which GBL related handbooks were produced to convince school teachers to use games in the classrooms (Ferdig 2008; Felicia 2009). However, this thesis argues that being able to recognise the educational potentials of games does not mean being able to turn the potentials into GBL practice that could benefit teachers, learners or both. In other words, something was missing in-between the perceived potentials and actual benefits of GBL, hence the need for re-examining the potentials and benefits of games and GBL.

ES1 and ES2 (see Section 5.1 & 5.2) indicated that SMEs and game experts realised the potentials of games and GBL in formal educational contexts. The proposition was consistent with the statistical findings of the questionnaire surveys; although both the SMEs in Survey 1 and the game experts in Survey 2 were uncertain whether or not the potentials were actually exploited in usual GBL practice.

In ES1, the secondary mathematics trainee teachers who had completed their one-year PGCE study were able to envision and justify professionally the potentials of

games in education. The perceived educational potentials of GBL covered three domains of learning—cognitive, affective and psychomotor, which demonstrated the trainees' capability for integrating various aspects of the subject matter into GBL. In other words, the teacher training programme they underwent was able to equip them with sufficient subject matter knowledge and pedagogic expertise to envisage the potentials of GBL in formal educational contexts. However, as newly appointed teachers, they would first need to establish their credentials in the teaching profession, particularly their mastery of traditional but proven-effective pedagogical methods, before acquiring the authority and confidence to put GBL ideas into practice.

Compared to trainee teachers, the commercial game experts who were involved in ES2 generally lacked positive vision in GBL, especially when they heard the notion of 'serious games'. To them, games should never be serious because that would oppose the nature of being 'games'. Such views were in line with the literature produced by game experts (e.g. Koster 2005; Barwood 2000). In terms of their breadth of views, the perceived potentials of GBL were based on their common-sensical reasoning, and this revealed their lack of understanding about the concepts used in GBL or in education in a broader sense. This in turn means that although they were capable of producing fun and engaging games, they were not able to design and develop games for use in formal education unless they collaborated with teachers or SMEs.

Another issue revealed in the exploratory studies was the diverse views about engagement in GBL. In academia, engagement is related to the presence of a 'flow state' (Csíkszentmihályi 1991), while in the game players' community, a synonymous concept called 'the zone' was commonly used instead (see Section 5.2.2). Both types of experts acknowledged the engaging capability of games, but the SMEs in ES1 treated the engagement as scale for measuring attention span or immersion in learning, while the game experts in ES2 regarded it as a threatening state which could lead to addiction to game playing, rather having educational potential. However, from a commercial point of view, game experts valued engagement with, or addiction to, game playing because it could determine the commercial success or failure of a particular game.

In the questionnaire surveys, a difference of attitude was uncovered between the experts; the majority of the game experts believed that bespoke educational games are usually boring and not creative, but most of the SMEs were undecided about this proposition. A change of positive attitude to games produced for use in formal education was also revealed. Both SMEs and game experts were uncertain whether or not those games were usually pedagogically sound or fitting curricular objectives, although they believed that should ideally be the case. Further investigation via semi-structured interviews discovered that some of the SMEs constructed their understanding about GBL based on their experience in using off-the-shelf commercial games, rather than bespoke educational games. The 'lack of contact' with bespoke games and with learners' experience conferred by the games caused the SMEs' uncertainty, and this could be a result of the insufficiency of good educational games available to them.

When the focus of research switched from the potentials to the benefits of GBL in follow-up interviews, the interviewees believed that GBL could become part of teachers' on-the-job training and enhance the teaching and learning interaction. However, slightly more than half of the interviewed SMEs (6 out of 11) did not mention any benefit they could gain from GBL, and most of the propositions were by the game experts interviewed. Thus, there were a higher proportion of game experts (9 out of 11) who could see the benefits of GBL to teachers than of the teachers themselves. Meanwhile, most of the interviewees saw GBL as a business opportunity for game experts—a new market that could yield financial benefits and job opportunities. Nonetheless, both the SMEs and the game experts need to be convinced that the perceived potential of GBL can actually be exploited and turned into measurable benefits, be they educational or commercial. In short, a conversion mechanism is needed to fill the gaps between perceived potentials and recognised benefits, which in turn could establish the confidence of SMEs and game experts towards GBL.

The key message drawn from the above mentioned studies was the presence of multiple gaps in the perceived potentials and the recognised benefits of GBL, and between what the participants expected in the ideal scenarios and what they usually experienced in GBL practice. Most participants believed that GBL could benefit

learners, teachers and game experts to some extent, despite some holding more positive opinions than others. However, believing in the presence of potentials does not mean being able to convert the potentials into observable or measurable benefit or value, for both educational and commercial purposes. Teachers and SMEs need to be convinced that the conversion is possible and could be achieved by employing their existing subject matter knowledge and pedagogic expertise; while the game experts have to be assured that the conversion would yield a positive return in investment.

One example of successful conversion of potential into benefit was ES3. The success story of the A-Level biology teacher who used a commercial game in his classroom to promote deep learning has been reported in the *Handbook of Research on Improving Learning and Motivation through Educational Games* (Tan *et al.* in press). Along with other case studies in the handbook, and of course other academic publications (e.g. Williamson 2009; Felicia 2009), the educational potentials of GBL had been proven to be convertible into valuable teaching and learning experience that can benefit not only the learners, but also the teachers. While more GBL ideas have been put into practice in educational contexts, fewer educational games have been produced for use in education. This distorted phenomenon was a result of teachers or SMEs having less confidence with the potential and the quality of bespoke educational games, so they rather turned to off-the-shelf commercial games which were not designed specifically for educational purposes such as *Civilization, Spore, Big Brain Academy* and *Wii Music*. Due to the reduced interest in custom-made educational games, game experts who relied on the commercialisation of bespoke educational games could not survive in the Darwinian-driven business world, and, as mentioned previously, eventually switched to producing commercial games (see Section 7.2.2.6).

This thesis argues that the teachers' lack of confidence in GBL practice was caused by the absence of skill in turning the potentials of games or GBL they perceived into measurable learning outcomes. Such lack of confidence could be avoided if good bespoke educational games were used in GBL practice. However, since teachers preferred to use non-bespoke educational games due to the uncertainty they held,

they bore the consequence of lacking confidence. This was the paradox of using games in formal educational contexts.

As for game experts, their scepticism towards educational games was a result of their lack of confidence in the prospective return on investment. One possible way to produce both pedagogically and commercially successful games is to involve the right experts at the right time to play the right role in GBL collaboration. In terms of investment, monetary injection is essential but might not guarantee success; while effective communication with SMEs and clear role delineation in game production could at least avoid immediate failure.

8.3 The characteristics of GBL teachers: a reference for GBL teacher training

The trainee teachers in ES1 were not able to turn their pedagogic ideas into educational games, but this did not deter them from generating innovative game ideas or using games in teaching. This finding was confirmed in the surveys wherein both SMEs and game experts did not see involvement in game production as a determinant factor for effective GBL practice. However, the trainees' incapability to produce games independently indicated the need for them to collaborate with game experts.

In terms of teachers' readiness for using games in formal education, game experts in ES2 predicted a strong resistance to change among senior teachers, which may prolong the transitional period of adopting GBL in schools, if indeed that would ever happen. Such a view was in fact overly pessimistic, especially after the case of ES3 was reported. The findings in ES3 echoed Prensky's (2007) pragmatic suggestion for GBL practice which focuses on 'how do learners learn *what'*, rather than 'how do learners learn' through games. Although the serendipitous nature of the case study strictly limited the generalisability of the findings, the teacher involved in the GBL practice had set up a trustworthy model for how to focus on what teachers wanted the students to learn in classrooms.

In ES3, the biology teacher decided in advance to use a game about evolution to foster deep learning skills among his students, instead of using the game to teach

evolution. This example reflected that teachers may not necessarily be constrained by the theme or gameplay of a particular game in GBL practice. By combining their pedagogical expertise and subject knowledge with the contents of a particular game, they should be able to adopt the game to suit their teaching needs. In the adoption, the game could be passively applied into teaching and learning activities, which forms a game-independent approach. Alternatively, if the contents fit the curricular objective of a particular lesson, teachers could adapt their lesson plan to the gameplay and make the optimum use of the game. In other words, the adaption allowed the game to be actively applied in the lesson, but this would be a game-dependent approach. However, the adoption and adaption were just two examples of pedagogical strategies associated with GBL practice which were depicted as part of the characteristics of GBL teachers (see Table 5.17, Section 5.4.2).

The inferred characteristics of GBL teachers, which were developed based on the surface–deep learning matrix, could serve as a reference for designing and developing GBL-related teacher training courses or programmes. It is worth stressing that the structure of characteristics does not include game design—and development—knowledge and skills, as these are not the requirements for using games effectively in teaching.

8.4 The rubrics of ideal GBL practice

As revealed in the explanatory study, the key to ideal GBL practice is having the ideal games, plus possessing the characteristics of a GBL teacher described in the previous section. Based on these findings, a set of rubrics were created for nurturing the ideal GBL practice (see Table 8.1). The rubrics was developed through an adaptation of Hays' (2006, p. 197–208) synthesis of instructional objectives. The first set of the rubrics covers the scope of knowledge required in GBL practice; the second suggests the set of intellectual abilities and skills; and the third lists the ideal attitudes (see Appendix XII, XIII & XIV for the lists of instructional objectives).

In GBL practice, the rubrics can be used to form an assessment tool for checking the level of readiness or proficiency of teachers, in which the tool could be used in analysing teachers' needs and deficiencies of knowledge, skills and attitudes. The result of the assessment can be used to inform the teachers and their superiors

regarding the training needed, which could either be knowledge-based, skill-based, motivation-based or a combination of them. For teacher trainers, the rubrics could be used as a reference for designing and developing a curriculum or syllabus which are related to GBL practice.

Table 8.1: Structure of the rubrics of ideal GBL practice

Domain	Level of complexity		Schema of criteria	
Knowledge	Knowledge of teaching, GBL and game playing		Knowledge of terminology	
			Knowledge of specific facts	
	Knowledge of ways and means of dealing with teaching, GBL and game playing		Knowledge of conventions	
			Knowledge of trends and sequences	
			Knowledge of classifications and categories	
			Knowledge of criteria	
			Knowledge of methodology	
	Knowledge of the universals and abstractions in teaching, GBL and game playing		Knowledge of principles and generalisation	
			Knowledge of theories and structures	
Intellectual abilities and skills	Surface	Comprehension	Translation	of knowledge associated with teaching, GBL and game playing
			Interpretation	
			Extrapolation	
		Application	Passive application of knowledge of teaching and game playing in GBL practice	
	Deep	Application	Active application of knowledge of teaching and game playing in GBL practice	
		Analysis	Analysis of elements in	Teaching, GBL and game playing
			Analysis of relationship among	
			Analysis of organisational principles in formal education	
		Synthesis	Production of unique communication for GBL practice	
			Production of lesson plans for GBL practice	
			Derivation of a set of abstract relations between pedagogic principles and GBL	
		Evaluation	Judgments in terms of internal evidence	
			Judgments in terms of external evidence	
Attitudes	Surface	Receiving (Attending)	Awareness of	GBL and game playing
			Willingness to receive training on	
			Controlled or selected attention to	
		Responding	Compliance in responding to	
			Willingness to respond to	
			Satisfaction in response to	
		Valuing (passive)	Acceptance of the value of	
	Deep	Valuing (active)	Preference for the value of	GBL practice
			Commitment to	
		Organising	Conceptualisation of the value of	
			Organisation of the value system of	
		Characterising by a value or value complex	Generalised set of	
			Characterisation of	

The application of the rubrics can also be extended to research methodology related to GBL. For instance, the rubrics can be used to form the criterion-referenced codes for classifying the behaviours and attitudes of the teacher or SMEs in GBL practices, as perceived by research participants. In practice, the rubrics can be integrated into Creswell's (2008) qualitative process of data analysis (see Figure 8.2), wherein the schema of criteria can be preset as the tentative themes for coding. Once the saturation state is reached in the data analysis process, the themes should be revisited and revised to form conclusive propositions.

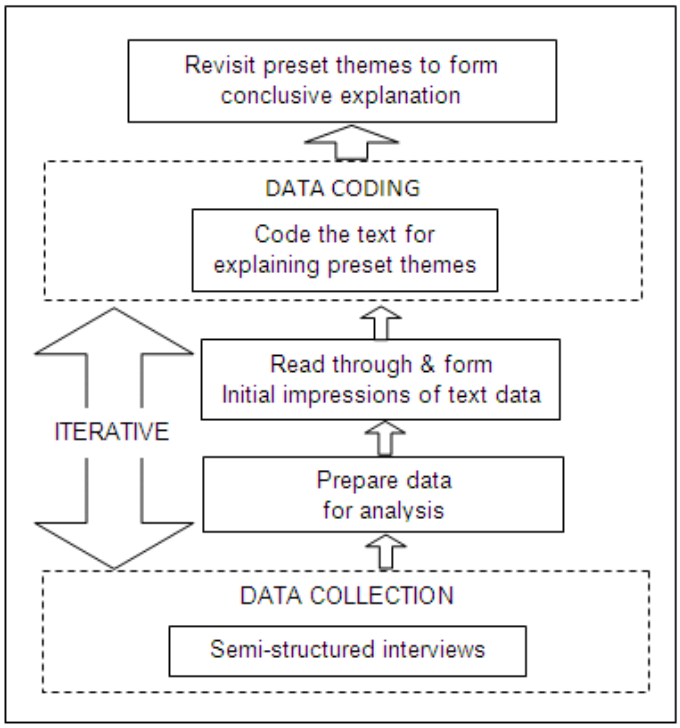


Figure 8.2: Example of research design which could use the rubrics of ideal GBL practice

8.5 Dilemmas for educational game studios and experts

Educational game studios were rare for several reasons, but the core reason revealed in this research was that some studios avoided producing only educational games. This was not a matter of choice; rather it was a matter of survival. Like the case of GX_D in the follow-up interview (see Section 7.4.2.3), some studios changed the nature of their core business into producing commercial games, while others shifted their focus from GBL for educational contexts to GBL for military or business training—making really 'serious' games. Bearing the negative image inherited from

edutainment, educational game studios were constantly discriminated against by commercial game experts for producing boring, non-creative serious games which might oppose the nature of game playing: to have fun (Tan *et al.* 2010). As a result, graduates of game design programmes would prefer to work in commercial game studios rather than educational game studios. This was the overarching reason why some commercial game experts did not regard GBL as something beneficial to them.

One potential solution to such a dilemma would be optimising productivity through creativity. Instead of competing with commercial games, educational games could adopt the business model of casual game production, which was mainly running on Web 2.0 applications such as Facebook, Ning, etc (Web 2.0 Expo 2010). Working with teachers or SMEs is crucial, as this would ensure the ecological validity of the games or at least warrant the pedagogical quality. A hybrid QA model should be developed to integrate production testing, playtest, 'learn-testing' and 'teach-testing'. The learn-testing and teach-testing should examine the usefulness and ease of use of the games in learning and teaching, which are an adoption of usability testing in ergonomics. Meanwhile, business strategies used by game publishers like providing online social networks, releasing teasers before the official game launching, etc. could be used by educational game experts to keep abreast with the trends of ICT used in daily living, which in turn could avoid the games they produced being seen as out of touch with learners' lives.

8.6 The pressing need for models of GBL collaboration

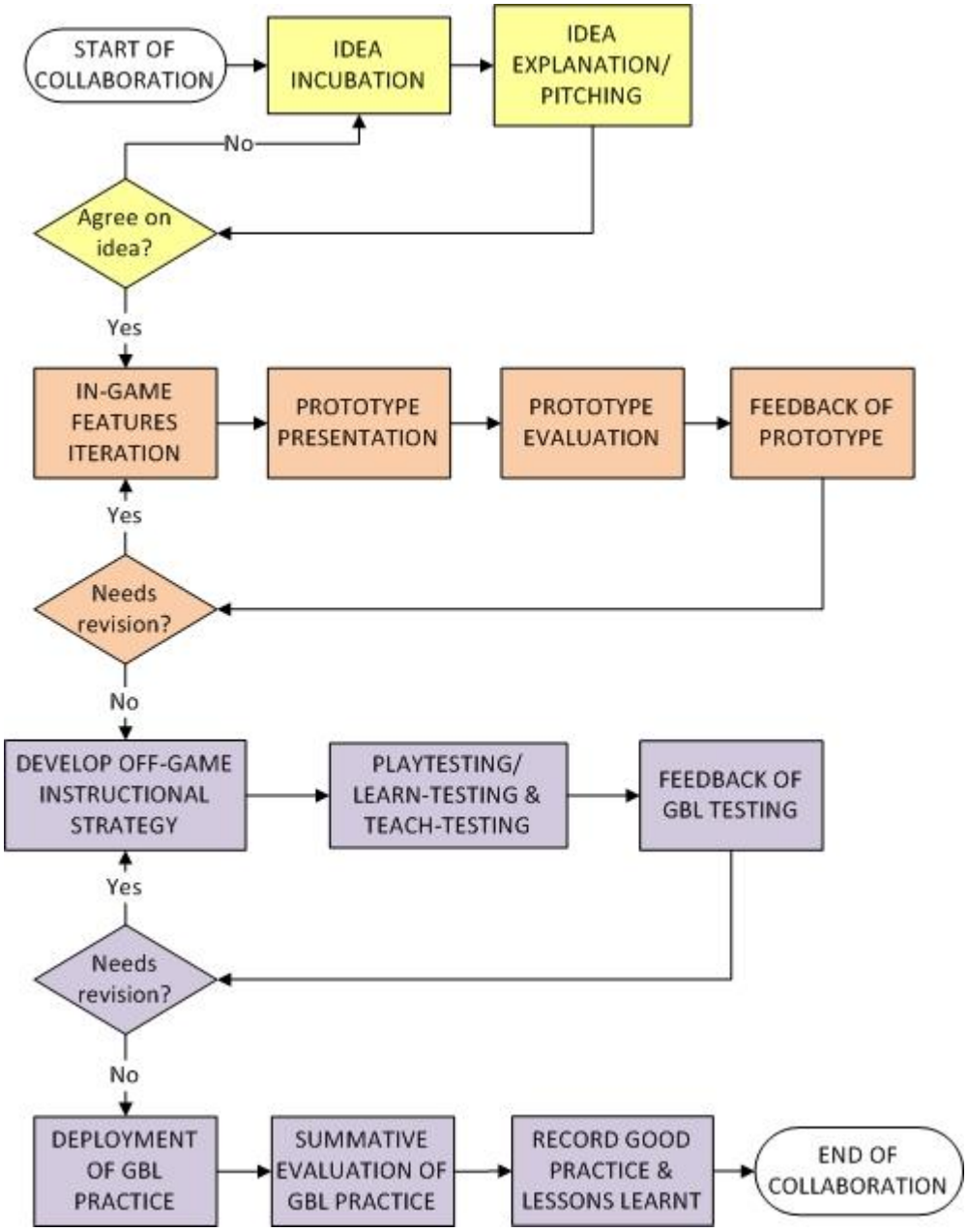
> *'If you know your opponents and know yourself, your victory can be sustained; if you know Heaven and know Earth, your victory can be repeated.'*
>
> *Sun Tzu*

The need for an ideal GBL collaboration model kept recurring throughout this doctoral research. In the exploratory stage, the need was revealed as trainee teachers in ES1 could not turn their pedagogic ideas into games, as they did not possess the expertise in game production. Evidence also suggested that the role and responsibilities of SMEs and game experts in GBL collaboration ought to be clearly

delineated to avoid finger-pointing if the end result was unsatisfactory to either one or both of them. Also, key GBL concepts such as engagement in learning were ambiguous, and this urged for effective communication in collaboration.

A GBL collaboration model was developed based on the findings of ES2 (see Figure 5.3). While admitting the need for the involvement of teachers or SMEs, the game experts excluded SMEs in the game production process, prompting a need to re-examine the attitude of SMEs and game experts towards the propositions made in the exploratory studies. The results of statistical analysis revealed that the majority of the SMEs and the game experts agreed with those propositions under ideal conditions, but their positive attitude changed significantly to uncertainty when referring to their experience in usual practice. This discovery strengthened the necessity for effective GBL collaboration between SMEs and game experts as a solution for creating games for use in formal educational contexts.

A variety of different collaboration approaches were suggested by both SMEs and game experts in the explanatory study. Their suggestions demonstrated not only what they knew about effective collaboration, but also the aspects of GBL they might not know. Therefore, the ideal collaboration model ought to integrate proposals from both types of experts, in which the aspects known by SMEs would cover the unknowns of game experts, and vice versa. Based on this argument, an integrated GBL collaboration model was proposed as a major contribution of this doctoral research to the field of GBL (see Figure 8.3).



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	Pre-production meetings and discussion
	Game production led by game experts
	GBL design, development, deployment and evaluation, led by SMEs

Figure 8.3: The integrated GBL collaboration model

As the GBL meant by this thesis is structured around the dynamic nature of learner-centred learning—evolving according to the characteristics of learners, the collaboration model could only be seen as a work-in-progress. The model is a means to an end rather than an end in itself, wherein the 'end' in this sense refers to the

GBL practice in formal educational settings. As a result, the ideal collaboration should not finish when a particular game was produced; it should include GBL strategy development and GBL practice deployment in the targeted context. In terms of leadership, both SMEs and game experts are equally important in the pre-production process, but after that, game experts should lead the game production, and then SMEs direct the GBL practice.

It is worth mentioning that in contrast to academic research, publications and dissemination of research findings might be commercially unwise for game experts because intellectual property, particularly the patents of gaming methodology and technology, and the copyright of creative work are actually valuable assets of game production studios (Bethke 2003, p. 387). Many of those IPs are in fact classified as trade secrets, wherein unauthorised disclosure would lead to legal disputes. In fact, issues regarding IP ownership could be a barrier which hinders GBL collaboration between academics and commercial game experts.

8.6.1 Idea incubation, explanation and negotiation

As shown in Figure 8.4, GBL collaboration could either be initiated by teachers, SMEs or game experts. The experts who generated the game or pedagogic idea have to present or pitch the idea during initial meetings. In these meetings, both types of the experts should convey their views based on the professional roles they play, wherein SMEs should lead discussion of pedagogical issues (coloured in purple), while game experts should be in charge of technical game playing matters (coloured in orange). In terms of pedagogical issues, SMEs should assess the pedagogical feasibility of the game idea, and game experts should try to understand the educational expectation and requirements, in order to offer appropriate solutions to teachers or SMEs. The solutions may include the design and art style, the game playing platform and associated apparatus, the estimated production duration and budget, and the degree and required time of SMEs' involvement. When discussing aspects of game playing, game experts should assess the technical practicality of the pedagogical idea, with reference to the subject matter information provided by SMEs. SMEs ought to be considerate in understanding technical challenges faced by game experts, particularly when negotiating the terms and conditions of the project

or contract with game experts. Once a mutual agreement has been reached, the game experts could start the game production iteration.

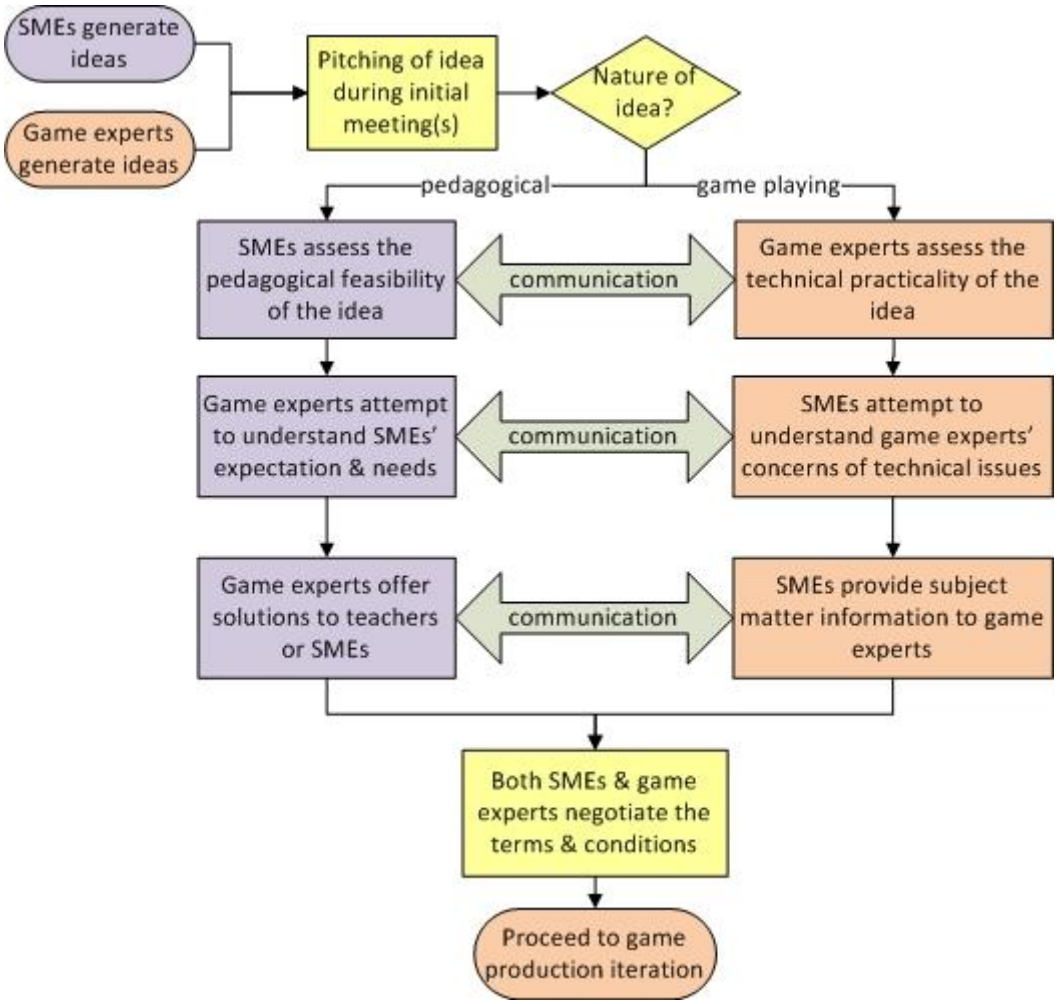

Figure 8.4: The pre-production phase of GBL collaboration

8.6.2 Game production iteration

The game production iteration must be led by game experts, but the importance of SMEs' contribution could not be overstressed. As illustrated in Figure 8.5, SMEs should provide the curriculum and related learning contents, indicate potential misconceptions in learning, and propose subject specific in-game learning strategies. Based on these educational materials, game experts set the rules of the game, and then produce features and components which are compatible with the rules. They also need to assure the technical quality of the game by debugging the programme during QA testing and production testing.

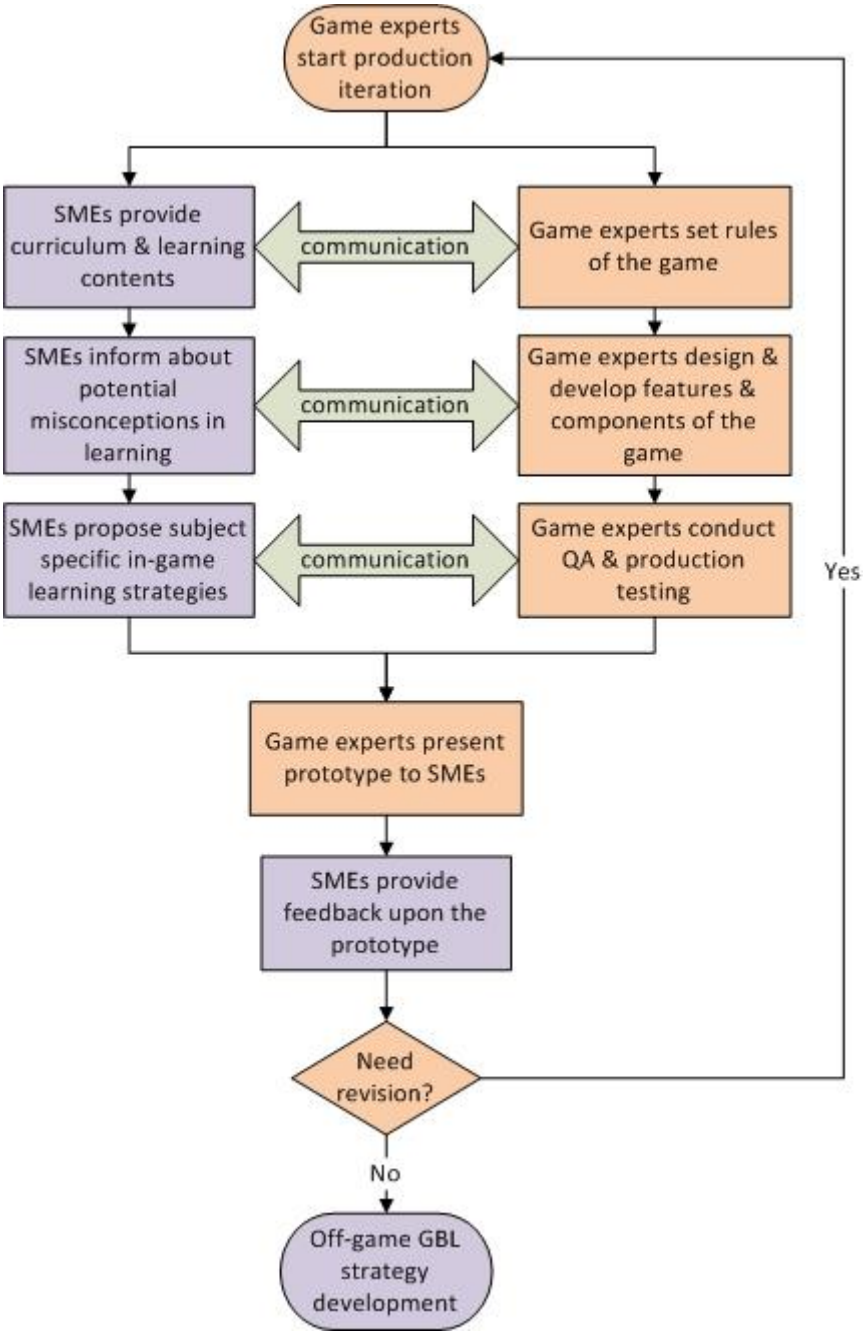

Figure 8.5: Game production iteration in GBL collaboration

The number of iterations involved depends on resources made available to the production team, which include money, time, equipment and manpower. The output of a single iteration is the ‘prototype’, which is the work-in-progress of the game. Once a version of the prototype is created, game experts would present it to SMEs, so as to collect feedback for revising or improving the prototype in subsequent iterations.

8.6.3 Incorporating GBL practice into GBL collaboration

This thesis proposes to extend the GBL collaboration beyond game production and include GBL practice as part of the collaboration. The rationale behind the inclusion of game experts' involvement is to share the positive experience and lessons learnt in the GBL practice among members of the production team. The sharing of knowledge and experience could be seen as a form of benefit to both SMEs and game experts, making the advancement, or at least the sustainability of GBL practice, possible. Unlike the production of the game which requires technical expertise in computer arts and programming, the design and development of GBL involves subject matter knowledge and pedagogical expertise. To avoid confusion, two terms—'in-game' and 'off-game' are coined in this thesis to differentiate game production and GBL design and development:

- In-game: a status of the GBL collaboration where the tasks carried out by members of the collaboration contribute to the creation or refinement of the game.

- Off-game: a status of the GBL collaboration where the tasks are carried out by members of the collaboration after the creation of, or alongside with the refinement of, the game.

Such delineation is crucial because game experts should be responsible for the output of in-game tasks; while SMEs should be responsible for the results of off-game tasks. No doubt, such dichotomous separation may seem overly simplistic, but it could at least set the basic ground of reference if the quality of the game or the GBL practice was in dispute.

Figure 8.6 shows the process of GBL practice in the proposed collaboration, in which the Dick and Carey Systems Approach Model (Dick, Carey & Carey 2008) was referred to and combined with the findings and insights collated in this research. The process begins with the design and development of assessment instruments, which involve integrating learners' in-game playing performance matrix (e.g. score gained over time or in different play sessions) with learners' off-game learning outcomes attainment (e.g. attitude shown in group discussion about the play session). After that, SMEs should develop subject-specific pedagogical strategies into lesson

plans or play session plans, in order to facilitate learners' engagement in game playing and attainment of learning outcomes. Table 5.17 could be used as a reference in this task.

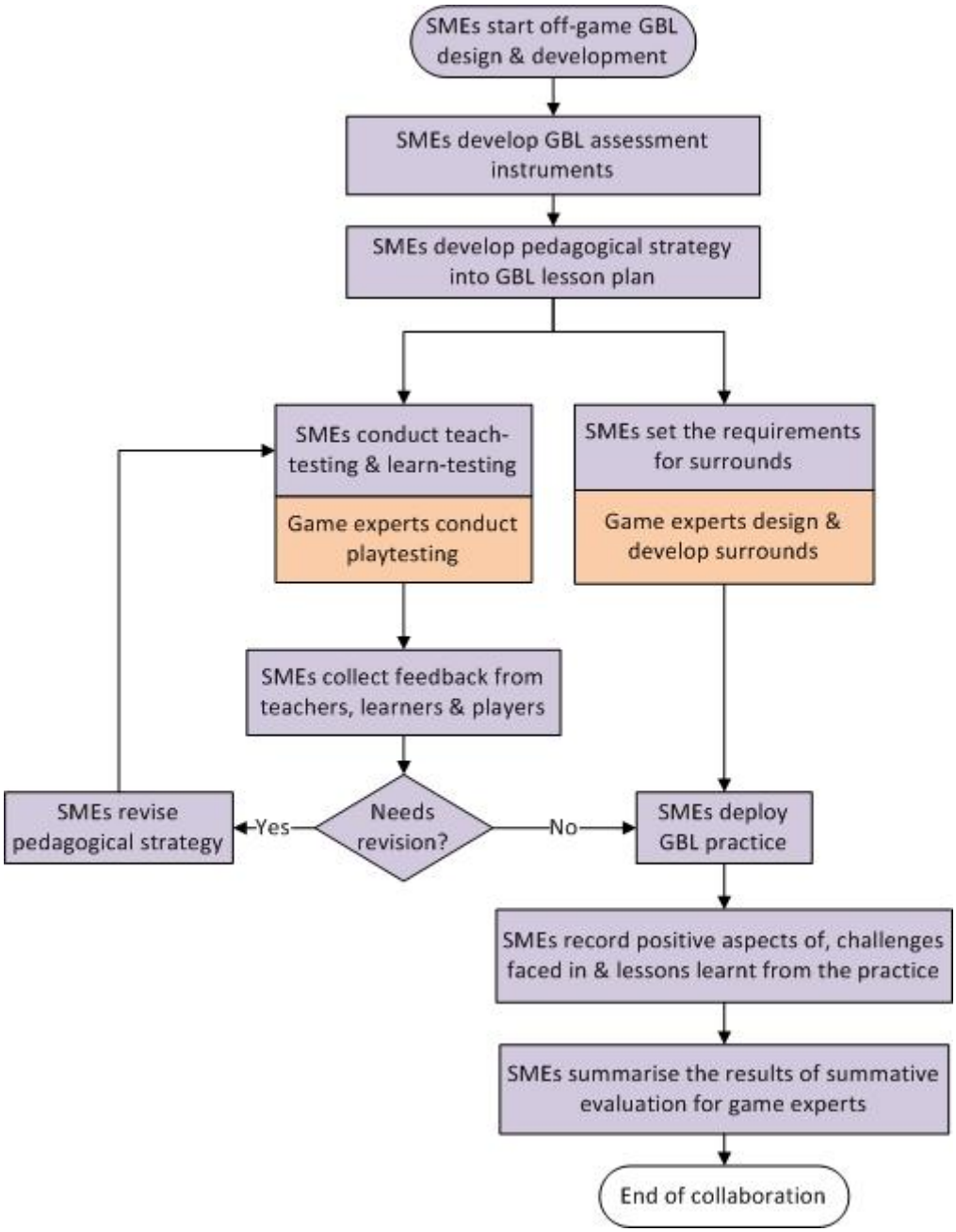

Figure 8.6: GBL design, development, deployment and evaluation in GBL collaboration

Formative evaluation of the GBL which involves game players, learners and teachers can be started, once the lesson plan is prepared. Although both the learners and teachers can also be game players, separating the conduct of playtesting, 'learn-

testing' and 'teach-testing' is necessary because this would not only make the collection and management of evaluation data easier, but also optimise using the expertise of SMEs and game experts. The SMEs should focus on the teaching and learning effectiveness and efficiency during the learn-testing and teach-testing; while the game experts concentrate on the fun and engaging elements in the playtesting. Horton's (2001) Four Levels of e-Learning Evaluation, which was modified based on Kirkpatrick's (2006) Four Levels of Evaluation, could be adapted to measure:

- the response and reaction of learners (Level 1),
- the learning outcomes attainment (Level 2), and
- the transfer of knowledge and skills from in-game playing to off-game performance (Level 3).

Three levels of the measurement were appropriate for formative evaluation, as the fourth level—measuring the business results—would be more suitable for game experts, and is beyond the interest of this thesis. The feedback, results and findings of the formative evaluation need to be interpreted through the eyes of GBL teachers, in which they should determine whether or not the proposed GBL practice needs revision. However, it is not feasible and cost-effective to revise the in-game features or components at this stage of the collaboration, due to the fact that the game production has been ended. What SMEs could do in terms of the revision is to modify the pedagogical strategies. In other words, this means changing the GBL lesson plan.

Alongside with the formative evaluation process, SMEs could set the requirements for 'surrounds' of the game. In the jargon of the game developers' community, 'surrounds' are products created based on the theme of the game, which include the dedicated website, online forum, merchandises, strategy guide, teaser video, etc. Surrounds are created not only by game developers and publishers, but also fans who intend to share their passion and interests about the game with others. When surrounds were used for academic purposes, a synonymous term 'paratext' was used, in which teachers encouraged pupils to write about the game playing experience and

treated the pupils' work as parts of formal literacy assessment (Walsh & Apperley 2010).

In the case of GBL collaboration, game experts could design and develop various forms of surround for use in GBL practice by both the teachers and learners. Teachers could refer to the rubrics presented in Section 8.1.3 when deploying GBL practice. Upon the completion of the GBL session, teachers or SMEs should conduct summative evaluation of the overall teaching and learning performance, including the positive experience, the challenges faced and the lessons learnt throughout the GBL collaboration. Then the summary of the evaluation results should be conveyed to game experts, and this marks the end of the collaboration.

8.7 Learning from peers and practitioners in both academia and the game industry

> *'The wise always considers positive and negative factors of a problem. Considering negative factors under advantageous circumstances, the issue could be resolved to enable progression; considering positive factors under disadvantageous situations, the difficulty could be overcome to end deterioration.'*
>
> *Sun Tzu*

Maintaining the passion towards a single research which encompassed interweaving progression and deterioration over the past three years was indeed a challenging matter. Various strategies were arranged to handle advantageous and disadvantageous circumstances, and these strategies were grouped as either internalisation or externalisation (see Appendix XV). The thesis defines internalisation as a series of reflection and reflexion efforts made to review and react to particular status or progress of the doctoral journey (see Section 4.2). These ruminations aimed to transform information received, either actively or passively, into insights upon GBL issues, which in turn contributed to the interpretation of the research findings. Externalisation, on the other hand, is denoted in this thesis as a collection of interaction maintained with stakeholders—those receiving the study, including the sponsors, supervisors and mentors of this doctoral research. Besides

interacting with the stakeholders, the act of gathering feedback from those who responded to issues or findings revealed by the thesis through formal and informal channels was also considered as externalisation. The purpose of externalisation was to verify the feasibility of the research design and the ecological validity of research findings, which in turn solidified the basis of arguments and conclusions.

GBL is a young and growing field of study where academic and commercial researchers who study a similar topic might possess very different backgrounds, perspectives and agendas. This could lead to 'reinventing the wheel' if acknowledgement or communication was missing between them. Therefore, for those who intend to study games, learning from researchers in both academia and the game industry is essential (see Appendix XVI).

Some of the information and resources gathered and used in this research were exclusive to members of a particular sub-community. Therefore, meta-learning in GBL research involved learning what, when, where, who and how to learn about GBL, which was essential to becoming an effective and efficient GBL researcher.

Apart from the discussion about findings above, an experience of involvement in a substantive game production deserves additional attention because the working experience gained in the game project demonstrates the reliability and relevance of the findings of this post doctoral research to the game industry. Thus the next section of this chapter depicts the ecological validity and trustworthiness of the research findings, although this was not planned as part of the doctoral journey.

8.8 Involvement in the FPS Trainer project

In the midst of finishing the writing of this thesis, a two-month consultation work opportunity (as an instructional designer, ID) was offered by GX_D between July and August 2010 in Scotland. The six-month project was funded by SMART: Scotland and supported by University of Abertay. One of the aims of the project was to design and develop a coaching system for a first-person shooter (FPS) game called FPS Trainer, where players of any FPS game could undergo systematic and professional training to improve their knowledge, skills and attitudes in game playing. The design of the system incorporated dynamic artificial intelligence

programming (Policarpo, Urbano & Loureiro 2009), principles of instructional design (Dick *et al.* 2008), and coaching ideologies in sport sciences. Agile production iteration technique was adopted in the collaboration (Larman 2004), involving ten individuals: one project manager, one SME, two programmers, two computer artists, one web designer, one instructional designer and one audio artist.

8.8.1 Highlighting the necessity of a suitable SME

In the early weeks of the project, the prospect of the project was placed in doubt because no suitable SME was available to supply coaching and training materials which could be turned into valid and reliable learning outcomes. In other words, the project was initiated by game experts, without appointing any SME. By referring to the evidence shown in this doctoral research, the project team was persuaded of the need for appointing at least a SME, which they had not previously realised. Although the team acknowledged the necessity of a SME in the project, two types of supposed SMEs—FPS game designers, frequent FPS game players—were found unsuitable, after comparing their coaching capability and experience with the findings of roles and responsibilities delineation (see Section 7.5.3).

8.8.2 Setting the learning domains for FPS game coaching and learning

While searching for a competent SME, the domains of learning in FPS game coaching and training were set by customising the structure of the rubrics of ideal GBL practice (see Table 8.1). These domains cover specific levels of attitudes, knowledge, intellectual abilities and skills associated with the performance in playing FPS games. The surface–deep learning matrix (see Figure 5.2) was used to classify the difficulty level of specific learning outcomes, which could then be sorted according to generic features of FPS games (Adam 2010), for use by game experts.

8.8.3 Resolving communication challenges

With no suitable SME in place, the progress of the project relied heavily on the conjectured learning outcomes, which were first generated by the ID and then presented to other team members for discussion, negotiation and approval. Due to the need for frequent interaction, effective and efficient communication across multiple disciplines in the team became the main issue in collaboration. Conflicts occurred from time to time due to misunderstandings of the technical terms used,

such as ‘learning objective’, ‘learning outcomes’ and ‘model’ which mean different things in different fields. The findings and knowledge gained through the doctoral research were used to resolve collaboration problems, in which the actual strategies applied by the team to solve communication problems were indeed reflecting what the *usual* experience was like in practice (see Section 7.4.1.1).

Three collaborative strategies or applications were used in the production, one after another to facilitate communication: daily scrum, Google Wave and MediaWiki. While the first strategy is commonly practiced in the game industry, the adoption of the other two strategies was in fact influenced—at least partially—by the findings of this doctoral research.

8.8.3.1 Daily scrum

Daily scrum was a project management technique adopted by the project manager to keep track of the progress of each individual’s task on daily basis. As mentioned in Section 6.5.1, the term ‘scrum’ was borrowed from rugby. Adam (2010, p. 51) provided a detailed and yet concise explanation of the technique:

> *‘In the scrum process, the team creates and tests updated, working versions of their product in short iterations called sprints. Each sprint lasts from one to four weeks. The team constantly examines and adjusts their progress so as to efficiently achieve both their interim and final goals. This enables them to identify and fix problems early on.’*

In actual practice, the project manager made it compulsory for team members who worked full-time to attend physically or virtually (through teleconference) the daily scrum session at 10:00 a.m. (see Figure 8.7). Each member ought to report the status of the task he or she had checked out, and if the task was accomplished, a new task would be checked out during the session. High level communication which minimised the use of technical terms was encouraged in the daily scrum session (see Section 7.4.2.3). If further explanation became necessary, then relevant individuals would hold separate discussions after the scrum.

While daily scrum was effective in allowing every member of the team to at least be aware of what others were doing, the technique was efficient for a smaller team (less

than ten people); with a larger team it could be time consuming to conduct daily scrums and probably hard for everybody to remember what everybody was doing every day. Also, for collaborations which involve multiple complex processes, it might not be necessarily for each individual of the project to know what others were doing at all.

Due to the inefficiency of the daily scrum, another method of communication—Google Wave—was recommended by a programmer of the team who claimed to have benefited from the application in his previous game production experience. The recommendation was seconded by me as it was consistent with the suggestion stated in Section 8.6.1, in which Google Wave is ideal for real-time online explanation and negotiation.

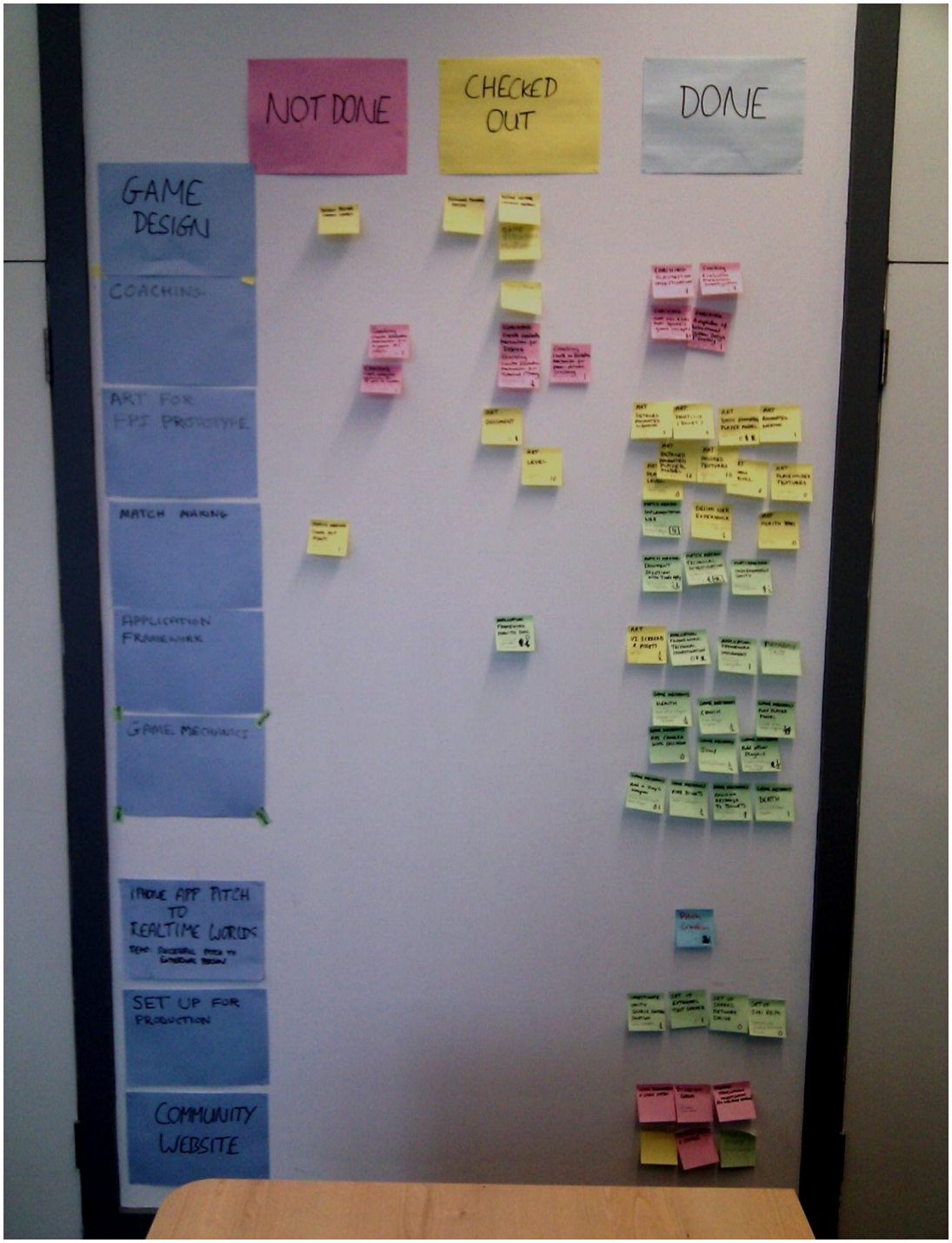

Figure 8.7: A sample daily scrum created in the FPS Trainer project

8.8.3.2 Google Wave

Google Wave was the online collaborative communication application used by the project team to discuss, share and organise tasks and work-in-progress documents. Figure 9.2 shows a print screen of how Google Wave was used in the project. Herewith the description of 'wave' provided by Google Wave Labs (2010):

> *'A wave is a conversation with multiple participants—participants are people added to a wave to discuss and collaborate on its content. Participants can reply any time [sic] and anywhere within a wave, and they can edit content and add more participants as a wave develops. It's [sic] also possible to rewind waves with the playback functionality, to see what happened, and when.'*

Similar to daily scrum, Google Wave is most beneficial to small project teams and less complex procedures. Once a wave grew beyond a hundred interactions, task tracking could become time-consuming. Also, overlapping information frequently occurred because the access to a piece of cross-disciplinary information may need to be made available to more than one wave to avoid communication breakdown.

While real-time communication was made possible between different experts, the Google Wave did not resolve communication barriers which were caused by the use of technical languages and terms. By referring to the findings of the doctoral research, the need for a glossary-like mechanism was insisted on for effective communication, and this led to the development of the internal glossary—MediaWiki for the project.

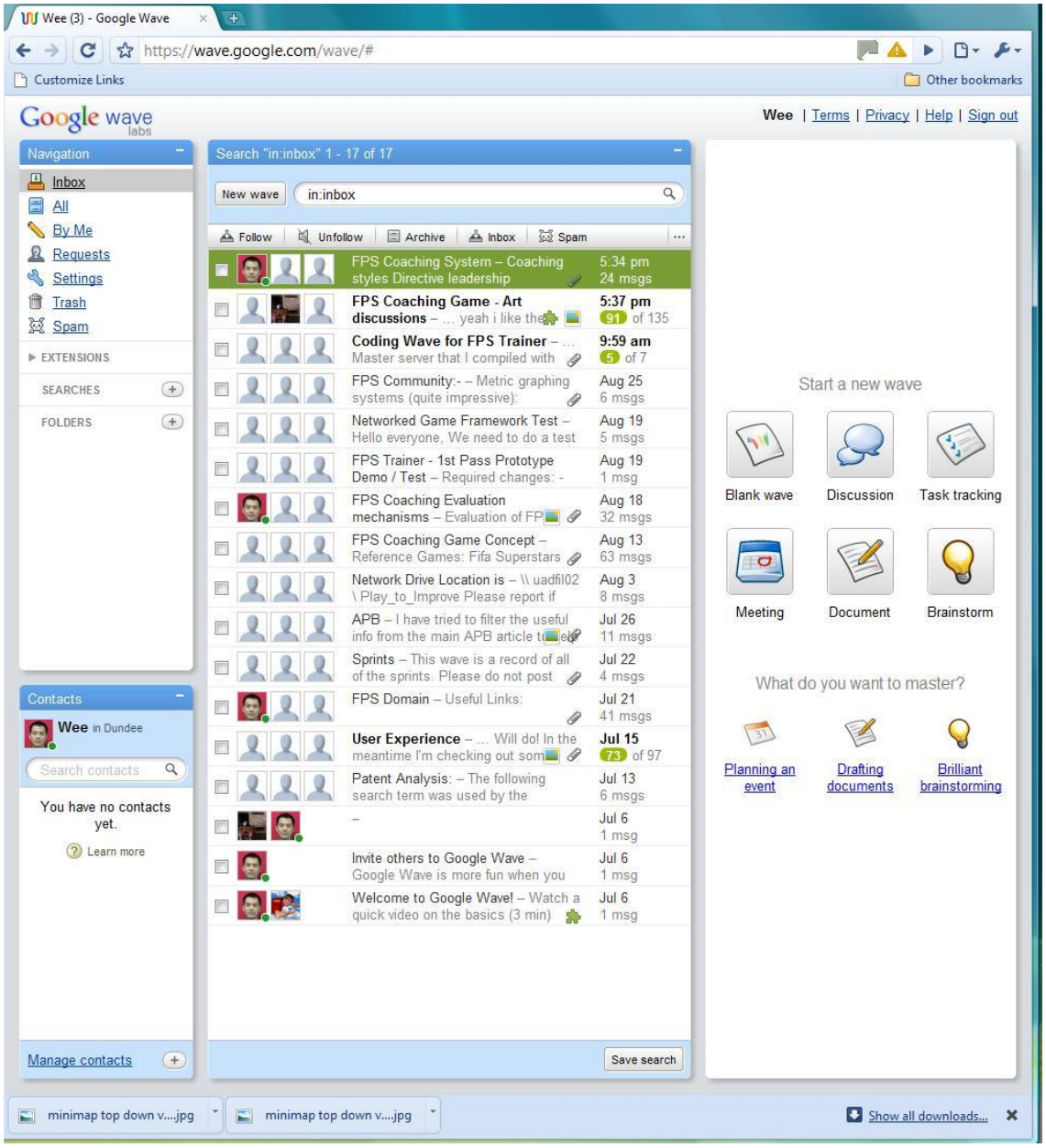

Figure 8.8: Collaborative discussion through Google Wave

8.8.3.3 MediaWiki

Both daily scrum and Google Wave were used from the beginning of the project. However, to resolve the redundancy and over-expansion problems of the information communicated through scrums and waves, an internal MediaWiki was developed by the web designer for the team, in which technical information and knowledge across different expertises were sorted and shared, based on a predetermined topic structure (see Figure 9.3).

Used as a knowledge management system for the team, MediaWiki enabled the creation and linkage of web pages which contain detailed descriptions of problems solved in the game production. Every member of the team was given access to the MediaWiki and was permitted to edit or update the contents as the production progressed. Technical terms were clearly defined from high level to low level, to ensure every member understood the meaning of specific terms used in the project.

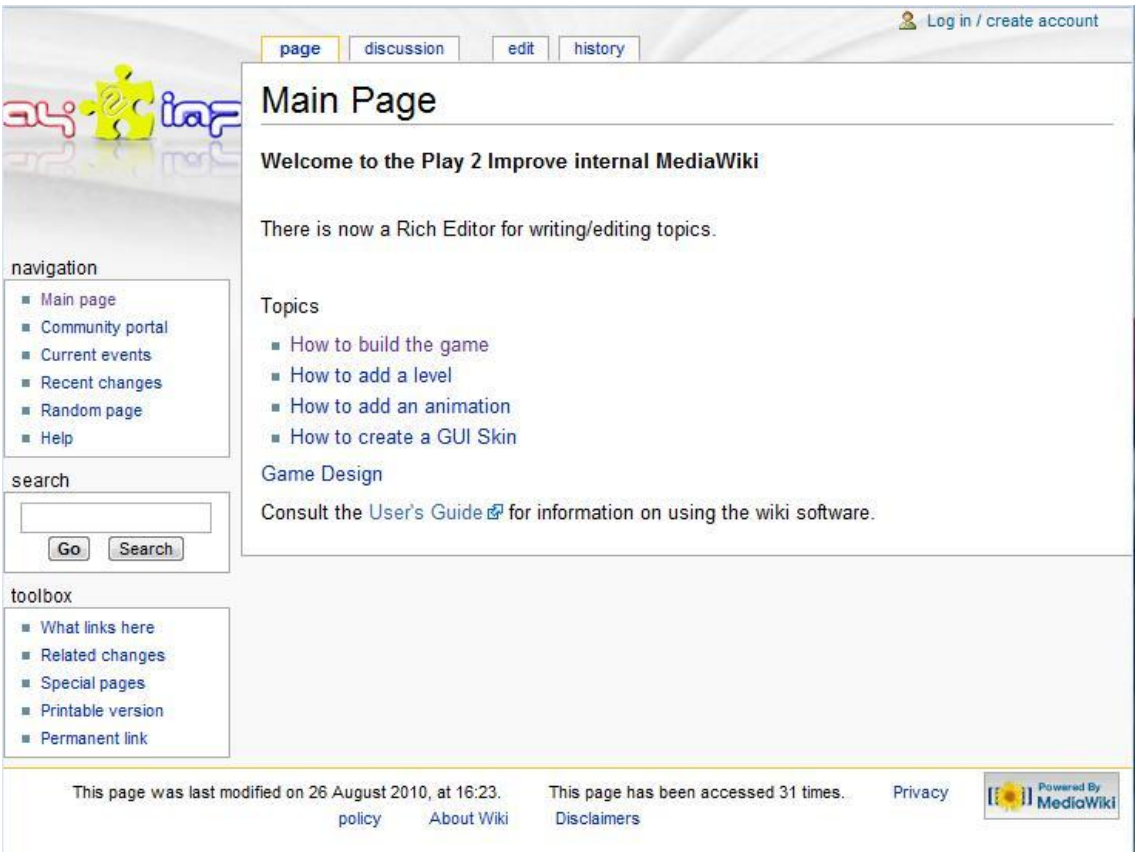

Figure 8.9: The internal MediaWiki used by the project team

8.8.4 Revealing the lack competence of the ID in playing the SME's role

The ID was expected to draft as many learning and coaching outcomes as possible before the SME of the project was found. Many FPS games and related materials were supplied to the ID, such as fans' blog entries and forum posts; strategy guides published officially (in magazines and periodicals) and non-officially (private web pages) by game reviewers; game playing manuals attached to the original game packages, etc. To ensure the comprehensiveness of the learning outcomes, references from various fields of study were used, including game design (Adam 2010; Rabin 2010), instructional systems design (Dick *et al.* 2008), human-computer interface (Isbister & Schaffer 2008),

military (Sun Tzu's The Art of War; Lethal Weapons Training Academy 2009), psychology and sports coaching (Shinar & Woodward 2008).

However, while generic learning outcomes could be generated mainly based on common-sensical understanding about FPS games, specific outcomes that should be able to coach FPS game players towards advanced levels of game playing performance could not be developed. The lack of subject matter knowledge and professional game playing skills had proven that the role played by a competent SME is always irreplaceable. This experience gained was consistent with the findings depicted in Section 6.4.1—the need for collaboration rather than independent production.

8.8.5 Capturing the subject matter knowledge using flowcharts of use cases

The desired SME was encountered in the Dare Protoplay 2010, during the weekend of Week Six of the project. A world FPS champion who had experience in game coaching was met by the project manager and the ID in the Dare Protoplay. After a brief discussion and demonstration, the suitability of the champion was verified, leading to his official involvement as the SME of the project. However, as the SME was representing the UK in tournaments around the world, the initial communication between the SME, the game experts and the ID was limited to one face-to-face discussion, followed by emailing and teleconference. This limitation prompted the need for developing a mechanism which could capture the subject matter knowledge of the SME.

By referring to the integrated GBL collaboration model (see Figure 8.4 and Figure 8.5), a series of flowcharts were generated, containing use cases which were prepared for the SME's revision and verification. In other words, the flowcharts of 'use cases' were created through discussion and negotiation between the SME, the ID and the project manager in the coaching system design process. According to Adolph and Bramble (2003, p. 1–2), *'use cases are simply stories about how people (or other things) use a system to perform some tasks'* which serve the following purposes:

- to form a semi formal framework for structuring the stories,
- to depict the system requirements for the error situation, in every use case, and at every level of description, and

- to afford the scaffolding which holds other project information.

In the FPS Trainer project, the flowcharts of use cases captured and synthesized the subject matter knowledge possessed by the SME in a format that could be comprehended thoroughly by game experts. While much collaboration between SMEs and game experts has suffered from the ineffectiveness and inefficiency in retaining and managing the subject matter knowledge possessed by SMEs, this technique—alongside with the rubrics described in Section 9.2.2—made a significant contribution to the progression of the project by capturing the right contents from the right expert, despite facing geographical barriers in communication.

Microsoft Office Visio was chosen to draw the flowcharts in practice, but the ideas contained in the use cases should be software independent, because they could also be recorded using paper and pencil—as long as the effectiveness and efficiency of collaboration were maintained, if not enhanced.

The actual flowcharts cannot be shown in this thesis because the contents are to be included in a patent application. Nonetheless, the FPS Trainer and its game coaching system have been scheduled to be presented in March 2011, during the 25th Game Developers Conference Expo in San Francisco (Seeney & Tan *in press*), when more details will become available.

8.9 Summary

Synthesizing findings from three stages of this research, this chapter presented one answer to the key research question—how SMEs and game experts can collaborate to design and develop games for use in formal educational contexts. The integrated GBL collaboration model has been developed as the major contribution of this thesis to the field of GBL. Four other GBL issues preceding and following the key question were discussed, in which solutions were proposed to the issues, based on insights accumulated along the doctoral research journey. The research journey was revisited through reflections upon the deployment of internalisation and externalisation strategies. These strategies were essential in consolidating segregated studies into one thesis.

CHAPTER 9: CONCLUSIONS

9.0 Introduction

The aim of this thesis has been set to investigate GBL collaboration between SMEs and game experts. This chapter presents a synopsis of the doctoral research, which includes its findings and evidence of its contribution to greater understanding of GBL practice and GBL collaboration. It also offers recommendations and implications, discusses the limitations of the research and directions for future studies.

9.1 A critical overview of the research

This thesis looks at the perceived potential of GBL in formal educational contexts and how SMEs and game experts can collaborate to design and develop games for the GBL practice. The focus was on comparing the perceptions, attitudes and attitude differences between SMEs and game experts. The research was started by exploring the potentials of GBL through the eyes of SMEs, game experts and learners. The findings of this exploration led to the need to compare the attitude of SMEs and game experts under two conditions: ideally and usually. The research revealed that there were statistically significant differences and changes of attitude between the conditions, and this discovery prompted the necessity to uncover the reasons behind these findings. Through a follow-up explanatory study, the perceived rationale of the attitude changes was examined. Based on the overall findings and insights generated from the cross-case analysis and synthesis, the integrated GBL collaboration model was developed, in which ideal GBL practice was included as a part of an ideal GBL collaboration. The research is presented chronologically in the thesis, where segregated studies were linked to one another via the SR model to overcome technical problems posed by linear mixed methods research design. In terms of the trustworthiness and validity of the research, internalisation and externalisation activities were added in the doctoral journey, in which the writing of this thesis has become a major part of those activities.

Although this research claims to reach a reasonable completion, there were at least five issues left unresolved but ought to be considered as avenues for future study and reflection.

9.1.1 The nature of research participants

At the early stage of this doctoral research, the notion of ‘practitioner’ was considered to replace the term ‘expert’ because there were doubts upon the eligibility of the research participants to be regarded as experts. However, this idea was discarded after considering the nature of the participants when they used games in teaching, were involved in game production, or studied GBL as a subject matter.

9.1.1.1 Teachers and academics as subject matter experts

Practitioners are people who practice in a profession, and in order to practice, the person should have gone through training and relevant learning processes. The training or learning involved would have to be designed or developed by experts in the field of study, hence the notion of subject matter experts. The output of the design and development process could either be a programme, a course or a lesson, depending on the scale or magnitude of learning needs and the expert's input.

The expert or group of experts who design and develop the training or learning could and would normally be a former practitioner, servicing practitioner or, in rare cases, beginning practitioner. The participants in this doctoral research comprise all three types of practitioners. In ES1, secondary mathematics trainee teachers who completed their one-year PGCE study were requested to play the role of SMEs based on the assumption that the teacher training which they have gone through would have equipped them with the knowledge, skills and attitudes to use e-games in teaching secondary mathematics. In other words, they should have been able to design and develop lessons that involved the use of games in teaching upon their completion of PGCE study. The underlying rationale of this assumption is that the practice of using e-games in teaching was seen as a form of game-based learning, in which the use of games was seen as parallel to the use of other learning media. So trainee teachers who had acquired sufficient knowledge of secondary mathematics education and skills in using learning media that qualify them to teach in formal

educational contexts, could be perceived as SMEs in the setting of ES1 even though they were actually beginning practitioners.

In ES3, the A-Level biology teacher was regarded as an experienced practitioner in GBL. The successful use of GBL with a dialogue teaching approach justified this judgement. Subject matter wise, he was also an experienced practitioner in teaching biology, i.e. an experienced biology teacher. While the trainees in ES1 might have experience in the use of games in teaching—presumably during their training—they were not regarded as experienced practitioner in teaching mathematics, i.e. having the qualification and capability to teach alone does not make them an experienced teachers. Nevertheless, both types of practitioners (in ES1 and ES2) have the quality and ability to teach in their respective subject area, and this was the reason they were all perceived as subject matter experts.

The respondents in Survey 1 were classified as SMEs even if they were not teaching or providing any forms of training or learning service when they participated in this research. They were perceived as SMEs because they were either:

- experts in GBL research—where GBL is regarded as a field of study, or
- experts in using games in teaching, i.e. having experience in practising GBL with a teaching approach that suits their subject matter, or
- experts in designing or developing games for use in their subject matter.

When the notion of 'subject matter experts' was used in this thesis, the focus was targeted on the practice of GBL, i.e. the quality and capability of using games in formal educational contexts, rather than the quality of being teachers, academics or researchers. While holding this focus, the thesis relies heavily on the judgment of individual institutions which have granted academic qualifications (teaching or research or both) to the perceived SMEs, to signal quality assurance over subject matter knowledge and the pedagogic skills associated to subject matter in relation to GBL practice.

The participants in Survey 1 and subsequent follow-up interview were seen as SMEs because they were experienced GBL practitioners, and the prerequisite for being

such practitioners is the possession of academic qualification in teaching profession or in conducting research. Nevertheless, this thesis asserts that the classification of SMEs in the data collection is reasonable and acceptable only while GBL is still not a common practice in formal educational contexts. In fact, the study of GBL itself is still far from being a common subject matter of study even at bachelor degree level, not to mention secondary or primary school level. When GBL practice has become common, hopefully in the near future, research into GBL should be geared towards specific subject matter. This in turn requires research participants to be certified GBL teachers, such as the practice of Montessori certification.

9.1.1.2 Practitioners in the game industry as game practitioners

The difference between practitioners and experts in game industry is less clear. However, the process of producing games is more similar to the design and development of a programme, a course or a lesson, as compared to the process of teaching or doing academic research. Therefore, those who work in the game production profession were regarded as game experts rather than game practitioners. Moreover, the notion of 'practice' in game could be misunderstood as a form of game playing activity, as opposed to game production. One may argue that 'game experts' could also be misleading as well, because they can denote game players who are good in playing certain types of games. However, a commonly recognised phrase—professional game players or pro-gamers would be used instead.

This thesis positions people who work in game industry and people who work in academia or school at equal level in terms of their professionalism, specifically in GBL practice and collaboration. Thus addressing both as experts reflects such parallel recognition.

9.2.2 The limited observational data

The most challenging task in this research was gaining access to the sites where SMEs use games in teaching or game experts produce games. The former involves strict criminal record checking—doubly challenging to a foreign student because of the bureaucracy involved and the time and money incurred. Furthermore, access often involves the signing of non-disclosure agreements and this greatly dilutes the extent to which the findings related to these sites can be reported legally.

Due to the above mentioned challenges, the distribution of questionnaires to schools was carried out through proxies—PGCE trainee teachers who did their practicum in schools. This strategy was used, taking full account of ethical considerations and gaining required permissions, because the trainees could identify teachers who actually used games in teaching through personal observation. Other respondents were identified through seminars, conferences and award giving ceremonies where teachers or academics who had their GBL practice revealed before they responded to the questionnaire. Nonetheless, there were at least two issues when these types of SMEs participated in this research:

- Would the experience they depicted reflect their actual GBL practice?
- To what extent they could represent the wider population of teachers or academics who have used games in teaching or involved in game production?

The first issue was addressed in part by splitting each question asked in the survey into two conditions: ideally, what should be the case; and usually, what is the case. By leading respondents to envisage the ideal GBL practice and then to reflect on their experience in usual practice, they would be encouraged to identify gaps between aspirations and practice.

The second issue raises the statistical generalisability of the findings. Here, the SMEs can represent at least people who had used games in teaching and willing to share their view on GBL practice. This purposive sampling method was the preferred strategy at that particular period because the attributes that form the population of GBL teachers and academics were unclear—and it is still a major issue under discussion among GBL researchers to date (as evidenced in papers for ECGBL 2011). Being a pioneering study, this thesis chose to sample a loosely defined population: teachers or academics who had experience in using games in teaching and were willing to respond to GBL issues. In other words, the voices of those who never use games in teaching and those who had used games but reluctantly or were unwilling to respond to the issues were not heard. As a result, the usefulness and applicability of conclusions inferred based on the findings should be restricted to like situations. Nevertheless, this should not be seen as a threat to the credibility of the

findings. Based on a solid questionnaire design, dependable participants and established nonparametric analysis, the research should be seen as trustworthy.

9.1.3 The pedagogical rationale for games

Although this research is about the use of games in formal educational contexts, the educational value, especially the pedagogical rationale for games was not investigated. Rather, the research examined the perceived potential or claimed values through the eyes of SMEs and game experts. This no doubt leaves remarkable room for further study and it is worth shedding lights on the possible directions for research into games related pedagogy.

Pragmatically, this thesis argues that games can either be learning media or learning methods, depending on: firstly, the contents of the chosen game and secondly, how the game is used in a particular educational activity. If the content is relevant and accurate, i.e. suits the specific syllabus and learning needs of a subject matter in a predetermined educational context, then the game can be used as the learning media of the subject matter. When such games are used as the vehicles for delivery of learning, various components of multimedia—typically texts, graphics, audio, video and animation—can be integrated to provide players the following learning features:

- multiple sensory arousal learning experience which could affect the degree of player's immersion in different phases of game playing (pre-, in- and post-game);
- pre-game anticipation, in which teasers or previews of the learning contents and outcomes are used to encourage preparation for game playing;
- synchronous interactivity, when real-time feedback is given and formative performance evaluation takes place upon learners' action and reaction in the game;
- asynchronous interactivity, when summative performance evaluation is carried out at the end of the game to debrief players; and

- post-game reflection and reaction, where players can review positive and negative in-game experience and then rearrange strategy to reinforce or enhance the positives and to remedy the negatives.

The above mentioned features are only available in well designed and developed bespoke educational games due to the strict requirements set to meet the accuracy and the relevancy of subject matter content. Nevertheless, the key advantage of having a tailor-made game in education is that both surface and deep learning activities across three domains (see Section 5.3.6) could be designed into the gameplay to achieve predetermined subject matter learning goals.

However, if the content is relevant but inaccurate, e.g. the use of Spore in biology lessons (see Section 5.3), the game should not be used at concept building learning activities, i.e. before learners accomplish most if not all surface learning outcomes which are associated to the subject matter. In the case of ES3, Spore was used to teach deep learning skills in A-Level biology, rather than the fundamentals of biology in Year 9. Using the game in Year 9—when learners might still be constructing their basic understanding of biology principles—could probably lead learners to misconception. Such games in formal education could jeopardise the reputation of GBL teachers and the credential of GBL practice as a whole. Therefore teachers and academics should be careful in analysing the content of non-bespoke games—be they educational or commercial—in order to match the right games to the right learners at the right time.

The use of games whose contents are irrelevant to the syllabus or even the subject matter deserves extra caution and additional attention among teachers and academics. Based on behaviourist learning theory, such games could still be used in formal educational contexts as tactics:

- to encourage desirable behaviour and/ or attitude, in which game playing is used as a reward before and/ or after a specific learning event;

- to direct desirable behaviour and/ or attitude, in which game playing is sanctioned when desirable behaviour and/ or attitude has not been performed;

- to stop undesirable behaviour and/ or attitude, in which game playing is sanctioned unless behaviour or attitude changes were made; and
- to stop undesirable behaviour and / or attitude by allowing game playing when undesirable behaviour and / or attitude has not been carried out.

Such 'carrot-and-stick' tactics relies heavily on a belief in game playing as a form of effective extrinsic motivation. Reward and punishment of positive and negative behaviour and / or attitude that base on such tactic could be dangerous because overly dependence of games in such conditions could lead to addiction in game playing. When game playing becomes the reason or purpose of learning, this would be an issue of learn-based gaming rather than game-based learning, which is beyond the scope of this research.

9.1.4 The involvement of learners in the study

One of the very first issues faced in conducting GBL studies is whether to address the pupils or students as players or learners. The issue was highlighted in ES2 and the follow-up interviews when research participants asked for clarification before responding the question: how players and learners could be benefited from GBL practice.

In the real world, all game players are learners because they need to learn how to play the game—the goal and the rules. However, not all learners are game players because game playing is not the only form of learning for learners to acquire appropriate knowledge, skills and attitudes, even if the learning is related to the game and game playing. In the game world, playing starts once the players enter or join the game. By joining the game, the players follows the rules and the goal(s) set by the game master who organises the game. Unlike games in real-life, non-players can 'play' e-games by joining the game without abiding by the rules or the goal. The non-players are not necessarily cheaters or hackers—although they might be; they can also be spectators, coaches or non-player character (NPC, humanoid creatures controlled by game master). In the setting of GBL practice, teachers or instructors who join the game together with their students are considered as non-players.

If playing games is about ‘abiding rules while attempting to achieve the goal’, game players may engage in various activities under the scope of ‘playing’, which include:

- learning to acquire knowledge, skills and attitudes which are required to play or continue playing the game;
- performing to overcome challenges or solve problems encountered in the game; and
- interacting with non-players and/ or other players through socialisation, competition, cooperation or collaboration.

The attributes of the notion of ‘learner’ vary, depending on how one perceives learning. For instance, constructivists may combine all the above mentioned playing activities when they explain what attributes a ‘learner’ (Yilmaz 2008); while proponents of situated learning theory would see game playing as learning by definition (Lave & Wenger 1991). This thesis proposes that for pragmatic reason, GBL researchers should stop arguing which learning definition or theory is better than which in GBL design or practice. It is the match of needs and the feasibility of fulfilling the needs that matters.

The needs of learners can be induced by gathering learners’ opinion, i.e. what the learners think they need to learn, or it can also be deduced from SMEs’ decisions on what the learners should learn. Ideally, a combination of both would contribute to a well designed and developed of GBL practice. However, this was not practical in this doctoral study. Therefore, if someone has the intention to expand the generalisability of the findings, he or she should refer to others’ research findings (e.g. Whitton 2010, Felicia *in press*) to fill in the gap. A brief comparison of GBL design and development models was made in the following section to address the gap of understanding.

9.1.5 Alternative design models

As depicted in Section 8.8, the integrated GBL collaboration model was deployed in the FPS Trainer project to address a key problem: how a SME can collaborate with game experts in game design and development process. The acceptance of the model in the project shows the credibility of the model, which in turn assures the usefulness

of the findings generated from this doctoral research. However, the project did not rely merely on the model to succeed—alternative design models were also referred to in the production. Three models were selected and compared to the one created in this research.

Akilli (2007) developed an instructional design / development model called ‘FIDGE model’ and claimed to have overcome the problems faced by generic instructional design / development model in designing game-like learning environment (see Figure 9.1). However, while juxtaposing an intensive number of components or activities involved in the design and development of game-like learning environment, there is no clear indication on how these components relate and interact to each other. As a result, SMEs and game experts who intend to base their collaboration using the FIDGE model might be arguing which component they should start first—a potential collaboration problem revealed in Section 7.4.1.

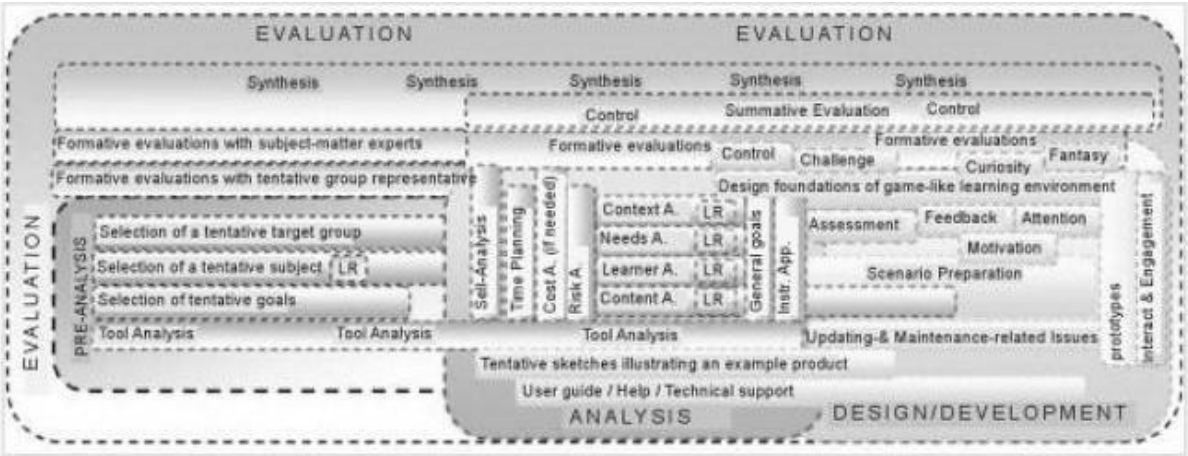

Figure 9.1: The overall appearance of the FIDGE model, proposed by Akilli (2007)

Marfisi-Schottman, George and Tarpin-Bernard (2010) are developing a GBL collaboration middleware which aims to assist SMEs and game developers to conceive, produce and test serious games. Their six-step method for designing serious games (see Figure 9.2) is indeed very similar to the model proposed in this research, and perhaps more systematic—suitable for those who have computer science or software engineering background. While the high level model is succinct and easy to comprehend, a coordinator would be required to translate technical language used in applying the proposed middleware into a language comprehensible

by SMEs—a key issue of collaboration revealed in this research (see Section 7.5.1). Nevertheless, this model reflects a very positive attempt and encouraging effort initiated by technical experts in solving the key research question addressed in this doctoral research.

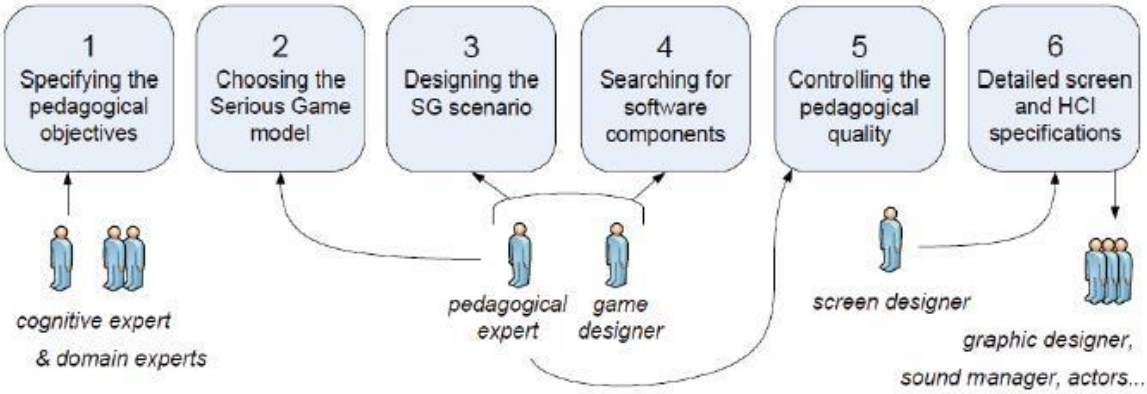

Figure 9.2: Six-step method for designing serious games, proposed by Marfisi-Schottman *et al.* (2010)

Having completed a PhD titled 'An investigation into the potential of collaborative computer game-based learning in higher education' in 2007, Whitton (2010) considered six types of skills—associated with the roles of subject experts, educationalist, game designer, programmer, interaction designer and graphic designer—that academics in higher education will need to develop games for learning. Unlike Marfisi-Schottman *et al.* (2010) who are creating a middleware to accelerate collaboration, Whitton (2010) listed five types of existing software or technical approach for creating games. Although she did not offer any specific model for collaboration, the comprehensive guideline she created, particularly the pedagogic design consideration and the suggestion on digital games evaluation, is highly compatible with the model proposed in this doctoral study.

9.2 The contributions of the thesis

The experience gained through the direct involvement in the game production mentioned above justified the usefulness, trustworthiness and ecological validity of the GBL collaboration model proposed in this thesis. Apart from the game production, the thesis has also contributed to the understanding of GBL in formal

educational contexts. These contributions were divided into four aspects of GBL and discussed in the following sub-sections.

9.2.1 The conceptualisation of GBL for formal educational contexts

In Chapter 1, this thesis argues that research into GBL should be delineated into formal, non-formal or informal educational contexts, depending on where the GBL practice was deployed. The delineation of contexts should not be confused with three forms of learning—formal, non-formal and informal learning. The differentiation between educational settings and forms of learning clarified the boundaries of these terms, which in turn contributed to the contextualisation of other GBL research.

The research focused on GBL in formal educational contexts and coined a dedicated definition of GBL which set its foundation in learner-centred learning. Each of the concepts used in the construction of the definition was explained and discussed, and two central concepts—games and e-games—were analysed in Chapter 2. The thesis asserts the importance of comprehending the definitions, elements, essence and classification of games and e-games because the lack of such understanding became the fundamental barrier of communication among different experts in GBL practice. One contribution to knowledge was the demarcation of concepts which are synonymous and yet ambiguous to games, such as play, game playing, gameplay, simulations and fun.

The need to identify specific research positions in both academia and the game industry was highlighted, because such positions were essential for assessing issues associated with GBL. Five issues associated with GBL were examined through the literature review in Chapter 3, where the outcomes of the assessment set the direction of the research and consecutively determined the focus of the thesis and key research question. Figure 9.1 recaps the step-by-step procedure of the preparatory stage of this doctoral research, which could be beneficial to beginning researchers who are looking for a structural approach in determining the scope of a literature review.

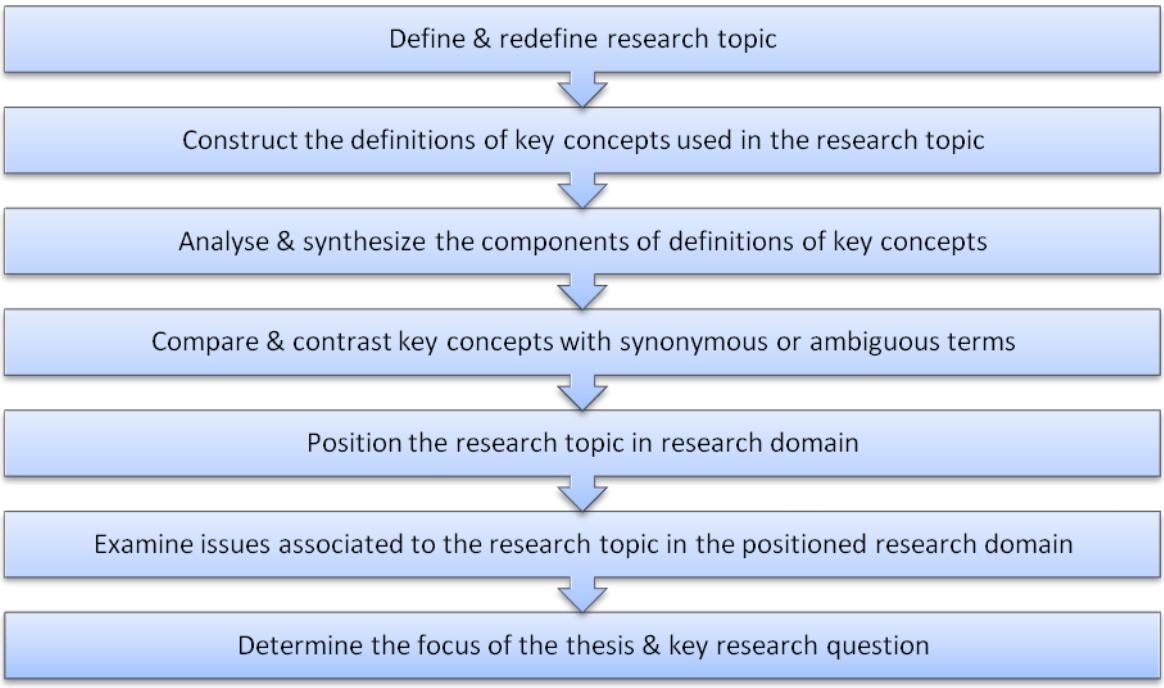

Figure 9.3: Step-by-step procedure of the preparatory stage

9.2.2 Research methodology for GBL studies

An alternative pragmatic research design to mixed methods has been proposed in this thesis for GBL studies. The evolutive spiral-segregated case study research model, aka the SR model has been developed to overcome difficulties encountered along the doctoral journey. The SR model divided the research process into a six-step quasi-linear cycle, and then combined studies of different natures into a spiral shape. These segregated studies were integrated through cross-case analyses and syntheses in order to accumulate knowledge, skills and insights along the research journey.

In addition, a temporal focus shift feature of the model permitted the evolution of research aims, which enabled the challenges of research planning and organisation to be tackled through a journey-oriented perspective, which complemented the conventional methodological perspective. With the combination of two perspectives, research methods and resources were interwoven even though the focus was not finalised at the beginning of the study.

9.2.3 GBL practice among teachers in formal educational contexts

This thesis identifies the gaps in and between perceived potentials and recognised benefits of GBL, which prompted the need for filling or bridging the gaps. The

surface–deep learning matrix was developed to analyse and categorise the nature of the gaps; while the socio-technical systems approach was used to classify the challenges faced in GBL practice. The results of the former analysis were used to form a set of characteristics of GBL teachers and the latter were used to structure the rubrics of ideal GBL practice. Both of these research outputs could be referred by those who intend to use games in teaching or to design courses for GBL teacher training.

9.2.4 The collaboration between SMEs and game experts to design and develop games and GBL

In the preparatory stage of this research, a GBL model was developed based on the preliminary literature review (see Figure 4.6). The GBL model depicted the inputs required from academia and the creative industry to produce games for use in the GBL context. Collaboration between SMEs and game experts were hypothesized as one solution to the issues of GBL practice. After the conduct of ES2, the perceived ideal GBL collaboration model was created (see Figure 5.3), in which issues related to GBL collaboration emerged and confirmation of both SMEs and game experts were needed to consolidate a GBL model that integrates both GBL practice and collaboration. Questionnaire surveys and follow-up interviews were conducted, and the findings of these studies provided the basis for developing the integrated GBL collaboration model (see Figure 8.2). Although the integrated model could only be seen as a tentative solution to GBL problems, its components in the collaboration flow chart reflected the expectation of both SMEs and game experts who participated in the research.

9.3 Limitations of the thesis

As an evolving field of study, there will always be relatively more recent data and research developments or progression which might indicate that what was found in this doctoral research is not reflecting the current case or phenomena. However, while technology changes rapidly, human beings change less rapidly (Bates 2000), which would probably include the change of learning abilities. Therefore the shelf life of the findings in this research should sustain the wear of the fast-changing ICT world, at least in the contexts of formal education. Nonetheless, at the time when the

data were collected and analysed with the resources available to the research, the conclusive propositions made in individual studies were the best conclusions that could be made. Although a repertoire of research methods and strategies such as the SR model, the surface–deep learning matrix and the reflection–reflexion continuum, were purposely developed to solve the methodological problems of the research design, this thesis still has several limitations which provide opportunities and directions for further studies.

9.3.1 Narrow research territories and small samples

Despite involving more than 150 participants in various stages, the research territories covered were limited to GBL for use in secondary and tertiary formal educational contexts in the UK. Therefore, the samples were relatively small, especially in the questionnaire surveys where nonparametric statistical techniques were the optimum choice for the quantitative data analysis. Although the selected research methods fitted the constraints faced and resources available, greater sample size and more rigorous parametric statistics would enhance the external validity and reliability of the findings. Thus, the confirmative stage of the research—questionnaire survey should be replicated in future, wherein the results could be compared and contrasted with the findings of this research.

9.3.2 Segregated studies and interview biases

This doctoral research was a series of segregated snapshots of the GBL phenomena; therefore, it could only reflect facets of both academia and the game industry. Also, it is important to stress that 'the whole is greater than the sum of its parts' (Aristotle's *Metaphysics–Book V*). The findings in exploratory and explanatory studies in this research, particularly those involved the use of semi-structured interviews, could only be used to make analytical rather than statistical generalisations. Although multiple research methods were deployed to enhance the trustworthiness of the findings, interview biases remained the biggest threat as the educational concerns of SMEs and commercial interests of game experts might be conflicting.

9.3.3 Questions left unanswered

As stressed in Section 4.1, this research takes a pragmatic approach, where the research question determines the choice of methods. Therefore, for pragmatic reasons, the answers to the research question should be practical and feasible for SMEs and game experts to implement in their usual working contexts. The account of experience depicted in Section 8.7 has proven the ecological validity of the research findings in the game industry, but whether or not the findings are pragmatic to experts who work in formal educational contexts remains an issue unanswered. While exposing a lacuna for potential further study, this issue is indeed a serious limitation of this doctoral study because it was an academic research rather than a commercial venture.

9.3.4 Balancing the depth and height of the research

Studying games as a subject was indeed a challenging task, mainly because issues associated with games could become popular topics that interest people from all walks of life; while at the same time, questions related to games could also be private and philosophical matters.

The former phenomena have granted this doctoral study a high profile in the game industry, which partially cast an illusion on the research conductor, as if he who has studied games must know everything about games—the origin, the history, the arts, the design, the strategy, the production, the evaluation, etc. While admitting that an individual GBL researcher can never be able to know everything about games, constant and rapid learning about games and from other researchers have become a self-imposed obligation and commitment, made to the growth of the field of games studies.

However, this study of games has led the research journey into a deep and uncertain terrain of self-discovery. The private philosophical explorations about games—the nature, the essence, the meaning, the ethics, the ontology and so on, have left a life-long effect upon the character of the research explorer, who has formed a strong belief system in games and game-based education.

While attempting to achieve both the depth and height for this research at the same time, efforts and resources available were spread along a continuum. This has turned

into another limitation of this study, although one could always argue that depth and height are relative in comparison and could be subjective in meaning.

9.4 Summary

This last chapter of the thesis summarises the research through a critical overview. The concluding propositions collated throughout the doctoral journey are listed and grouped under four types of contributions: the conceptualisation of GBL in formal educational contexts, research methodology for GBL studies, the GBL practice among teachers, and the collaboration between SMEs and game experts to design and develop games and GBL. The thesis ends with its limitations and a discussion of opportunities and directions for further studies.

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APPENDICES

I. Research degrees: Application for Ethical Approval

Name of student **Wee Hoe Tan**	MA By research	EdD	PhD X

Project title: **Meta-learning in new media: a study of game-based learning**
Supervisors: **Dr Sean Neill and Sue Johnston-Wilder**

Please ensure you have read the Guidance for the Ethical Conduct of Research available in the handbook.

Participants

Please specify all participants in the research including ages of children and young people where appropriate. Also specify if any participants are vulnerable e.g. as a result of learning disability.

Case study 1: Commercial game production (Codemasters, Leamington Spa, UK)	Game designers and playtesters (adults)
Case study 2: Serious games production (The Digital Lab, Univ of Warwick)	Subject matter experts, game designers and instructional designers
Case study 3: Teacher training in WIE	PGCE trainers and trainee teachers

Respect for participants' rights and dignity

How will the fundamental rights and dignity of participants be respected, e.g. confidentiality, respect of cultural and religious values?

Before the conduct of each case study, an invitation email will be sent to all potential participants to involve in this research on voluntary basis. There are three levels of participation: questionnaire survey, semi-structured interview and participants observations. A set of ethical issues related documents will be given to each potential participant, which include an information sheet (see Appendix A) and a consent form (see Appendix B). The information sheet is meant for stating the nature of this research project, the rights of participants (the right to refuse to participate in this study and the right to withdraw at any time), how the results will be used and what they have to do if they take part in this project. The consent form is used to obtain prior informed consent from each participant.

During the conduct of the study, the anonymity of the participants is protected and guaranteed upon the information provided or data collected throughout their participation. Besides, non-discriminatory language will be used in all the reports associated this research.

Privacy and Confidentiality

How will confidentiality be assured? Please address all aspects of research including protection of data records, thesis, reports/papers that might arise from the study.

A standard Non-disclosure Agreement will be signed before the research can be carried out within a game studio. By signing this agreement, no business information or trade secret obtained directly or indirectly during the data collection can be disclosed to a third party.

The participants will be requested to grant permission to use their responses anonymously and confidentially through the consent form. They are able to complete as much or as little of the data collection mechanism as they wish. No information which could identify any particular participant will be shown in thesis, or reports/papers that will arise from the study. The data collected throughout this data will be made separate with any document that might reveal the identity of the participants. Computers used for storing participants' background information will be password-protected. This is meant to protect the confidentiality of the data and to keep the data anonymous at all time.

Consent - will prior informed consent be obtained?

- from participants? | **Yes** | NO | from others? | Yes | **NO** |

- *explain how this will be obtained. If prior informed consent is not to be obtained, give reason:*

Prior informed consent will be obtained before the conduct of each case study, particularly interview sessions (see Appendix B). All potential participants will be given a consent form to be signed before they are interviewed.

- *will participants be explicitly informed of the student's status?*
Yes, they will be explicitly informed of the student's status.

Competence

How will you ensure that all methods used are undertaken with the necessary competence?

Besides attending lectures on 'Ethics in Educational Research' in Fundamental Research Methods (FRM) and Advanced Research Methods (ARM) courses, two guidelines published by British Educational Research Association (BERA): Revised Ethical Guidelines for Educational Research (2004) and Good Practice in Educational Research Writing (2000) were read and referred to ensure all methods used are undertaken with the necessary competence.

Responsibility

i) Well-being

How will participants' safety and well-being be safeguarded?

The interviews with game production practitioners will be conducted in the studio's meeting room; while interviews with teacher trainers or trainee teachers will be carried out in a standard classroom or office in Warwick Institute of Education, which conforms to the standard university safety requirements.

ii) Addressing dilemmas

Even well planned research can produce ethical dilemmas. How will you address any ethical dilemmas that may arise in your research?

The possible ethical dilemmas that may arise in my research would be the use of discriminating language or behaviours implicitly. This might be a result of the cross-cultural differences and the differences in personal and social values. Conducting a research in a context which is foreign to me inherits such ethical dilemmas. However, with the guidance of both my supervisors, I should be able to minimise the probability of such occurrence. A pre-pilot study was conducted with 25 PGCE trainee teachers, while a pilot study was done with 8 game production practitioners in Malaysia. With these experiences gained in both UK and Malaysia contexts, hopefully the possible ethical dilemmas could be minimised.

iii) Misuse of research

How will you ensure that the research and the evidence resulting from it are not misused?

All the communications with any people other than those involve in this study and publications will be monitored and filtered by my supervisors or authorised WIE members of staff.

Integrity

How will you ensure that your research and its reporting are honest, fair and respectful to others?

Every participant will be granted permission to access his or her interview transcription for verification. They could verify the genuineness of the data collected. A final or published copy of the associated case study report will be sent to each participant when the research is completed.

Have you and your supervisor discussed and agreed the basis for determining authorship of published work other than your thesis?

Yes. The authorship of published work other than my thesis depends on the amount of contribution in the work. An example of published work can be accessed in my ePortfolio at http://go.warwick.ac.uk/ep-edrhal/research/publications/BSRLM-IP-28-3-21.pdf

Other issues?

Please specify other issues not discussed above, if any, and how you will address them.

None

Signed

Research student Date 3/12/2008

Supervisor Date 10/12/08

Action 10/12/08

Please submit to the Research Office (Louisa Hopkins, room WE132)

Action taken

✓ θ Approved

θ Approved with modification or conditions – see below

θ Action deferred. Please supply additional information or clarification – see below

Name G L INDST Date 13.1.09

Signature

Stamped

Notes of Action

II. Information sheet

Project Title: Creating better e-games for education
Date: __ /___/ 20__

You are invited to take part in a research study which is being conducted as part of a PhD degree at the Institute of Education, the University of Warwick. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Please feel free to contact us if you would like more information or you have any concern regarding this research. Take time to decide whether or not you wish to take part.

What is the purpose of this study?
This study aims to explore how electronic games (e-games) could be designed and developed for education.

Why is the study being done?
Game-based learning is a form of learner-centred learning that uses electronic games for educational purposes. It is a relatively new approach that could fundamentally re-design, re-format and re-structure the instructional systems in educational institutions to make learning fun and engaging. Hence this study is being done to gather the views of practitioners in both education and the game industry upon the creation of effective and efficient e-games for education.

Why have I been invited to participate?
You have been invited to take part in this study because this study intends to collect your views as a practitioner in either education or the game industry.

Do I have to take part?
It is up to you to decide whether or not to take part. If you decide to take part, you have to sign a consent form for this study. You will be free to withdraw at any time and without giving a reason. This decision will not affect you or your rights in any way.

What do I have to do?
You will be asked to sign a consent form and take part in an interview. The interview questions are attached together with this document. The questions are open-ended in nature and there will be no right or wrong answers. The interview session would take about 30 to 45 minutes.

What are the possible benefits of taking part?
There are no direct benefits to you from taking part in this study. We are hoping that the data collected will produce information about and contribute to the design and

development of game-based learning. However, you would be exposed to key concepts and terms associated with game-based learning and used in academia. Such indirect benefits could be life-long.

What are the possible disadvantages of taking part?
The interview will take some of your time. Every effort has been made to keep any inconvenience to a minimum.

Will my taking part in the study be kept confidential?
The use of any information that identifies you during the course of the research will be kept strictly confidential. This information will be kept in a secure place and only people involved in the study or authorised individuals will have access to it.

What happens when the research stops?
The data obtained will be used for internal publication for a PhD Project and submitted for assessment with a view to being published in academic journals/ conferences. We can also send participants a summary of the study results on request.

Contact details
If you would like any further information please contact:

Wee Hoe Tan
Institute of Education
University of Warwick
Coventry, CV4 7AL
Tel: +447961502211
Email: wee-hoe.tan@warwick.ac.uk
Web: http://go.warwick.ac.uk/ep-edrhal/

Thank you for taking the time to read this information.

THE UNIVERSITY OF WARWICK

III. Consent form

Project Title: Creating better e-games for education
Name of Researcher: Wee Hoe Tan

I confirm that I have read and understood the information sheet dated __/__/20__ for the above project which I may keep for my records and have had the opportunity to ask any questions I may have.

I agree to take part in the above study and am willing to have my involvement in the interview recorded.

I understand that my information will be held and processed for the following purposes:

- To be used anonymously for internal publication for a PhD project and submitted for assessment with a view to being published in academic journals / conferences.

I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason without being penalised or disadvantaged in any way.

_____	_____	_____
Name of Participant	Date	Signature
_____	_____	_____
Researcher	Date	Signature

Institute of Education
The University of Warwick
Coventry CV4 7AL United Kingdom
Tel: +44 2476 524443
Email: wee-hoe.tan@warwick.ac.uk

IV. Questionnaire: Covering letter 1

THE UNIVERSITY OF WARWICK
Institute of EDUCATION

THE UNIVERSITY OF WARWICK

Title: Game-based learning for formal educational contexts: subject matter experts' perception.

Dear Respondent,

I am writing to request your participation in my research project to survey subject matter experts (SMEs) who have the experience of either using games in teaching or involving the design and development of games. The aims of this study are twofold: to find out whether SMEs would agree or not with the perceptions of game experts about the use of electronic games in educational contexts; and to gather SMEs' opinion on how they would like to collaborate with game experts to design and develop game-based learning for formal educational contexts. This project is being conducted as part of my PhD degree at the Institute of Education, University of Warwick. I have attached a survey which I hope you will fill out and return it to me. It should take you about fifteen to twenty minutes to complete. The findings of this study will be used to propose suggestions or guidelines for future collaboration between SMEs and game experts.

If you choose to participate in my survey, please fill in your answers and send the survey back to me using the stamped addressed envelope. The questionnaire is anonymous and I am committed to respecting your privacy. I will make sure that your answers cannot be linked to you personally when I write the report or publish the results in academic journals /conferences.

There are no risks to you or to your privacy if you decide to join my study by filling out this survey. But if you choose not to participate that is fine. Whether or not you decide to respond, I would be very happy to share my results with you if you are interested. To get a copy of my results, please email me at wee-hoe.tan@warwick.ac.uk.
If you have any questions about the survey, or about taking part, please email me or phone me at +447961502211. Thank you in advance for your help and contribution to this study.

Sincerely,

Wee Hoe Tan
PhD Candidate
Institute of Education,
University of Warwick,
Coventry, CV4 7AL
Tel: +447961502211.
Website: http://go.warwick.ac.uk/ep-edrhal/research/

V. Questionnaire: Covering letter 2

Title: Game-based learning for formal educational contexts: game experts' perception.

Dear Respondent,

I am writing to request your participation in my research project to survey game experts who have the experience in electronic games creation. The aims of this study are twofold: to find out whether game experts would agree or not with the perceptions of subject matter experts about the use of electronic games in educational contexts; and to gather game experts' opinion on how they would like to collaborate with subject matter experts to design and develop game-based learning for formal educational contexts. This project is being conducted as part of my PhD degree at the Institute of Education, University of Warwick. I have attached a survey which I hope you will fill out and return it to me. It should take you about fifteen to twenty minutes to complete. The findings of this study will be used to propose suggestions or guidelines for future collaboration between SMEs and game experts.

If you choose to participate in my survey, please fill in your answers and send the survey back to me using the stamped addressed envelope. The questionnaire is anonymous and I am committed to respecting your privacy. I will make sure that your answers cannot be linked to you personally when I write the report or publish the results in academic journals /conferences.

There are no risks to you or to your privacy if you decide to join my study by filling out this survey. But if you choose not to participate that is fine. Whether or not you decide to respond, I would be very happy to share my results with you if you are interested. To get a copy of my results, please email me at wee-hoe.tan@warwick.ac.uk.
If you have any questions about the survey, or about taking part, please email me or phone me at +447961502211. Thank you in advance for your help and contribution to this study.

Sincerely,

Wee Hoe Tan
PhD Candidate
Institute of Education,
University of Warwick,
Coventry, CV4 7AL
Tel: +447961502211.
Website: http://go.warwick.ac.uk/ep-edrhal/research/

VI. Questionnaire: Questions related to the demographic profile in Survey 1

A. ABOUT YOU – please tick the appropriate box in response to each question

1. Age: ☐ 21–25 ☐ 26–30 ☐ 31–40
☐ 41–50 ☐ 51–60 ☐ 61+

2. Gender: ☐ Male ☐ Female

3. Ethnicity:
White (European origin, including UK) ☐
African-Caribbean ☐
Asian origin ☐
African origin ☐
Other: ☐ Please specify: _____

4. Phase: ☐ Under 5s ☐ Primary/Middle ☐ Secondary ☐ Special
☐ Pupil Referral Unit ☐ LA post ☐ Higher Education ☐ Others

5. Length of Service (please tick) How long have you been teaching?
☐ 1 year ☐ 2–3 years ☐ 4–6 years ☐ 7–9 years
☐ 10–15 years ☐ 16–25 years ☐ over 25 years

6. Your Post (please tick the box which reflects your main responsibility)
☐ Class teacher ☐ Curriculum Co-ordinator ☐ SENCO
☐ Middle management ☐ Head of year ☐ Leadership group
☐ Assistant head teacher ☐ Deputy head teacher ☐ Head teacher
☐ Lecturer ☐ Other: _____

7. Are you a subject specialist?
☐ Yes (Please state your specialisation: _____)
☐ No

B. USE OF GAMES IN TEACHING

1. How many games in an average term do you use in teaching? (please tick)
☐ None (skip to Section C) ☐ 1 ☐ more than 1

2. How long have you been using games in teaching?
☐ 1 year ☐ 2–3 years ☐ 4–6 years ☐ over 6 years

3. Please indicate which of the following components are contained in the games you have used in teaching
☐ Action ☐ Adventure ☐ Fighting ☐ Simulations
☐ Puzzle ☐ Role-playing ☐ Sport ☐ Strategy
☐ Other:_____

C. INVOLVEMENT IN GAME PRODUCTION

1. How many games have you been involved with developing? (please tick)

   ☐ None (skip to section D) ☐ 1 ☐ more than 1

2. Please indicate which of the following components are contained in the games you have been involved in developing

   ☐ Action ☐ Adventure ☐ Fighting ☐ Simulations
   ☐ Puzzle ☐ Role-playing ☐ Sport ☐ Strategy
   ☐ Other:_____

3. What role did you play when you were involved in the game production? (please tick all that apply)

   ☐ Subject matter expert ☐ Game designer
   ☐ Game tester ☐ Project manager/ coordinator
   ☐ Other:_____

VII. Questionnaire: Questions related to the demographic profile in Survey 2

ABOUT YOU – please tick the appropriate box in response to each question

1. Age: ☐ below 21 ☐ 21–25 ☐ 26–30 ☐ 31–40
☐ 41–50 ☐ 51–60 ☐ 61+

2. Gender: ☐ Male ☐ Female

3. Ethnicity:

White (European origin, including UK) ☐
Black: African-Caribbean ☐
Asian origin ☐
African origin ☐
Other: ☐ Please specify: _____

4. Highest qualification achieved:

☐ GCSE / Or other secondary equivalent
☐ A-Level / AS-Level
☐ Diploma (Please specify) : _____
☐ Degree (Please specify) : _____
☐ Master's degree (Please specify) : _____
☐ Others (Please specify) : _____

5. Length of Service (please tick)

How long have you been working in game industry?

☐ 1 year ☐ 2–3 years ☐ 4–6 years ☐ 7–9 years
☐ 10–15 years ☐ 16–25 years ☐ over 25 years

6. Your Position: _____

7. Please indicate which of the following components are contained in the games you have been involved in developing (please tick all that apply):

☐ Action ☐ Adventure ☐ Fighting ☐ Simulations
☐ Puzzle ☐ Role-playing ☐ Sport ☐ Strategy
☐ Other:_____

VIII. Questionnaire: Perceptions of subject matter experts / game experts

Prior to this survey, interviews were carried out with game experts and sixth form students. The following questions are derived from their perceptions on the use of games in formal education contexts. Each question is asked in two facets:

- **Ideally** or **in theory**, what the best example would be like
- **Usually** or **in practice**, what the experience of average situation would be like.

Please indicate whether you agree or not with these perceptions.

1. Please tick the boxes for what you believe how teachers who use games in teaching should **ideally** be and tick the boxes for what your experience **usually** is like.

Teachers who use games in teaching		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
a. … must have understood the concept behind using games in teaching.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
b. … need to be trained to use games in teaching.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
c. … are open-minded to the latest ICT.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
d. … are willing to listen to students' suggestion in the use of games in classrooms.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
e. … cannot use game-based learning effectively unless they get involved in game production.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
Any further comments						

2. Please tick the boxes for what you believe how studios that produce games for use in formal education contexts should **ideally** be and tick the boxes for what your experience **usually** is like.

Studios that produce games for use in formal education contexts		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
a. … produce boring games.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
b. … produce games which are not creative.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
c. … produce games which are not pedagogically sound.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
d. … produce games which do not fit curricular objectives.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
e. … experience limitations preventing them making games fun.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
f. … constantly face the dilemma of balancing educational elements and gameplay elements.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
g. … should let players enjoy playing the games without realising they are learning.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
Any further comments						

3. Please tick the boxes for what you believe how teachers (as subject matter experts, SMEs) and game experts should **ideally** collaborate to design and develop game-based learning (GBL) for use in formal education contexts and tick the boxes for what your experience **usually** is like.

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
a. The roles played by both SMEs and game experts in the collaboration have to be clearly defined.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
b. The responsibilities held by SMEs and game experts in the collaboration have to be clearly separated.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
c. They need to understand each other's job scope.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
d. Effective communication is the key factor in successful collaboration.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
e. They both need to understand the technical terms used in game production.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
f. They both need to understand the pedagogical concepts used in teaching.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
g. They both need to understand the concepts used in GBL, e.g. simulation, serious games, engagement, etc.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
h. They both need to understand the nature of game playing.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
i. They should have agreed objectives about the output of GBL collaboration.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
j. A coordinator who knows about both education and game production is required in the collaboration.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
k. An induction session for teambuilding is essential at the beginning of collaboration.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
l. Game experts should determine the production methods used in GBL collaboration.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
m. SMEs should determine the contents of GBL.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
n. SMEs have to convey 'what and how' teaching is supposed to be to the game experts.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
o. Game experts have to explain to SMEs how they inject their own creativity in GBL design and development.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
p. SMEs should be involved in the testing of games.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
q. Game experts should be involved in the teach-trials using GBL.	Ideally	☐	☐	☐	☐	☐
	Usually	☐	☐	☐	☐	☐
Any further comments						

IX. Challenges faced in GBL practice

Source	Challenges faced in GBL practices	Themes
SME_A	1. The fear of failure	Lack of confidence
	2. The most difficult challenge is: how to teach somebody using a new approach?	
	3. In the project SME_A organized, the approach had not worked with some teachers, particularly those seniors who felt reluctant to fail.	
SME_D	4. I think to use it in schools for me personally, I would need to feel very confident of the purpose of what it is achieving…there is a big lack of confidence at the moment, not only in some of the teachers—what's the games do, how to use them, but also whether they should be using games with children in the free time.	
SME_E	5. Probably I need to see the effects on learning, I need to see that happening.	
SME_K	6. After witnessing constant cycles of the promise—failure of the then new learning technologies, SME_K was quite sceptical with the promise of GBL. SME_K regarded GBL as a form of renew interest of using games for learning, which used to be called 'edutainment'. The failure of edutainment, as SME_K claimed relates to the use of instructional design approach in game design and development. To avoid repeating the same mistake, SME_K suggested that investigation should be carried out to find out exactly how learning takes place when people play games. Then based on the evidence, the learning could be amended to meet educational purposes without affecting the game playing.	
SME_A	1. Games used to be very anti-social as it took up time people would be out and playing football, or doing their homework.	Negative views on games
	2. Games are distraction, a way to get away from other matters.	
SME_B	3. There are games which have no learning at all.	
GX_K	4. To many people, games used in education mean educational games for children, although GX_K expected more than that.	
SME_G	1. There is a tendency in the current accountability culture of education, particularly in the UK region. It is a concern which people will want to know the exact educational benefits of GBL, the specific rationale of using games to enhance students' learning. This created a problem when the concern was interpreted as *'learning needs to be serious and students need to be serious; while having fun, enjoying themselves is distraction.'* SME_G had heard quotes like *'I don't care how much fun students are having, I just need to know how important the learning is.'* The implication of such view was that if students are having fun, then they are not learning. While indicating that that was what the accountability culture has resulted in, SME_G regarded that view as absolutely appalling.	Accountability culture of education
SME_B	1. Some of them are just keeping them busy…	Trivial usage
SME_C	2. They are 'games' because they are games that are used to try to convince students to do questions which they won't otherwise do, like rolling a dice and they are not really games at all.	
SME_H	3. To keep children busy or occupied	
GX_J	4. When GX_J had his secondary education in a technology college, learning through computer was limited to IT and computer technology related lessons, although the school had a lot of computers. The only GBL experience he remembered in secondary level was BBC Bite Size website, which was really just a revision guide which was not very fun. Indeed, he claimed that it was actually a lot easier just to read the	

	revision guides.	
SME_B	1. '*Oh, they are doing maths, therefore they are learning maths.'* That is a good thing it seems like, where it might not be. They are different.	Lack of good educational games
SME_C	2. At the moment, not very much.	
GX_J	3. However, GX_J believed that the negative GBL experience he had was due to the poor use and the lack of readily available educational games. Therefore GX_J suggested that GBL practices should be deployed after researching how it could fit into curricular objectives.	
SME_B	1. Some of them are being well thought through, in which students are learning while playing games; some of them are played for fun but students are actually having learning benefits; some of them are quite not so well thought through; other games like racing games, they have a learning aspect too, but that's not obvious, most people would completely oblivious to that.	Inconsistent quality
SME_C	2. The ICT ones tend to be a bit more exciting, but some of them aren't brilliant, some are better than others.	
SME_K	1. As for commercial game studios that produce entertainment games which were used in education by teachers, SME_K regarded that was serendipity because these games were meant for entertainment rather than education. In fact, SME_K could not think of any commercial game studios that purposely produce games for use in education. To SME_K, the benefits of GBL that involved non-bespoke educational games were claimed by teachers or GBL researchers rather than the commercial game experts who produced the games. He was being sarcastic about this phenomenon because the educational value of entertainment games is very questionable, particularly in the issue of implicit play and gameplay elements created for those games. SME_K challenged the effectiveness of games which were and are being used in schools, such as Brain Training, because some if not most of the presumptions underlying those games were indeed unknown—[a trade secret owned by game company exclusively.] However, as an e-learning expert, SME_K could conjecture commercial games like Civilization, Total War Rome, War Empire, or even Call of Duty: Modern Warfare have educational potentials, because of 'the amount of learning that contained in those games.' Based on this understanding, SME_K suggested: *'Maybe there isn't that very sharp distinction. There is in terms of who produced that game, but not in terms of games as either purely entertainment or purely learning. I suppose one thing you could say, the games that are purely learning tend to not entertaining; but the games that are entertaining are quite often educational.'*	Accountability of off-the-shelf commercial games
GX_C	2. As card games and computer off-the-shelf games were not designed for a learning outcome, they caused problems in GBL	
SME_F	1. Academics just assume that all students have great physical perspectives and perceptual skills, but the actual situation is worrying	Learners' readiness
SME_G	2. Based on nine years experience of teaching secondary science in schools, SME_G explained that there were always be students who could not possess the ability for learning through computers. To him, *'GBL presupposes some kinds of knowledge and skills on behalf of the students to be able to use computers and the games,'* which is the basis for learning enhancement. According to SME_G, for those students who are less confident in the use of computers, less interested in games, or less expertise in game playing, GBL is a big challenge. And there will always be a big differential among the students, which leads to the concern of some students who face challenges in learning through computers and	

	games. SME_G further advised that the students need to develop their game playing skills first, to the extent where they *'can engage in the game in a way they would have learnt what it is they suppose to be learning.'* However, this prompts another challenge to GBL practices because it means a delay of deployment.	
SME_A	1. Time is the key barrier to teachers.	Time constraint
SME_A	1. In terms of what would they have to come away in the exam, it's limited.	Disjointed with formal education system
	2. The game manufacturers have been [making] completely separate games from education.	
GX_A	3. GX_A had limited views about how games could be used in classrooms, as he described: 'If a teacher was to deliver something from the board, giving students some bullet points of something, teachers would play a game just as a motivator. So games in education are mainly used as motivator to get students to understand the point by delivering or thinking about the point in a different way.	
SME_B	1. SME_B did not accuse only educational game experts for causing the situation, but she thought that was a problem caused by the lack of support for educational game studios that produce good quality learning games.	Lack of support
	2. There is not enough financial support for schools to make good educational games accessible for teachers who need it. The price of those games is more expensive, that's why the schools are reluctant to buy it because they can't afford it, though they knew they need the games.	
SME_G	1. Restriction to approved teaching methods: When teachers adopt an approved and supported teaching method, then they have a clear structure which they have to follow. Bringing games into classrooms means stepping outside the structure to do something different from the norm, and this requires the particular teacher to be 'an extremely brave person, one who would be very confident in teaching ability'. Regardless of the success or failure of the GBL practice, there will be people who come along and criticize the teacher either for it did not working or for not using the adopted, approved method. Consequently, the fun and creativity of GBL practices will be squeezed.	Restriction to approved teaching methods
GX_J	2. As for GBL practices in formal educational contexts, GX_J expressed his worry as 'what teachers want to teach at the moment is what is in the curriculum,' which is meant to enable children to pass exams.	
SME_D	1. There's a lot of stuff at the moment about Facebook, and teachers maybe two years ago might have linked up with children, but they won't do that now…I am wondering if some of that might actually impact on the use of games because I think you'll find that teachers, say they got a homework and it's on the VLE, and it's some sort of Avatars, sort of simulations with the children.	Online security for minors
GX_H	1. When GX_H was a pupil, the games he played in school focused on educational objectives, which he regarded as serving its purposes. However, he thought that was due to the fact that computer games were not as readily available as they are now. Also, it was more unusual to own a computer and be able to play games at home, whereas now all children are used to playing all kinds of games. Therefore, if nowadays children would sit down and play one of the educational games that GX_H used to play as a child, then they would say at the first scene, *'this*	Stagnation of educational games

	is really rubbish game. It's nothing like anything I play at home.' GX_H would not describe the educational games he played as a child as being fun, except for the fact that it was fun at the time to be allowed to use a computer. So when he got to play the educational game, *'being allowed on the computer was as fun as the game itself.'* Whereas now because the act of being allowed on computers is not exciting anymore, educational games need to be more fun to make up for that and keep people interested.	
GX_J	1. Imposing exact learning objectives into games is very difficult because this becomes an extra constraint on games and it ignores the fact that games in themselves are learning experiences. These experiences, according to GX_J allow players to learn transferrable abstract skills like pattern recognition through hand-eye coordination.	Teachers' lack of understanding about games

X. Factors of positive GBL practice

Sources	Positive GBL experiences	Themes
SME_G	1. There are two elements being used in education: one of them is specifically as a learning activity in classrooms, and in that regard, I've only ever seen games specifically designed for school being used; and the other use of games in education is in giving students a space where they can do some other things at home in school. So they feel belong more in school. SME_G provided an example where his students were timed and competing with each other in matching organs into the body. In his experience with bespoke educational games, there were a lot of different GBL mechanisms and certain selection criteria would appear, including interactivity type, elements of competition, etc.	Flexibility in practice
SME_I	2. The way SME_I used games is to create an environment that replicates a real-life situation, where learners *'can develop their own understanding or their own critical appraisal of the situation'* through experience of interacting with elements in the game world. According to SME_I, this has to be some sort of means of, not just letting them do something but also letting them reflect back to it, hence reflective learning.	
SME_K	3. It involves a lot of very good pedagogical principles, and it does this naturally. For example in traditional learning there often an obvious distinction between the learning process and the assessment process, but this is not the case in games as players are constantly being assessed, i.e. it is 100% constant continuous formative assessment. If you are not any good, you will get killed or somebody will tell you, depending on the kind of games that you are playing, and that's a great principle.	
	4. Game designers commonly used fading principle which based on behaviourism where players get the maximum amount of support initially and gradually the amount of support will be faded out	
	5. Games also offer players dynamic difficulty in which the challenge is uniquely matched to individual player's capacity to deliver on the challenge. This feature, which has theoretical foundation in Csikszentmihalyi's concept of flow, was seen as very interesting educationally by SME_K.	
GX_B	6. GX_B provided two incidences of GBL practices: using games for training simulations and as a stimulus for further discussion.	
GX_D	7. Games can be used in any area of education. If they were done, probably, they can be used to teach any subject or area. However, certain areas are naturally appropriate for games, e.g. area related to working together with other people. GX_D had developed several games with GX_E which were meant for solving problems in team building, in which the games became a medium that equalized members of a particular team. One phenomena GX_D found was that although there will always be someone who do not play as much as or as well as others in a team, this was not a barrier because people who were better at games would naturally help others, and this did not stop any team member from contributing ideas or efforts in problem-solving.	
GX_E	8. All age groups can take value from GBL. However, it can specifically help learners to integrate life back into education.	
GX_K	9. GX_K provided two examples of games used in education: Imperialism was used to teach business management; Civilization was used to learn about history.	

SME_C	1. The kids tend to respond quite well to that, because there's a lot of graphics.	Application of media-rich resources
GX_C	2. Educational games use a lot of multimedia, web-based resources (GX_C).	
GX_I	3. Pictures are easier to remember than text, in which she can clearly remember the archaeologist game used in her schools from over 10 years and ones from much longer before that but she did not remember much of what was said in the lessons from that long ago unless they were very special in some ways.	
SME_A	1. By referring to a completed ICT project which SME_A led, he depicted how ICT was adapted into lessons: *'…all of sudden every student got a computer. Well, they are there, no more exercise book…How you are going to teach them now? …one of the things that came out was that, don't be afraid to fail, just try it. That's what I have been doing. I have done it and this is my second year. Last year we didn't use even one exercise book, only used one textbook, but how you create the lesson and that is interesting because it makes you think.'* But to those who succeeded, they did not mind failure in trying new teaching approach, because even if it failed, they learned something positive from it.	Positive attitude to new teaching methods
	2. One strategy to learn from failure is to employ students as the sounding board, herewith the experience of C01: *'I am very clear to the students, say 'let's try it!' If they (the new approaches) didn't work, they'll say, 'ok, it's fine.' And they are very happy to give you feedback. They are always very honest: Do you like doing that? Yes? No? What do you like? What didn't you like?'* [Treating students as sounding board]	
SME_D	3. There is huge potential now for access the technology that just simply wasn't before. [Perceived promising potentials]	
GX_J	4. The negative image of video games portrayed by mass media was neutralized and people are more willing to attempt GBL.	
SME_D	1. There are potentials for interaction and ownership, where children own avatars in games, which had moved on beyond the simulation. The ownership of avatar that link between home and school, where the virtual learning environment (VLE) would become better, moving beyond simulations. [Learners' sense of ownership]	Trendy learning strategies
SME_J	2. Digital natives expect seeing computer games used in the classrooms because that is part of their life and SME_J believed that education should be congruent with life. [Readied learners]	
GX_I	3. According to GX_I, the greatest potentials of GBL is to add a memorable tag to a topic. Learning in a classroom is very repetitive and it is always easier to learn when one attaches feelings or images etc. to specific topics as tags.	
SME_A	1. Starting with DS Lite, SME_A saw more and more GBL activities.	Maturation of GBL systems
SME_D	2. Nonetheless, there is still a place for simulations and the sort of questioning games, because VLEs are becoming more established, better quality games are becoming more widely distributed.	
	3. …another generation of teachers who join the teaching profession and use it. [Recruitment of new generation teachers]	
GX_J	4. GX_J had a positive vision of GBL in the future, because the accessibility to computer is no longer an issue among children and people are more used to game playing.	

XI. Problems faced in GBL collaboration

Sources	Positive GBL experiences	Themes
SME_B	1. Game designers attempted to be the pedagogic experts by rationalising how learning happens; while SMEs tried to take over the roles of game designers and justify how games work through common-sensical thinking. This had resulted games whose potential were not thoroughly exploited.	Unclear roles and responsibilities
GX_D	2. *'It's always difficult defining that kind of roles and boundaries, and certainly when you got a game designer, instructional designer (ID), SMEs, it's very very difficult… obviously the SMEs and ID haven't necessarily got the technical expertise required to sort of engage at that point in the process. So all they can do there is providing feedback based on the games being developed.'*	
SME_J	1. It is normally the publishers who define the games. At the moment, it is the publishers who are responding to government policies and the curricula. So when the policies remain unchanged, the publishers will not do anything which is not in the curriculum.	Dependence on publishers
GX_C	2. Game publishers do not take the needs of schools and teachers into consideration in funding game production; while teachers do not take the initiative to inform the publishers what is required in teaching.	
GX_J	1. During game programming, a programmer can become very isolated particularly when specific learning objective might be ignored.	Need of cross-disciplinary checking
GX_C	1. It is very difficult for game experts to keep away from using technical terms which teachers do not understand.	Language barrier
SME_F	1. While both game experts and students are very much closed in, wanting to produce great ideas, teachers might have a sort of critical, wise stance in the collaboration.	Teachers' scepticism
GX_C	1. The government got involved into game production when they should not be.	Unnecessary governmental involvement
SME_A	1. Plenty of attempts at GBL had fallen flat on their face because very quickly students had gone bored. Teachers used non-challenging games, e.g. 'fill in the missing gap' games or games with easy goals.	Lack of understanding about games
GX_H	2. There are always going to be instances where a teacher wants to teach something, and thinks games probably help here, but going out and producing a software package or a full game that does not necessarily make sense.	
SME_I	1. It is difficult for game experts to grasp the requirements of teaching…It is highly unlikely to find game experts who have good teaching experience and can combine the abilities of teaching and game development in helping the whole group collaborate.	Lack of understanding about education
GX_C	2. Generally, game experts do not understand learning theories.	
SME_E	1. Secondary teachers are overly bound in their subject matter which hinders the generic, transferability and cross-curricular nature of learning.	Subject matter boundary
SME_D	1. Teachers have limited research-based evidence and understanding in common misconceptions made by learners. Yet, they participated in the collaboration, so they might not be able to justify or even identify the best content for GBL. Moreover, the curriculum is changing quite drastically and assessment is changing hugely at the moment.	Limited expertise

SME_K	1. SMEs typically do not understand how to make compelling games; game experts often do not understand the nature of the subject or how learning is achieved to create the game that put learning across…There is not any tool that can be used to share a vision on how SMEs and game experts should work.	Absence of collaboration mechanism
SME_E	1. Working with teachers in schools is challenging in itself because it is often extremely difficult for teachers to find additional time to be involved in research or development.	Time constraints
SME_F	2. The programming team were hidden away in the office, never really getting enough time with the end users.	
SME_B	1. The quality of games dispersed because the experts placed their personal priorities on top of professional judgments in decision making.	Discrepancy of expected quality
SME_C	2. Discrepancy of quality expectation occurring across two different professions. *'One example we had with those matching activities involving graphs, where pupils have to connect the equations to the graphs. We'd drawn all the graphs and sent them off. But the game designer didn't know what were the important features, so they hadn't drawn the line precisely, just roughly, instead of going to the points they need to go to. They look similar but to mathematicians, they weren't the same.'*	

XII. The rubric of knowledge for being the ideal SMEs and game experts involved in GBL practices or collaboration (Adapted from Hays, 2006, p. 197–200)

1. Knowledge of pedagogy, GBL and game production
   - 1.1 Knowledge of terminology
     - 1.1.1 To identify technical terms used in pedagogy
     - 1.1.2 To identify technical terms used in GBL
     - 1.1.3 To identify technical terms used in game production
     - 1.1.4 To define technical terms used in pedagogy by giving their attribute, properties or relations.
     - 1.1.5 To define technical terms used in GBL by giving their attribute, properties or relations.
     - 1.1.6 To define technical terms used in game production by giving their attribute, properties or relations.
   - 1.2 Knowledge of specific facts
     - 1.2.1 To list major facts about pedagogy
     - 1.2.2 To list major facts about GBL
     - 1.2.3 To list major facts about game production
     - -
2. Knowledge of ways and means of dealing with teaching, GBL practice and GBL collaboration
   - 2.1 Knowledge of conventions
     - 2.1.1 Familiar with the styles, forms, convention and practices of teaching and learning
     - 2.1.2 Familiar with the styles, forms, convention and practices of GBL
     - 2.1.3 Familiar with the styles, forms, convention and practices of game production
   - 2.2 Knowledge of trends and sequences
     - 2.2.1 Familiar with the trends underlying the GBL practice
     - 2.2.2 Familiar with the trends underlying the GBL collaboration
   - 2.3 Knowledge of classifications and categories
     - 2.3.1 Familiar with the taxonomy of learning
     - 2.3.2 Familiar with the genre of games
     - 2.3.3 Familiar with the type of GBL
   - 2.4 Knowledge of criteria
     - 2.4.1 Familiar with the assessment schemas in education
     - 2.4.2 Familiar with the rubrics of evaluation in education
     - 2.4.3 Familiar with the criteria for playtesting in game production
     - 2.4.4 Familiar with the criteria for quality assurance in game production
   - 2.5 Knowledge of methodology
     - 2.5.1 Familiar with the methods used in teaching and learning
     - 2.5.2 Familiar with the methods used in GBL practices
     - 2.5.3 Familiar with the methods used in GBL collaboration
3. Knowledge of the universals and abstractions in pedagogy, GBL practice and game production
   - 3.1 Knowledge of principles and generalizations
     - 3.1.1 Familiar with the important principles in teaching
     - 3.1.2 Familiar with the important principles in GBL practice
     - 3.1.3 Familiar with the important principles in game production
   - 3.2 Knowledge of theories and structures
     - 3.2.1 Familiar with the major theories about teaching and learning
     - 3.2.2 Familiar with the major theories about GBL practice
     - 3.2.3 Familiar with the major theories about game design and development

XIII. The rubric of intellectual abilities and skills for being the ideal SMEs and game experts involved in GBL practices or collaboration (Adapted from Hays, 2006, p. 200–204)

1. Comprehension

    1.1 Translation

        1.1.1 To translate technical terms or jargon used in education to non-technical language

        1.1.2 To translate technical terms or jargon used in game production to non-technical language

    1.2 Interpretation

        1.2.1 To interpret the pedagogical concepts or elements used in GBL practices

        1.2.2 To interpret the game playing concepts or elements associated with GBL practices

        1.2.3 To interpret the concepts or elements of games in game production

    1.3 Extrapolation

        1.3.1 To infer the learning outcomes by referring to the associated the learning objectives

        1.3.2 To predict the playability of games based on the proposed game ideas.

        1.3.3 To infer the effectiveness of learning attainment with reference to the GBL plan

        1.3.4 To predict the effectiveness of GBL practices based on the model of GBL collaboration

2. Application

    2.1 To apply educational theories to GBL with a particular teaching approach

    2.2 To apply production methods for commercial games to educational games

    2.3 To apply collaborative practices in the game industry to GBL collaboration between SMEs and game experts

3. Analysis

    3.1 Analysis of elements

        3.1.1 To recognise implicit and explicit educational elements in a particular educational approach

        3.1.2 To recognise implicit and explicit game elements in a type or genre of game

        3.1.3 To differentiate effective and ineffective teaching or learning

        3.1.4 To differentiate fun and boring games or game ideas

    3.2 Analysis of relationships

3.2.1 To check the consistency of learning objectives with given game prototypes

3.2.2 To check the consistency of engagability with given game prototypes

3.2.3 To recognise the linkage between learning and game playing

3.3 Analysis of organisational principles

3.3.1 To recognise patterns or general techniques used in teaching

3.3.2 To recognise patterns or general techniques used in GBL practice

3.3.3 To recognise patterns or general techniques used in game production

3.3.4 To recognise patterns or general techniques used in GBL collaboration

4. Synthesis

4.1 Production of a unique communication

4.1.1 To describe pedagogical ideas for GBL clearly and logically

4.1.2 To describe game ideas for GBL clearly and logically

4.1.3 To communicate with experts in other fields without using technical terms or language in GBL practice or GBL collaboration

4.2 Production of a plan or proposal set of operations

4.2.1 To propose plans for GBL practices

4.2.2 To propose plans for GBL collaboration between SMEs and game experts

4.3 Derivation of a set of abstract relations

4.3.1 To formulate principles or guidelines for effective GBL practices

4.3.2 To formulate principles or guidelines for effective GBL collaboration

4.3.3 To make generalisations based on GBL studies

5. Evaluation

5.1 Judgments in terms of internal evidence

5.1.1 To assess the quality of GBL practices based on internal standards

5.1.2 To assess the success or failure of GBL collaboration using internal standards

5.1.3 To assess the accuracy of statements, documentation or proof provided by experts from other fields in GBL practices or collaboration, based on internal standards

5.1.4 To indicate logical fallacies in arguments made by experts from other fields in GBL practices or collaboration

5.2 Judgments in terms of external evidence

5.2.1 To compare GBL practices with other recognised educational approaches using the highest known standards in the education system

5.2.2 To compare GBL practices with successful learn-based gaming ventures using the highest known standards in the game industry

5.2.3 To compare major facts, methods and models of GBL practices between SMEs and game experts

5.2.4 To compare major facts, methods and models of GBL collaboration between SMEs and game experts

XIV. The rubric of attitudes for being the ideal SMEs and game experts involved in GBL practices or collaboration (Adapted from Hays, 2006, p. 208–215)

1. Receiving (Attending)
    - 1.1 Awareness
        - 1.1.1 Develop awareness of teaching approaches related to GBL
        - 1.1.2 Develop awareness of educational games and GBL practices
        - 1.1.3 Develop awareness of GBL collaboration
    - 1.2 Willingness to receive
        - 1.2.1 Attend carefully when experts from other fields initiate conversation or discussion
        - 1.2.2 Appreciate with tolerance the cultural patterns exhibited by experts from other fields.
    - 1.3 Controlled or selected attention
        - 1.3.1 Attend selectively when experts from other fields initiate conversation or discussion
        - 1.3.2 Alert to the game ideas proposed by experts from other fields.
2. Responding
    - 2.1 Compliance in responding
        - 2.1.1 Comply with educational conventions.
        - 2.1.2 Comply with the game industry interests.
    - 2.2 Willingness to respond
        - 2.2.1 Accept roles and responsibilities in GBL collaboration
        - 2.2.2 Volunteer a GBL practice
        - 2.2.3 Volunteer for participating in GBL collaboration
    - 2.3 Satisfaction in response
        - 2.3.1 Enjoy GBL practices
        - 2.3.2 Enjoy participation in GBL collaboration
3. Valuing
    - 3.1 Acceptance of a value
        - 3.1.1 Develop the sense of kinship to GBL practices
        - 3.1.2 Develop continuing desire to participate in GBL collaboration

3.2 Preference for a value

3.2.1 Actively participate in GBL practices

3.2.2 Deliberately examine a variety of viewpoints on GBL practices with a view to forming opinion about them

3.2.3 Assume responsibility for motivating passive members in GBL collaboration

3.2.4 Deliberately examine a variety of viewpoints on GBL collaboration with a view to forming opinions about them

3.3 Commitment

3.3.1 Devote resources to GBL practices

3.3.2 Devote resources to GBL collaboration

3.3.3 Hold faith in the potentials and benefits of GBL

3.3.4 Hold faith in the importance of GBL collaboration

4. Organising

4.1 Conceptualisation of a value

4.1.1 Attempt to identify the characteristics of excellent GBL teachers

4.1.2 Attempt to identify the characteristics of engaging educational games

4.1.3 Attempt to identify the factors of effectiveness in GBL practices

4.1.4 Attempt to identify the success factors of GBL collaboration

4.1.5 Form judgments as to the responsibility of academia, the game industry and other related entities for making engaging educational games.

4.1.6 Form judgments as to the responsibility of academia, the game industry and other related entities for promoting GBL practices.

4.1.7 Form judgments as to the responsibility of academia, the game industry and other related entities for encouraging GBL collaboration.

4.2 Organisation of a value system

4.2.1 Develop a plan for pragmatic GBL practices in accordance with the curricular programme

4.2.2 Develop a plan for realistic GBL collaboration in accordance with the need of SMEs and game experts

5. Characterising by a value or value complex

5.1 Generalised set

5.1.1 Ready to revise judgments on educational games in the light of research evidence

5.1.2 Ready to change GBL practices in the light of research evidence

5.1.3 Ready to change methods of GBL collaboration in the light of research evidence

5.1.4 Judge GBL issues in terms of situations, problems, purposes, and consequences involved rather than in terms of fixed, dogmatic precepts or emotionally wishful thinking

5.2 Characterisation

5.2.1 Develop a code of behaviour and attitude for effective GBL practices based on research findings consistent with pedagogic ideals

5.2.2 Develop a code of behaviour and attitude for effective GBL collaboration based on research findings consistent with recognised mutual benefits

XV. Internalisation and externalisation in the research journey

A. Periodic and interim research reports

The progress of this doctoral research was reported every six months to Warwick Institute of Education (the administrator) and Sultan Idris University of Education (the sponsor); and every year to Warwick Graduate School (the administrator) and Malaysian Ministry of Higher Education (the sponsor). Apart from these periodic progress reports, interim reports were also written upon the completion of every sub-study.

In January 2009, the Upgrade Panel of Warwick Institute of Education granted the permission to transfer this research from 'working towards an MPhil' to 'working towards a PhD'. An Upgrade paper depicting the initial research design and conceptual framework was produced and submitted for assessment. However, a series of revisions have been made to the research design subsequently due to the constraints of real time, availability of participants and other logistic considerations. All the changes were documented and attached as appendices to the above mentioned periodic reports.

Writing and re-writing about the research played an important role in determining the scope and direction of the doctoral journey, because the writing process involved constant internalisation and formal externalisation, which gradually formed the structure of this thesis.

B. Non-formal writings in ePortfolio

Apart from compulsory report writing, non-formal writing also influenced this research, especially in the incubation and development of ideas and strategies. An ePortfolio (http://go.warwick.ac.uk/ep-edrhal/) was developed and dedicated to the conduct of this research. The major contents of the ePortfolio include the evolution of research design, the attainment of research milestones, preliminary literature reviews, interim reports and publications. Three core writing strategies were used to create these contents: mind mapping, self-interview and soliloquy. Mind mapping was used together with the Six Thinking Hats in a brainstorming session, which was a form of structured reflection for predetermined issues of concern. The second strategy, self-interview, was always used alongside with 5W1H (What, Who, When, Where, Why & How), which was adapted to identify, justify and evaluate the instruments designed for data collection and data analysis. Sometimes, soliloquy was preferred as opposed to writing because spoken words were found more intuitive than written words. The flow of thought could also be maintained, especially when certain ideas or concepts were alien to the English language, in which other languages could be used to replace English tentatively to avoid disturbance of flow. When soliloquy was conducted, the voice would be recorded and then transcribed and translated into English if necessary.

XVI. Learning from researchers in both academia and the game industry

- Became a member of the international editorial review board of the International Journal of Game-based Learning.
- Became a member of Naace, IGDA and DiGRA.
- Observed and discussed GBL issues raised in fora and newsletters, such as Microsoft Innovative Teachers Forum, LinkedIn Game Developers group, IGDA Special Interest Group, Games Research Network, etc).
- Visited research groups, centres and institutions in the UK, including Computers and Learning Research Group (CALRG) in the Open University, Serious Games Institute in Coventry University, London Knowledge Lab, Centre for Excellence in Computer Games Education in University of Abertay Dundee.
- Subscribed to newsletters, periodicals and reports published by GBL related organisations (Engage Learning, Futurelab, Learning and Skills Council).
- Participated in conferences, symposia, seminars, webinars and workshops which are relevant to GBL, including ECGBL in Graz (2009) and Copenhagen (2010), National Workshop of Immersive World in Coventry (2009), GBL Conference in London (2010), GBL Symposium in Milton Keynes (2010), and Interactive Technologies and Games (ITAG) Conference in Nottingham (2010).
- Took part in peers' doctoral studies and academic research projects (e.g. 14–19 Deep Learning Project funded by Becta in 2009).
- Involved in educational game design competition organised by Warwick Game Design Society.
- Involved in a game production (FPS Trainer) which involved collaboration among game experts, SMEs and instructional design.