UNIVERSITY OF SKÖVDE

DOCTORAL DISSERTATION

UNPACKING DIGITAL GAME-BASED LEARNING

The complexities of developing and using educational games

BJÖRN BERG MARKLUND
Informatics

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ABSTRACT

Digital game-based learning has traditionally been examined from an 'artefact-centric' perspective that focuses on understanding how game design and principles of learning are, or can be, intertwined. These types of examinations have resulted in many descriptions of games' educational potential, which has subsequently led to many types of arguments for why games should be used more extensively in formal education. However, comparatively little research has been done to understand the educational settings in which many game-based learning processes and educational games are intended to be applied. The relative lack of research on formal education settings has resulted in a scenario where the educational potential of games is well detailed through theory and understood independently of their actual contexts of use, while successful examples of games "making good" on their promises as educational tools remain rare.

This thesis explores and describes the various challenges that the realities of formal education present to developers and educators who attempt to work with educational games. In order to examine the multi-faceted nature of educational games, the research has used a qualitative mixed-method approach that entails extensive literature reviews coupled with several case studies that involve educators, students, and developers. Interviews were conducted in order to investigate these actors' various attitudes towards, and experiences of, educational games and game-based learning. In addition, more in-depth researcher participation methods were employed during case studies to examine the processes involved in developing, integrating, and using educational games in formal settings. The research revealed obstacles which indicate that processes associated with "traditional" game development are incommensurable with educational game development. Furthermore, the research demonstrates that the use of games in formal education introduces heavy demands on the recipient organisations' infrastructures, cultures, and working processes. So, while games created for "formal" and "informal" use are superficially similar, the different contexts in which they are used make them distinctly different from one another.

The conclusion of this research is that educational games manifest a unique mixture of utility, gameplay, and context-dependent meaning-making activities. Educational games cannot be understood if they are only seen as a teaching utility or only as a game experience. To make educational games viable, both educators and developers need to alter their working processes, their own perceptions of games and teaching, as well as the way they collaborate and communicate with each other and other actors within the educational game 'system'. The thesis thus argues that a more systems-oriented understanding of educational games, where the game artefact is not treated separately from the context of use, is necessary for both research and practice in the field to progress. To contribute to such an understanding of educational games, a comprehensive model (dubbed the *Utility, Gameplay, and Meaning Model*) of the 'educational game system' is presented, as well as a series of recommendations and considerations to help developers and educators navigate the complex processes involved in creating and using educational games.

SAMMANFATTNING

I denna avhandling presenteras en djupgående undersökning av digitala lärospel och hur de utvecklas för, och används inom, skolutbildning. Lärospelsforskning har traditionellt sett främst fokuserat på att undersöka spels utbildningspotential ur ett produktcentrerat perspektiv där spel och spelare sätts i centrum. Detta perspektiv har bidragit till en högre förståelse av sambandet mellan olika typer av spelmekanik och pedagogiska principer, samt vad spelare lär sig av sina interaktioner med spelinnehåll. Allteftersom denna typ av forskning påvisat olika typer av positiva sammanhang mellan spelande och lärande har således även argumenten och trycket för att använda spel i skolan ökat. Men trots att vår förståelse för vad som händer i förhållandet mellan spel och spelare stärkts, så är förståelsen av de krav och förutsättningar som spel ställer som utbildningsverktyg fortfarande väldigt begränsad; prioriteringen av att förstå spelens inneboende potential har lett till ett synsätt som inte tar utbildningsmiljöers realiteter i beaktande. Resultatet av detta är att det i dagsläget finns en stor mängd argument för varför digitala spel har stor potential för lärande och därmed bör användas mer i skolutbildning. Men det finns få studier som påvisar hur denna potential faktiskt kan uppnås, eller om den ens uttrycker sig som förväntat när spel används i verkliga utbildningssammanhang.

Med denna kunskapsbrist i åtanke undersöker och beskriver denna avhandling hur formella utbildningssammanhang och digitala spel förhåller sig till varandra både konceptuellt och praktiskt. Genom fältstudier som inkluderat både utvecklare, utbildare och elever har utmaningar som uppstår i det unika mötet mellan utbildning och spelande identifierats. Observationer från fältstudier stöds även av intervjuer där lärare och utvecklares arbetsprocesser och synpunkter kring utbildning och lärospel undersökts. De huvudsakliga utmaningarna som uppdagats i dessa studier är att den ”traditionella” synen på spelutveckling, spelande och spelare är svårförenlig med skolutbildnings realiteter, pedagogiska principer och skolan som marknad för spelkonsumtion. Kort sagt så delar spel skapade för informellt och formellt spelande (till exempel för hemmabruk respektive klassrumsanvändning) många ytliga likheter, men användningskontexterna introducerar så pass olika krav och förutsättningar att informella och formella spel och spelsituationer inte är jämförbara.

I avhandlingen konstateras slutligen att lärospel utgör en unik blandning av användbarhet, spelupplevelser och kontextberoende aktiviteter för meningsskapande. Lärospel kan inte förstås till fullo om de endast ses som läroverktyg, eller endast som spelupplevelser. För att lärospel ska mogna och bli användbara och effektiva inom skolutbildning i större utsträckning behöver både utvecklare och utbildare förändra arbetsprocesser i sina organisationer, och metoderna genom vilka de skapar och använder spel som läromedel. Lärospel kan inte förstås som ett förhållande mellan spel och spelare då de i själva verket utgör ett stort system av aktörer, processer och användningskontexter, som var och en påverkas av individuella och lokala krav och förutsättningar. Med detta i åtanke yrkar denna avhandling för en mer systemorienterad förståelse av lärospel där spelobjektet inte separeras från kontexter och arbetsprocesser. Avhandlingen bidrar till detta systemperspektiv genom att presentera modeller som beskriver systemet som lärospel utgör, samt en serie rekommendationer som kan hjälpa utbildare och utvecklare att navigera de komplicerade processerna involverade i användandet och utvecklingen av lärospel.

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I was around seven years old when my older brother and I got our first gaming system, a Super Nintendo, from our grandparents. Now, twenty years later, I am putting the finishing touches on a thesis about games' place in education. When I take stock of those twenty years, it feels as though there was really no other way this could have played out. Both of my parents were teachers when I was growing up, and my brothers and I spent our allowances on games in all conceivable forms. In essence, I grew up surrounded by both games and education, and I just so happened to fall into a line of work where I get to continue enjoying both.

I would like to start this thesis with a gargantuan 'Thank you!' to my supervisors Henrik Engström, Per Backlund, and Anna-Sofia Alklind Taylor. Thank you so much for, again and again, going above and beyond the supervisor's call of duty. I consider myself incredibly fortunate to have been able to work with such an understanding, insightful, patient, enthusiastic, and encouraging team of supervisors. I can assertively say that I would not have made it this far without your unwavering support.

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CONTENTS

PART I

THESIS INTRODUCTION AND SUBJECT MATTER FRAMING

This inaugural part of the thesis is structured to give an introductory overview of the problem area and research question tackled in this thesis, as well as the contours of the overarching strategy that shaped the various studies conducted throughout the research process.

Chapter 1 is intended to contextualise my research question in the broader field of research on educational games and game-based learning, and subsequently provides a summary of the objectives pursued, and methods used, to ultimately answer it. In chapter 2, some key terms are defined and a delimitation of the conducted research's scope is specified. Finally, chapter 3 describes the overall research strategy that has informed my work throughout this thesis project.

CHAPTER 1
INTRODUCTION

I stand in the back of the classroom, trying to make myself as inconspicuous as possible. We are several weeks into our game-based history curriculum and, since I cannot stay with this class forever, the teacher wants more practice in navigating gaming activities with her students without too many interventions on my part. "Hey teacher, this computer is lagging!" an exasperated student shouts from the centre of the classroom as she gestures at a big hole in the stable wall that she is struggling to repair. Simultaneously, another pair of students are talking about the high prices of horses in the Medieval Age and try to settle on how many a monastery could realistically afford to purchase. Yet another group gesticulate intensely at their laptop screen as they ponder how to make the front gates of the monastery that the class has built look as realistic as possible. Some other student pairs play quietly, and their silence is only occasionally broken by quiet laughter, or some whispered discussions. If, at this precise moment, a snapshot was taken of the classroom and of what the students have managed to create in their game world, one would have a decent poster that both advertises the educational value of computer games and vies for the importance of furthering the acquisition of more modern technology in educational environments. In this snapshot, eager students are transfixed on their collaborative historical recreation; they are discussing details of the subject matter in order to make sure they represent a medieval monastery as truthfully as possible. The only noticeable frustration in a few of the students is rooted in the technology not performing as well as they would like, thus limiting their engagement within the educational virtual world.

What this snapshot does not capture, however, is the months of preparation and the continuous efforts needed to make all of it happen. It does not capture the process of establishing a technological infrastructure in which these types of gaming sessions can be planned and executed reliably. Nor does it capture the initial scrounging for laptops from different classrooms, the recurring task of tracking down their chargers and computer mice, or the task of setting up multiplayer servers for every gaming session. It does not capture the time spent acquiring game licenses, and installing them on all the computers. It does not capture all the prior weeks, during which the subject matter context was established with the use of textbooks, films, drawings, and collaborative classroom exercises. It does not capture the additional preceding months when I talked to the teachers about how the game and the technology could be used, and the many meetings we had to discuss and design the structure of the game-based curriculum. It does not cover the first unruly weeks of actual gameplay, when half of the class would proficiently build advanced structures within the first hour of playing and simultaneously talk about the game servers they run from home and their favourite YouTube gaming celebrities, while the other half of the class needed tutoring in how to start their game and steer their avatar. It does not capture the daily exercise process in which: the correct laptops had to be gathered and the game software loaded up on each of them; the server with the students' saved game worlds was started up and its address was identified; the students connected to the server and the ensuing troubleshooting was conducted; and the progress made during the exercise needed to be saved and backed up for subsequent play sessions. It does not capture the journey the teachers had to make to become confident enough with this process to finally start setting everything up without my help. And, even if the aperture was kept open to capture the entirety of these processes, it would still miss a larger and equally crucial part before it – the creation of the product we have had to work so hard to make use of.

The first single snapshot of the gaming activity is the "face" of game-based learning. It is the side of educational games and game-based learning that most people see, and the one that research has historically been wont to document. The immediately visible features on the surface of game-based learning are games' unique capacity to model the structures of complex systems, distil them down to their essence and present them to the player for him or her to experience and manipulate first-hand in an engaging way (Annetta, 2008; Annetta, Cook & Schultz, 2007; Blumberg & Ismailer, 2009; Gee, 2005, 2009). It is their capacity to invite the player to form an understanding of intricate subject matters based on participation and experimentation rather than mere observation (Guillén-Nieto & Aleson-Carbonell, 2012; Ko, 2002; Squire, 2011). And on these merits, games are frequently argued to have great potential as learning environments and as educational tools (Arnseth, 2006; Kirriemuir & McFarlane, 2003, 2004; Lieberman, 2006).

In a game, the player is invited to take on the mantle of a medieval ruler, a business tycoon, a soldier in the midst of a conflict or any other actor that can be imagined. If it is a well-crafted game, the player typically spends hours upon hours engrossed in it, with the sole purpose of mastering whatever challenges it contains. The game itself is designed to become progressively more challenging to keep the player interested, and introduces new concepts, items or manoeuvres that the player eagerly experiments with in order to be able to confidently wield them and to continue traversing the game. If the game is set in medieval times of war, the player might gain control over different types of armies throughout the game and will experiment with what type of units and tactics suits certain strategic situations: when is the longbow superior to the crossbow; when is the best time to let loose the cavaliers; when is it time to retreat or huddle up behind a wall of shields and lances? If it is a multiplayer game, the players can interact with each other and discuss strategies to better utilise each other's capabilities and resources. These types of situations, where the player is fully engaged and immersed in the game world, are what educators aspire to achieve with their educational processes (Annetta, 2008; Habgood & Ainsworth, 2011). There is an intense sense of intrinsic motivation to learn and master new concepts (Franzwa, Tang & Johnson, 2013; Habgood & Ainsworth, 2011), a way to construct an understanding of complex events and processes through experimentation (Malone, 1980b; Squire et al., 2004), as well as discussions and collaborative problem solving with others that help the player vocalise and reflect on what they know (Bennerstedt & Linderoth, 2009; Nilsson, 2008). Given these properties, the value that games can potentially bring to an educational setting is argued to be immense (Lieberman, 2006; Squire, 2002). There is an increasing interest to include more game-based learning in school curricula, based on the argument that students are starved for an educational format that makes use of their affinity for new technologies (Gee & Hayes, 2012; Linehan et al., 2011; Srinivasan, Butler-Purry & Pedersen, 2008).

While this first snapshot is the "face" of game-based learning, the parts that the snapshot misses - the pieces that come together to make up the processes of creating them and putting them to use - are the rest of its "body". And, as opposed to the inviting features of the face, the body of game-based learning is still awkward and intractable. The body consists of contradictions, of resource intensive development, acquisition, and organisational restructuring, and of laborious setup, execution, maintenance, and assessment procedures. Educational games are an unwieldy chimera, a cat's head attached to a hippopotamus's body; the features that are immediately visible on the surface are inviting, optimistic, and sleek – but whenever one attempts to approach and play with them, unexpected problems start emerging rather quickly. Not only are there inherent issues with the assumption that increased skill or knowledge regarding the contents of a game has any bearing on the world outside of the game, even when the game content is closely tied to a specific subject matter (Arnseth, 2006; Frank, 2012; Linderoth, 2009, 2012; Rick & Weber, 2009; Shaffer, 2012). There is also the simple, often glossed over, fact that many complex components need to be in place, before even the most rudimentary play session can be made possible in a school environment, and to even get to the point where the conceptual issues of educational games and their effects become pressing. Hardware availability (Morgado, 2013; Ross, Morrison & Lowther, 2010), the teacher's grasp of the game (Bourgonjon & Hanghøj, 2011; Chee, Mehrotra & Ong, 2014), the students' gaming abilities (Arnseth, 2006; Macklin & Sharp, 2012), and the strict schedule limiting the length of the play sessions are but a few of the practical considerations you face when attempting to insert games in formal educational contexts (Egenfeldt-Nielsen, 2008; Klopfer, Osterweil & Salen, 2009; Ritzhaupt, Higgins & Allred, 2010; Squire, 2005; Westera et al., 2008). Educational games also go through a great number of challenging phases before they even reach the educational environment and the target recipient of the learning content (Egenfeldt-Nielsen, 2010, 2011; Wagner & Wernbacher, 2013). So, while plenty of interest and effort has been put into educational games in recent years, and promises have been made that games are harbingers of a revolution in educational practice (Linehan et al., 2011; Squire, 2002), the challenges involved in developing, integrating, and using games in formal educational settings make widely implemented game-based learning practices a rather elusive proposition (Young et al., 2012).

This thesis aims to examine the reasons behind this incongruity. Largely speculative statements of the high educational potential of games continuously proliferate among scholars (e.g., Becker, 2005, 2011; Gee, 2003, 2005; Squire, 2002; Tan, Neill & Johnston-Wilder, 2012) and practitioners alike (e.g., Cobb, 2013; Huynh, 2013, 2014; McGonigal, 2011; Prensky, 2001). However, the actual practical usefulness and impact of games in formal educational contexts is still relatively unexplored, and successful examples of games reaching wide-spread use in schools are still rare (Arnab et al., 2012; Egenfeldt-Nielsen, 2008, 2010; Linehan et al., 2011; Young et al., 2012). Since this issue arises in the merger between two different fields of research and practice (games and education), it is necessary to examine the issue from both perspectives. The central tenet behind this thesis is that the viability of games as educational tools cannot be understood by studying either games or educational contexts in isolation from one another. Thus, the research presented in this thesis has been designed to create a comprehensive understanding of the many different stakeholders and processes, as well as their relationships to one another, which make up the full body of game-based learning. This has been achieved through a combination of literature reviews and case studies involving both educators and educational game developers.

1.1 GAMES AND FORMAL EDUCATIONAL CONTEXTS

What happens when the two disparate concepts of "games" and "formal education" cross paths? On one side, you have the multi-faceted craft of designing and developing engaging gameplay experiences. The designers and the development team work together to cater to an audience which seeks out and plays games they enjoy for leisure and personal enjoyment. On the other side, you have principals, teachers, and administrative staff at educational institutions that make up unique organisational cultures and processes with requirements and goals towards which they work. The institutions also, of course, work with students and parents, each with their own individual backgrounds, proficiencies, preferences, and ambitions. In other words, both game-based learning as educational processes and educational games as products are the result of complex systems where many different types of technologies, stakeholders, and beneficiaries become deeply intertwined with one another. As previously mentioned, however, little research is conducted to examine what actually happens when these two concepts and practices collide.

Schools seem to be running head-first into information technology and digital games, which are often seen as panaceas for many of the issues the educational system is currently facing (Ausserhofer, 1999; Habgood & Ainsworth, 2011). Ipads are purchased, laptops are distributed to students, and educational game development projects are embarked upon without much deliberation as to whether or how these items can be properly utilised to assist students' learning and teachers' working situation (Klopfer, Osterweil & Salen, 2009). Likewise, research within educational games and serious games has primarily been focused on isolating and describing the game artefacts and their virtues (Backlund & Hendrix, 2013; O'Neil, Wainess & Baker, 2005; Young et al., 2012), and less effort has been directed towards understanding how games fit into the contexts for which they are intended (de Freitas & Oliver, 2006; Squire, 2003). However, it is important to realise that in the study of educational games, as with other neighbouring genres in the wider field of serious games, the produced artefact plays but one part within a larger process, and understanding the context of use is, in many cases, as important as understanding the artefact itself (Alklind Taylor, 2014; Nilsson, 2008; Nilsson & Jakobsson, 2011).

Just like earlier media and technologies before them (e.g. film and television), games have been introduced to education as improvements over their predecessors and 'traditional' forms of teaching (Bourgonjon & Hanghøj, 2011; Linderoth, 2010). Games are often examined as isolated pieces of software and are either juxtaposed with pedagogical principles to highlight the educational potential of games, or displayed next to caricatures of educational processes and institutions in order to highlight the comparative staleness of traditional teaching. Studies frequently show that games increase student engagement during learning activities (e.g., Annetta et al., 2009; Fowler & Cusack, 2011; Kiili et al., 2014; Rai & Beck, 2012a, 2012b), or that they provide more efficient teaching in the styles of newer pedagogical paradigms (e.g., Gee, 2003; Mayo, 2007; Shapley et al., 2011). As previously mentioned, however, the use of games in educational institutions remains relatively rare, in spite of the positive discussions and findings surrounding them.

The mismatch between the positivity surrounding the potential of games and the form and extent of their actual application has several possible explanations. During the early 00s, a popular explanation was that an overwhelming majority of teachers and parents had a fundamentally negative attitude towards games (e.g., Becker, 2005). While negative attitudes towards games have certainly been pervasive in the past (Ketamo et al., 2013), research indicates that the thoroughly negative opinions regarding games as educational tools are in the minority (Ruggiero, 2013; Wastiau, Kearney & Van de Berghe, 2009).

Another commonly recurring explanation that is still proliferated widely today is that there are no “good” educational game titles out there to be used (Egenfeldt-Nielsen, 2010; Young et al., 2012). This critique has certainly held merit in the past. The low production values and stale gameplay in educational games, compared to entertainment games, have been blamed for the stagnation of the educational games market before the turn of the millennia (Egenfeldt-Nielsen, 2011; Ito, 2009; Shuler, 2012). However, as more and more critically praised, best-selling, and high-budgeted games have been modified for educational use, the “educational games do not hold up to their entertainment counterparts”-explanation is becoming increasingly untenable (Egenfeldt-Nielsen, 2011; Wagner & Wernbacher, 2013; Young et al., 2012).

These explanations, though perhaps more valid in the past, no longer seem to reflect reality, and continuously returning to them only serves to maintain an outdated narrative that games are destined to revolutionise education. This thesis aims to explain the gap between formal education and games from a different perspective. Rather than examining educational games as design challenges or as encapsulated learning processes, this thesis examines the actors, processes, and situational factors that are involved in the merger of games and education. The integration of games in formal educational settings, the teachers’ approach to using them, the way students interact with them, the way developers work to create them, and the way that the cultures of educational organisations perceive and receive them are all components of the larger educational game and game-based learning system. As this thesis argues, understanding the relationship between all of these components is a necessary prerequisite to begin to understand the actual usefulness and quality of educational games as educational tools.

1.2 RESEARCH QUESTION AND OBJECTIVES

In this thesis, I argue that the challenges and benefits involved in developing and using educational games cannot be sufficiently understood and navigated if we do not understand how they affect, and are affected by, the contexts they are put into. As described in more detail in the literature review chapter, the field of educational games has historically suffered from a lack of empirical studies. Past research has fetishized the educational game artefact to a high degree, and primarily focused on dissecting games in order to find ‘natural’ couplings between their anatomy and principles of learning (Egenfeldt-Nielsen, 2006; Linderoth, 2010). The popularity of the theoretical approach to understanding the potential of educational games as educational tools is problematic, as it has resulted in a field where empirically untested hypotheses and theories are adopted as axiomatic truths (e.g. the concepts of ‘digital nativity’, ‘stealth learning’, and the assumed convergence of flow-theory and learning/scaffolding in educational games). This is not only true for educational games and game-based learning research, but for most research on digitalisation and technology integration as well as its effects on educational organisations and student learning (Ross, Morrison & Lowther, 2010). An over-reliance on theoretical work can become problematic for any field of research, and it can severely hamstring a field that studies objects and processes intended to be applied in real-world settings. Following Flyvbjerg’s (2006) treatise on the importance of keeping a field grounded in pragmatic research, this thesis employs real-world case studies as one of its core research strategies:

> “Great distance to the object of study and lack of feedback easily lead to a stultified learning process, which in research can lead to ritual academic blind alleys, where the effect and usefulness of research becomes unclear and untested. As a research method, the case study can be an effective remedy against this tendency” (Flyvbjerg, 2006, p 223)

With the precedent set by previous research on educational technologies and games in mind, the research presented in this thesis has focused on understanding the educational usefulness of games by examining how they mesh with the properties of formal educational settings. Or to be more direct, this thesis work has been conducted with the following research question in mind:

How do organisational components, processes, and actors found in formal education affect the development and use of educational games?

The research question involves three distinct venues of investigation: an environment and its properties (formal education), a set of processes (development and use), and an object (educational games). Examining these different aspects of educational games, in order to ultimately reach a systemic understanding of them as a cohesive unit, required the use of several different research methods. To that end, this thesis work borrowed from information systems research, instructional system design, game studies, as well as educational game research, and combined them during case studies where educational games were put to use in formal educational settings. Approaching the research question from these different angles made it possible to produce a comprehensive examination of educational games as objects of research, as development projects, and as educational tools in relation to formal educational settings.

The answer to the multi-faceted research question was produced through the pursuit of four research objectives. It is important to note that all of the research objectives were not explicitly stated in the initial stages of the entire research process. Instead, the objectives were iteratively created and moulded into shape as the research progressed. In essence, this thesis work is the result of a thoroughly non-linear journey whose end-goal was discovered as new aspects of the studied phenomenon were revealed along the way. For example, findings of the case studies conducted early on in the research uncovered unexpected aspects of educational games and formal education that I felt needed closer examination, and, thus, the subsequent objectives (and the methods with which they were pursued) would be informed by these findings. So, while each leg of the journey was conducted with a definite purpose, claiming that the concluding objective of the entire thesis was evident at the outset would be misleading. The remainder of this sub-chapter focuses on explaining the four research objectives and how they relate to one another. The flexible and iteratively changing research process is described in more detail in chapter 3.

Objective 1: Explore educational games through literature and case studies with both educators and developers as respondents.

Conduct a literature review and a broad case study aimed at building a body of knowledge regarding the design, development, use, play, and research of educational games and a comprehensive overview of different stakeholders' perspectives on educational games and game-based learning.

The first research objective was important in establishing the general direction for the subsequent studies conducted during this thesis work. By studying the literature, as well as the stakeholders involved in educational game development and use, a broader understanding of educational games and game-based learning was constructed. A few key incongruities were revealed between the way developers and educators work, which demonstrated the necessity to think of educational games and game-based learning as small parts of larger systems. The explorative enquiries of phase one was essentially an attempt to gather practitioners' experiences and perspectives on educational games as business ventures, creative endeavours, and educational tools, in order to generate ideas and hypotheses for future, more in-depth and detailed research. Shortly summarised, the case study shows that educational games not only constitute design challenges of balancing gameplay and educational content, but also challenges informed by the larger educational, market, and development systems of which they are a part. The subsequent research objective focused on further examining educational games from that perspective.

Objective 2: Explain educational game development and use by contextualising them in formal educational settings.

Conduct a field study on an 'extreme case' in order to make participatory observations of the working processes involved in integrating educational games in formal settings and executing a rudimentary game-based curriculum.

When the first research objective had been achieved, my own understanding of educational games had become increasingly systems-oriented. At this stage of the overarching research process, the literature studies underpinning the research were expanded to include neighbouring fields that provided useful models and theories for understanding educational games as parts of larger systems of development and use. A case study was also conducted on an 'extreme case' where the realities of integrating games into an educational context were examined. Through the combination of literature and field work, some general contradictions between the design, working and business practices of game developers and the work structures and realities found in formal education were outlined. The purpose of the subsequent research objective was to describe these contradictions in more detail.

Objective 3: Describe the processes and situational factors involved in educational game research, development, and use.

An additional literature review, examining how educational games and game-based learning processes are researched in the game studies community. Conduct two final, in-depth case studies involving more representative instances of game-based learning.

The penultimate research objective entailed more in-depth participatory studies with educators, which involved implementing and using games (specifically an educational modification of *Minecraft)* in two different types of K-12 classrooms. These case studies served to examine the viability of previous research outcomes in more 'representative' educational settings, as well as find ways of solving the challenges identified in previous studies. In addition to the field work, the concluding steps of the research also involved an examination of previous research. The literature examination helped inform the research design of the final case studies, and was also used to conduct a critical evaluation of research practices in educational games research.

Objective 4: Create a systems-oriented description of educational games and game-based learning.

Aggregate research results into a comprehensive and pragmatic description of educational games and game-based learning that takes the realities of game development and formal education, and the situational factors, processes, and actors they involve, into account.

The previous research objectives served to construct a body of knowledge of the actors, organisational components, processes, and goals involved in the development and use of educational games, as well as theoretical considerations regarding the values of educational games as educational tools. The final research objective served to summarise all of the outcomes produced during previous objectives into an answer to the research question of this thesis.

1.3 KNOWLEDGE CONTRIBUTIONS

As described previously, this thesis work approaches educational games and game-based learning from a systems-oriented perspective. Functionally, this means that I do not treat educational games as an artefact separable from its broader context, but rather as something whose properties and potentials are dictated by how it fits into a larger system. Educational games are fundamentally interdisciplinary, as they rest upon principles developed in the fields of pedagogy and game studies – the latter of which is highly interdisciplinary, in and of itself. As this thesis takes a systems-oriented approach to understanding educational games, even more disciplines become highly relevant. Information Systems research, for example, became relevant in describing how organisations' use of technology and software can be studied and analysed, as well as the many different factors that affect how individual members of organisations accept and adopt them. The field of instructional systems development has mapped out many processes of solutions design and development, which are highly relevant to educational games and game-based learning. Theories and research methods, as well as design, development, and implementation processes found within these fields, are all used in this thesis to analyse educational games and game-based learning.

The motivation for steering the research in this direction arose from observations gathered both from studies of previous research in the area of serious games and my own interactions with educators that were in the early stages of appropriating games for educational use. When discussing educational games with educators, the intended audience for a significant portion of educational games, the ambitions and concerns they would frequently discuss were seldom mirrored in educational game or serious game literature. The primary discrepancy between researchers and practitioners was what "stage" of an educational game's lifespan they tended to discuss. Researchers often discuss educational games in a similar way to how entertainment games are discussed – for example, they focus on design choices (Engström et al., 2011; Franzwa, Tang & Johnson, 2013) (Harteveld et al., 2010), certain mechanics' effects on player experience (Squire et al, 2004), how games instil immersion and engagement (Habgood & Ainsworth, 2011; Jones, 1998; Kickmeier-Rust et al., 2011; Malone, 1980b, 1981), and so forth. However, the educators I discussed educational games with had a more practical approach and focus on the processes that can make an educational game useful in a formal educational setting. For example, their discussions would gravitate towards questions regarding how the teacher would construct lesson plans using the educational game, how the game adhered to curriculum criteria, how much the game and necessary devises would cost, how reliably they could be expected to function, and how student performances could be evaluated. This is not to say that previous research has been kept on an irrelevant level of discourse; understanding the nature of the artefact is important to defining its values and potential. However, studying the practicalities of educational environments and the characteristics of games in tandem is also crucial, as it can reveal challenges and opportunities that might be overlooked if only one perspective is considered.

The primary contributions this thesis offer span across many areas of the highly interdisciplinary field of educational games research, but there are some aspects of educational games and game-based learning that are deliberately avoided. This work does not pretend to offer significant insights into learning outcomes of gaming. Nor is it particularly concerned with specificities of educational game design. The primary contributions offered by this thesis are examinations and descriptions of working processes, and an overview of the different challenges – practical as well as intangible ones – that arise when games and formal education merge. The empirical studies presented here include the perspective of many different stakeholders in the educational game cycle (e.g.

developers, teachers, principals, and students). The end result is thus a comprehensive description of the entire game-based learning "lifecycle" that identifies the challenges each stakeholder or actor face individually and together. By grounding the research in real-world settings and examining the working processes and organisational cultures of a wide variety of stakeholders, this thesis contributes knowledge regarding the real-world application of educational games and the challenges they present to both developers and educators.

The multiple perspectives included also present the opportunity to examine incongruities between the needs and requirements that each stakeholder works under – thus highlighting some of the inherent practical paradoxes of educational games and game-based learning. Furthermore, the thesis also presents a literature review that examines the epistemological foundation of previous research, where different perspectives and effects of game-based learning and educational games are investigated. Ultimately, the research has resulted in the following contributions:

- *A retrospective and state-of-the-art description of educational games and serious games.* By summarising influential practices, paradigms, and debates within the field of educational games, the broader context in which educational games exist as an interdisciplinary craft and academic field is described in detail. This contribution focuses on getting the reader conversant in the peculiarities of educational games as a practice, topic of research, and as educational tools.
- *A categorisation of research in educational games.* By conducting a literature review of the field, a categorisation of educational game and serious game research is made according to common research foci and used methodologies.
- *An examination of the ontology and epistemology underpinning previous educational games research.* By examining how the body of knowledge surrounding educational games is constructed in previous research, and examining the interventions I have had to make during my own case studies, I present the argument that most conclusions regarding the effectiveness and viability of educational games as teaching tools are based on studies conducted in 'artificial' contexts for which generalizations are difficult. In other words, our understanding of educational games' usefulness and effectiveness hales from studies where the context of use is either heavily tailored by the researchers behind the studies, or conducted in non-formal educational contexts (e.g. in summer schools or after-school clubs). Subsequently, the impact that these research practices have on our understanding of educational games' usefulness and viability as educational tools is analysed.
- *A description of common practices of educational game development.* By interviewing educational game developers and participating in educational game development projects, an overview of the common practices for funding, developing, and marketing educational games is produced.
- *An examination and description of the processes involved in integrating and using educational games in a formal educational setting.* By interviewing teachers and principals and collaborating with them during the integration and execution of educational game curricula, a description of the working processes that educational game use entails is produced.
- *An analysis of the differences and discrepancies between the realities of educational game development and the realities of using games in formal educational settings.* The literature reviews and the conducted case studies revealed several important conditions in both educators' and developers' working environments and processes that dictate the success of educational game

endeavours. After compiling the findings of the different case studies and literature reviews, a broader analysis of educational games' usability as educational tools and viability as business endeavours is conducted.

- *A comprehensive description of educational games from a systems-oriented perspective that includes the goals, actors, situational factors, and working processes involved in educational game development and use.* From the analysis of the conducted interviews, participant observations, and conducted classroom gaming activities, a model (the Utility, Gameplay, and Meaning model) that describes educational games as a collaboration between developers, educators, and students is presented. The educational impact or value of a game is described as a complex interplay between these different actors and situational factors present in formal education that affect the way they work and play.

1.4 THESIS OVERVIEW AND STRUCTURE

This thesis is structured to first introduce the research strategy underpinning the various case and literature studies conducted within this thesis work. Subsequently, concepts and theories important for understanding educational games as development projects, educational tools, and subjects of research are categorised and described in the background chapter. In the latter half of the thesis, the details of the research methodology are presented along with the results of the conducted case studies. Finally, the results are analysed, and their implications for the broader field of educational games are discussed. The thesis structure is summarised visually in Figure 1.1.

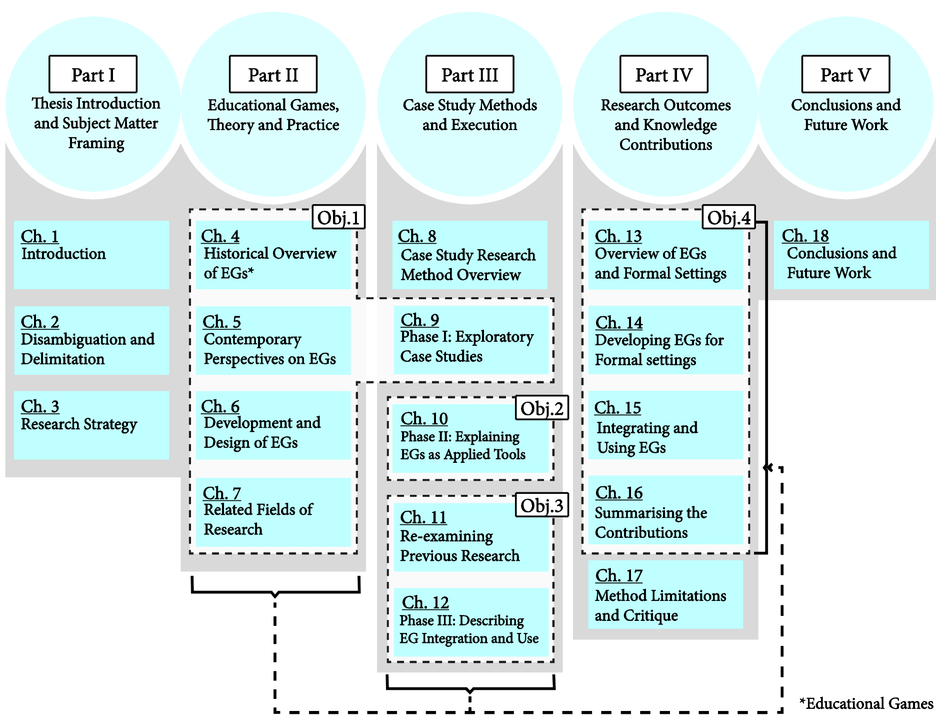

Figure 1.1: Overview of the structure of the five parts of the thesis, their chapters, and what research objectives the different chapters are associated with.

Part I of the thesis details the ontological and epistemological foundation that informed the execution of the literature reviews and case studies presented in this thesis. After introducing the topic of research, the chapter subsequently provides a brief overview of the strategy underpinning the research conducted throughout this thesis work. Part II serves the purpose of describing the previous research and theories that provide the foundation for this thesis, and that have informed my own methodological choices, the analysis of gathered data, and the final research conclusions. The overview in the background provides an explanation of educational games as a practice and field of research, and positions it within the broader field of serious games and game studies. The background also provides overviews of certain aspects of neighbouring fields of research that are highly applicable when examining educational games' qualities as educational tools, as well as how they affect and are affected by schools as organisational systems, from a pragmatic perspective.

After establishing the broader context for this research, Part III describes the methodology employed during the different case studies conducted during the thesis work, as well as their outcomes. As previously described, this thesis incorporates results from several different case studies, the designs of which iteratively changed as the thesis work progressed. In order to detail the different studies and how the methodology changed between them, the research method chapter also provides a chronological overview of the different research phases. Given that the methodology evolved between the conducted case studies, they are presented as parts of separate research 'phases', according to the research objectives they were meant to fulfil. The research results are subsequently aggregated and subjected to in-depth analysis in order to answer the research question of the thesis in Part IV. The implications that the results have for educational game development and use are discussed, and recommendations for how developers and educators can address and manage the challenges identified during the case studies are presented. Finally, Part V summarises the thesis and its implications for educational games research, development, and use. The concluding part also contains reflections on the employed research method and discussions of future directions for educational games research.

CHAPTER 2
DISAMBIGUATION AND DELIMITATION

As previously mentioned, the research conducted within this thesis project has been highly interdisciplinary. This necessitates the use of a wide terminology set, borrowing terms from game studies, education, information systems, and instructional systems development. This chapter provides definitions of the most important and frequently used terms employed in this thesis.

2.1 LEARNING AND MEANING-MAKING

As an overarching definition, learning is the process which results in a person acquiring new (or modifying previous) knowledge, skills, or attitudes. As stated previously, this thesis does not attempt to detail specific learning outcomes of game-based activities or pinpoint the efficiency and educational potential of specific games. Instead, the thesis focuses on understanding how games fit into processes and systems that are constructed for and around learning. Thus, this disambiguation focuses on clarifying how learning can happen through gameplay and game-based activities.

Firstly, this thesis does not consider that games have intrinsic educational values that are automatically imprinted on a player upon contact. Games can, however, contain interesting commentaries, arguments, lessons, and knowledge that can be unpacked through active reflection and contextualisation. In essence, this thesis takes the stance that learning and educational pursuits are dependent on the users'/players' intent and the context of play, collaboration, reflection, and dissemination that they establish. The potential learning that a game can facilitate is thus not something that is dictated by the rules, mechanics, and aesthetics of a game (see chapter 5 for more elaborate explanations). Naturally, a game can be designed in a way that *facilitates* the pursuit of certain types of learning objectives, but it will still require active investment from its participants, and a willingness to actively reflect upon its content rather than just navigating it.

This stance is partly necessitated by the context in which this research is conducted. I do not outright refute the notion of 'incidental learning'. For example, an avid *World of Warcraft* (Blizzard Entertainment, 2004) player might certainly improve their command of languages and statistics after years of playing the game. However, the primary goal of this thesis is to examine the application and usefulness of games in formal educational settings. As formal education is about pursuing defined learning objectives (see sub-chapter 2.3), simply throwing students into a game in the hope that they will extract valuable lessons from it is not practical. While players may learn *something* while playing a game, there is no reliable way of knowing *what* they learn unless the system around the game activities (e.g. preparatory lessons, real-time reflection and interpretation, discussions, debriefings, and guiding assignments) encourages active reflection and discussion (Frank, 2014; Linderoth, 2012).

Building upon this further, this thesis does not discuss games' merits as 'stealth learning' apparatuses. Stealth learning builds on a core belief that effective learning can occur if students can be made to unknowingly engage with educational content[1], which is usually achieved by dressing the content up in more appealing trappings (Prensky, 2001). As this thesis approaches learning as a context-dependent process that requires active reflection on the part of learners, it also implies that learning cannot be surreptitiously 'snuck onto' an individual. While several chapters could be devoted to debating the validity of stealth/incidental learning, I will try to condense my view of the matter here for the sake of delimitation. The problem with treating games as inherently sound systems for learning lies in a baseline conflation of what a game "says" and what meaning a player extracts from it. The distinction comes down to whether learning/knowledge is something that a game simply radiates and inflicts on its players. The notion that the meaning of game content and what players take away from engaging with it can be objectively defined by looking at what is presented through the game's rules is problematic and excludes the fundamental traits of interactivity and agency that games manifest (Arnseth, 2006; Habgood & Ainsworth, 2011; Squire, 2002). In a response to proponents of this notion (cf. Douglas, 2002; Poblocki, 2002), whom specifically pointed out that a historically biased argument was being taught to players by games in the *Civilizations series (Firaxis Games, 1991-2014)*, Carr (Carr, 2007) summarised the issue well:

> "It is as if the internalisation, reinforcement and reconfiguration [that is linked with] meaning, is something that happens to the player through exposure (like a form of radioactivity). [...] evidence tends to be collected from two schemas (rules, culture), yet conclusions are drawn in a third (play). The trouble with such critique is that play is the schema of the experiential, and it involves the actualisation, interpretation and configuration of the game in real-time by users. As soon as play enters the equation, the assertion that [game content] necessarily mean anything specific begins to disintegrate." (Carr, 2007, p 7)

In a similar vein, the spuriousness with the notion that games 'inflict' learning and meaning upon its players has also been pointed out by Arnseth (2006). Arnseth specifically critiques educational game scholars' focus on the relationship between players' cognition and game stimuli to the exclusion of the important social interactions and processes that happen outside of the game's confines:

> "... models where the effects of computer games on cognition and learning are sought, are problematic for several reasons; the most important being that they do not enable us to investigate how computer gaming is enacted or the meanings which are constituted in relation to game playing. By paying serious attention to how players make sense of what they do, including the resources they draw on in the process, I believe that we as educational

[1] 'Stealth learning' and 'incidental learning' are closely related, and are at times treated somewhat interchangeably. MacCallum-Stewart (2011), for example, describes stealth learning as the valuable, but difficult to measure (thus "stealthy"), learning effects that games can have on its players (e.g. improving language, reading, collaboration, heuristics, technology familiarity, incitement to research a topic, etc.) without the game being explicitly designed to be educational. Others refer to stealth learning as an effect that is deliberately pursued by way of concealing educational content in game mechanics so that players play "without realising" that they are in actuality learning something (cf. Prensky, 2001; Tan, Neill & Johnston-Wilder, 2012). I take the stance that 'incidental learning' more appropriately encapsulates the serendipitous learning effects described by MacCallum-Stewart (2011), and that 'stealth learning' is rooted in deliberate methods of designing educational games.

> researchers can provide more realistic accounts of what computer gaming is about, how computer games might be used in order to facilitate learning in schools, and what, in fact, people learn when engaged in activities of computer game play." (Arnseth, 2006)

According to Arnseth (2006) and Carr (2007), players' own subjectivity is a crucial factor when the meaning of a game is produced, and is heavily informed by a complex interplay of situated culture, processes, and contexts. This implies that gaming, without a system that encourages a reflexive and analytical 'mode of play' when playing, will have highly unpredictable outcomes in regards to learning and meaning-making (Alklind Taylor, 2014; Arnseth, 2006; Frank, 2014). This is, however, not a dismissal that games have the potential to be useful and impactful educational tools. It is merely a clarification that their potential is not a product of some inherent educational quality of the medium, but rather in the interactions and processes that they allow for and that can be built around them. If a system that maintains actively reflexive play can be established, many types of games can potentially be slotted into it in the pursuit of a wide variety of learning objectives. Again, this thesis aims to examine the working processes involved in establishing and maintaining systems that enable different types of learning situations, rather than identifying specific learning outcomes or ties between pedagogical principles and particular educational game designs.

2.2 EDUCATIONAL GAMES AND GAME-BASED [ACTIVITIES]

This thesis discusses both educational games and game-based educational activities. The two terms are closely intertwined, but refer to two distinctly different 'aspects' of my research. The first relates to the tool being developed and played/used, whereas the other relates to the process of play/usage itself.

Throughout this thesis, the term *educational game(s)* is used to encapsulate both game software that is developed and marketed explicitly as being 'educational', as well as games that might not explicitly be designated as 'educational' but are being appropriated for educational purposes. The former category is easier to identify and reign in, and involves games such as *Global Conflicts: Palestine (Serious Games Interactive, 2007)*, *Oregon Trail (Six to Start, 2012)*, *Math Blaster! (Davidson & Associates, 1983)*, *Ludwig (ovos, 2011)*, *Testament* (Immersive Learning, 2010), or *Where in the World is Carmen Sandiego (Brøderbund Software, 1985)*. The latter category is more unruly, as it does not have much to do with the content of the games themselves and their declared purpose, but rather with the intentions of the people utilizing them. Some examples of these types of games are *Sim City (Maxis, 1989-2014)*, *Civilizations (Firaxis Games, 1991-2014)*, *Europa Universalis (Paradox Development Studio, 2001-2013)*, *Portal (Valve Corporation, 2007)*, *Minecraft (Mojang, 2011)*, and *The Walking Dead (Telltale Games, 2012)*. By devising new 'house rules' around the game or contextualising the game content in real-world subject matters, these games can be (and have been) used to pursue specific learning objectives (Egenfeldt-Nielsen, 2008; Nilsson, 2008; Squire, 2005).

Thus, the term educational game is not particularly dependent on properties of the software artefact or developer intent, but instead dependent on the users'/players' intent and perceptions when playing them. The reason for not confining the term to solely refer to games created with educational agendas comes down to the core ethos of this research, which is that the context and intent of play are crucial factors when examining educational games. Commercial off-the-shelf games, like commercially produced films or books, can be transformed into an argument, commentary, or educational activity not intended by their creators when interacted with in a certain context or with specific intent. Thus, limiting the 'educational game' term to only refer to games that fulfil a certain creation and marketing criteria would be antithetical to the focus of this thesis.

The term 'game-based', followed by either 'learning', 'curriculum', or 'classroom activity', is used to describe the act of conducting pedagogical work with a game as the core educational tool. Whereas the 'educational game' is the tool being developed and used, 'game-based learning' refers to the activity that surrounds it and students' interactions with it. These two definitions can thus be seen as denominating two different aspects of games as they relate to education: games as educational tools and educational processes that incorporate game software.

These terms have been chosen over the perhaps more widely used term *Serious Games*. While the term does, for all intents and purposes, encapsulate the types of applications of games examined in this thesis, its usefulness is somewhat blunted by its broadness. Games developed by a car company to market one of their new vehicles, physical exercise equipment specifically designed to work together with gameplay challenges, or games that aim to portray the situation for citizens of third-world countries are all examples of serious games. This makes using the term somewhat difficult, as it covers such a wide range of products and this has led to new sub-categories emerging in the field; for instance, the three aforementioned examples can be categorised as a *marketing game*, a *game for health*, and a *game for social change* respectively (Ratan & Ritterfeld, 2009). In other words, the definition of serious games is very broad. The term has previously been defined by the presence of agendas that are largely heterotelic to the gameplay experience:

> "Serious game: a mental contest, played with a computer in accordance with specific rules, that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives." (Zyda, 2005, p 26)

In other words, the term 'serious games' is often used to describe the entire range of games with a purpose beyond just providing an engaging experience. So, while serious games as a term does describe what the basic overarching discipline that the research presented here lies within, the term is too broad to be useful when discussing the presented ideas and conclusions in this thesis. Therefore, in order to more precisely define the scope of my research and to clarify who the final beneficiaries may be, the terms educational games and game-based activities (e.g. learning, curriculum, lectures, and collaboration) will be used instead of serious games.

With all of these considerations in mind, the definition I will be using for educational games in this thesis is:

> *Educational games are games that contribute to the achievement of heterotelic learning objectives. These contributions come in the shape of game-like elements such as: challenges that are pursued within the boundaries of defined interaction rules; interfaces mediated through avatars or other player personifications; or simplified representations and analogies of objects', events' and actions' characteristics and aesthetics. An educational game can have explicit educational intent, but learning objectives are ultimately negotiated and assigned to games by their users.*

This definition has been inspired by the previous definitions of serious games provided in Susi, Johannesson & Backlund (2007, p 5), and in Alklind Taylor (2011, p 21), and is intended to: declare the heterotelic nature of educational games; set games apart from educational software and simulations; and distance educational games from notions of stealth/incidental learning by declaring user intent as a crucial factor for ascribing learning objectives to games.

The trait of heterotelic objectives is an especially important signifier in distinguishing educational games from 'entertainment games'. I would consider 'entertainment games' to be autotelic experiences in that the satisfaction of navigating the challenges and interacting with the subject they present is the main reason for playing the game. In essence, performing the act itself is the reason for performing the act. Educational games and serious games, however, pursue a purpose beyond the act of gameplay – be it educating the player in an academic subject matter, training rescue service personnel, assisting physical rehabilitation, advertising a product, or encouraging social change. In short, the gameplay is the vehicle to reach goals outside of the gaming activity, while entertainment games aim to provide an engaging driving experience.

2.3 FORMAL, NON-FORMAL, AND INFORMAL EDUCATION

The differences between the formal, non-formal, and informal settings in which games can be played are pivotal points of several arguments posited in this thesis. The primary differences between these three application settings, with regard to educational games and game-based learning, are: the structures of gaming activities; the ways in which the audience is invited to participate; the purposes and goals pursued by the use of game-based activities; and the constraints put on time and space for play sessions. Shortly put, formal application means that the game has a captive audience, that it is played under supervision of some type of tutor, that it has specific requirements of learning objectives that need to be fulfilled, and that it has a structured time and space allotment in which to do so. When games are played as non-formal educational activities the environment may have a structure, but game play might not be explicitly designated as learning, and the requirement of participation is lessened. In informal settings, the conditions and parameters that characterise a formal setting are usually not explicitly present, and can even be totally absent.

For the purposes of this thesis, the different settings are defined according to how interactions with (ostensibly) educational material are structured, and what the purpose of the activity is according to its participants. The precise definitions that I will be using are taken from the *Terminology of European education and training policy* report published by the European Centre for the Development of Vocational Education and Training (CEDEFOP) in 2014. According to the report, formal educational activity and learning:

> "… occurs in an organised and structured environment (e.g. in an education or training institution or on the job) and is explicitly designated as learning (in terms of objectives, time or resources). Formal learning is intentional from the learner's point of view. It typically leads to validation and certification" (CEDEFOP, 2014, p 85)

The characteristics that are of special importance here are that the activity occurs in a structured environment, is allocated time and resources, and that it is explicitly designated as a learning activity conducted with specific objectives in mind. Non-formal educational activities differ from the formal ones as they are not as structured and are instead:

> "… embedded in planned activities not explicitly designated as learning (in terms of learning objectives, learning time or learning support). Non-formal learning is intentional from the learner's point of view." (CEDEFOP, 2014, p 133)

Important to note is that while the educational intent of the activity is made explicit to the learner, it is not characterised by specific learning objectives. Whereas formal activities are institutionalised, non-formal educational activities relate more closely to 'extra-curricular' activities (e.g. youth organisations, summer schools, or sports clubs). The definition of informal educational activities and learning explicitly distances itself from the concepts that define both formal and non-formal activities, and are described as:

> "… daily activities related to work, family or leisure. It is not organised or structured in terms of objectives, time or learning support. Informal learning is in most cases unintentional from the learner's perspective." (CEDEFOP, 2014, p 93)

To supplement the definitions given by CEDEFOP, the descriptions of education archetypes used by physics education scholar Dib (1988) provide some more key differentiators. According to Dib, formal educational activity "corresponds to a systematic, organised education model, structured and administered according to a given set of laws and norms" (Dib, 1988, p. 1). Informal educational activity, on the other hand, does "not necessarily include the objectives and subjects usually encompassed by the traditional curricula" and "imposes no obligation whatsoever" on its participants (Dib, 1988, p. 6). Furthermore, Dib provides some examples of educational activities that can qualify as informal:

> "There are many instances of situations/activities encompassed by informal education, from those that may take place in the students' homes - such as scientific or didactic games, manipulation of kits, experiments, reading sessions (biographies, scientific news, etc.)..." (Dib, 1988, p. 6)

In essence, informal educational activity is somewhat synonymous with unguided leisure activity – and while they may result in 'incidental' learning that is supplemental to formal education objectives, the activity is not primarily defined as a learning activity, nor does it follow a formalised structure.

Being familiar with the type differences of these settings is important, as the context in which a game is used poses different types of constraints on what it is 'allowed' to do as well as the requirements put on its performance. This thesis primarily focuses on examining games' properties as objects that provide venues for formal educational activities, and statements made regarding the viability of games as educational tools refer to their applicability in formal educational settings. As mentioned previously, this means that the thesis does not intend to contribute any material towards the debate on whether games are 'useful' leisure activities that result in incidental learning when played 'informally'.

CHAPTER 3
RESEARCH STRATEGY

This chapter describes the research strategies employed during this thesis work, as well as the experiences, contexts, and theoretical considerations that influenced and changed them. The studies conducted under the auspices of this thesis have all aimed to answer the overarching research question of *how organisational components, processes, and actors found in formal education affect the development and use of educational games*. A foundational paradigm for this research is the treatment of educational games as parts of larger systems consisting of environments, processes, mechanisms, and participants that can co-exist in many different arrangements. Teachers, students, principals, legislators, researchers, and developers all influence both the system and the game artefact that tries to exist within it to some degree. Therefore, using a research approach that has the flexibility to accommodate a multitude of different perspectives on educational games has been a crucial component in answering the research question.

In order to map out the research process, this chapter first describes *what* was studied, and the overarching strategy which informed *why* and *how* the different types of studies were conducted. After the strategy and the ontological and epistemological outlines of the research have been described, the rationale behind the methodological choices and the construction of the theoretical foundation upon which the research is built are presented in more detail. Ultimately, the final parts of the chapter describe the specific design of the conducted case studies in detail.

3.1 USING AN ITERATIVE RESEARCH STRATEGY

The research conducted during this thesis project has been characterised by its plasticity and its evolutionary nature. The process of becoming entrenched in new contexts and organisational cultures frequently revealed aspects of educational games and formal education that my research methods were not sufficiently nuanced to capture. This lead to a continuous re-examination and reformulation of the methods employed between the different studies conducted during this research project.

One of the major changes this research process has gone through has been the shift of focus from trying to understand how the “anatomy” of educational games can be improved to increase their usefulness and impact in school environments to understanding how educational games and the environment produce impact and usefulness together as a system. In the initial stages of my research, the intent was to examine the links between educational game research, game studies, and educational psychology and use them as the primary point of reference with which to examine the design of educational games and describe good design practices. However, as I started working closer with educators, developers, and students while also examining previous research in the field, it gradually became harder to explain the peculiarities of educational games with those delimitations. This led me to focus on development, implementation, and use of educational games as a unified process, and to expand the scope of my theoretical grounding to include information systems, instructional systems design and development, as well as technology acceptance. In short, there has been a significant shift in the ontological foundation guiding what I have chosen to focus on during my research; from a) the impact and usefulness of educational games depend on their ability to match and balance educational content and suitable gameplay mechanics, to b) the impact and usefulness of educational games depend on their accommodation for peculiarities of the system into which they are to be implemented as well as the specific properties of said system.

As my ontology shifted, the epistemology naturally followed. Merely understanding the design of games, their development processes, and their adherence to pedagogical principles, is not a sufficiently inclusive perspective when the object of the research question switches from being a software artefact to an entire system. Instead of dissecting games as objects, the research scope widened to include actors and environments whose characteristics I now consider crucial to understanding what educational games can bring to formal educational settings.

More important for this chapter, however, is how these changes have impacted the methodologies employed during the research. As previously stated, the initial aim of this research was to explore and describe ‘appropriate’ methods for educational game design. The studies conducted during this research phase were primarily experimental and comparative (e.g. comparing educational games with entertainment games, or juxtaposing the ‘anatomy’ of games with pedagogical theories). However, as my research interests rapidly transformed to include the complex real-life systems that educational games are developed to be a part of, the research method was taxed to transform with it. These changes, which were primarily brought about by experiences during my field work, naturally also extended into the theoretical grounding upon which continued research rested, and through which previous efforts were evaluated. This is not to say that the methodological changes were without structure or forethought, but rather a product of an overarching research strategy that emphasised the iterative refinement of methods with grounded explorative studies as its genesis.

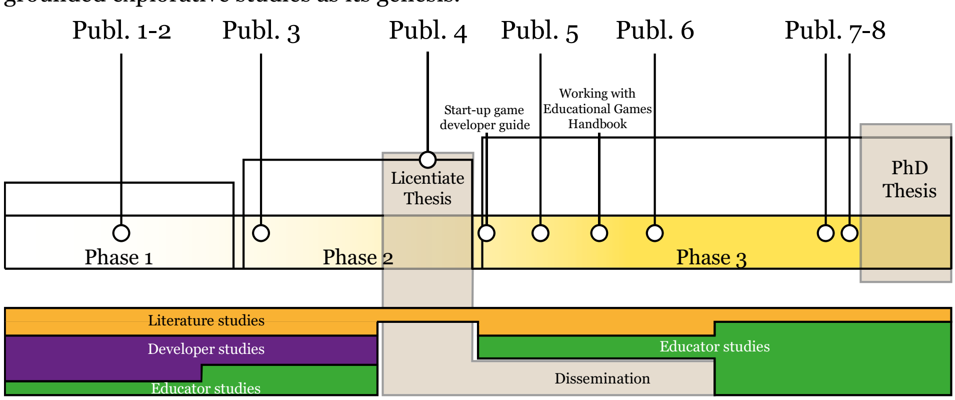

Figure 3.1: Thesis project timeline, including publications and an outline of how literature and different actors were studied during the different time periods.

The research strategy was inspired by the process used by my colleague Alklind Taylor, who has studied the use of serious games in military training scenarios (Alklind Taylor, 2011, 2014). Alklind Taylor employed an evolutionary strategy, 'abductive research strategy' (ARS), which is described by sociologist Norman Blaikie (2007) as a strategy that accommodates unanticipated empirical findings and new theoretical realizations during the research process. ARS is a flexible and primarily qualitative approach of carrying out case studies, and it "makes use of a combination of empirical fieldwork, case analysis and established theoretical models, where the researcher is constantly going back and forth between empirical observations and theory" (Alklind Taylor, 2011, p. 8). ARS does share some similarities with inductive processes, but there are some key differences between the two. For example, compared to an inductive process such as grounded theory, where the researcher approaches an area completely "clean" from set preconditions and generates a problem statement or theory from it, ARS stresses the development and iterative refinement of theory rather than strict theory generation from the grounded baseline case (Blaikie, 2007, 2009; Dubois & Gadde, 2002; Ong, 2011). Dubois and Gadde (2002), for example, describe ARS as being evolutionary and characterised by iterative refinement and restructuring rather than being static and linear. This summarisation echoes the works of Blaikie, who provides a concise differentiation between abduction and other approaches:

> "Induction and deduction [involves] linear processes, the former being bottom up and the latter top down, and retroduction and abduction [involves] much more complex processes that can be thought of as a rising spiral involving numerous iterations." (Blaikie, 2007, p. 3)

In the book *Designing Social Research,* Blaikie (2009, p. 156) also states that the central characteristic of ARS is that the researcher's role is to "[alternate] periods of immersion in the relevant social world, and periods of withdrawal for reflection and analysis." Especially resonant with my own research process is his resolute and repeated statement that "theory is generated as an intimate part of the research process; it is not invented at the beginning nor is it just produced at the end" (Blaikie, 2009, p. 156).

The reason that the evolutionary abductive strategy was deemed suitable for this research is partly due to my own academic background and partly due to the context in which the research was conducted. As for the former, my background would primarily characterise me as a game designer and scholar, rather than a scholar of instructional design or education (either of educational psychology or didactical processes). With only limited experience of examining educational settings and their characteristics, the primary point of entry for my research was through the game artefacts that are being introduced in those settings. In essence, my own understanding of the contexts of educational game use was limited to theories regarding the ways they could be affected and influenced by the educational games' design. With the research question in mind, however, examining the formal educational setting through the lens of game design could exclude crucial findings when it comes to understanding how games can function with and within formal education as a unified system. Employing ARS meant that the research process was designed with the flexibility to incorporate new venues of inquiry when unanticipated patterns and characteristics of formal educational settings emerged, or as my understanding of the field of education improved.

As previously stated, the choice of ARS was also in large part influenced by the context in which the research was conducted. The majority of the research presented in this thesis was conducted as a part of the *Scandinavian Game Developers* project, financed by the *European Union Interreg IV a* program. The project, which was an international collaboration between Danish and Swedish universities, schools, and developers, influenced my research by facilitating the developer- and educator interactions that contributed significantly to the early stages of my theory development. The early research on developers and educators included numerous and diverse actors who often emerged quickly without any opportunity to investigate their previous working processes and experiences. Thus, I often entered many of the interviews and participations during the case study without an opportunity to establish a too formalised means of data collection and without many preconceptions regarding the respondents' attitudes and policies with respect to working with educational games. In the initial stages of the research, a flexible mixed-method research approach was thus a necessity. Also, the abductive strategy entailed using the initial studies both as an important means of method refinement and reflection, and as a means of theory and argument generation.

The benefit of employing an evolutionary research strategy is perhaps most evident when it comes to the execution of the later, lengthier, and more in-depth case studies, where the patterns whose contours were partially uncovered during the initial studies were thoroughly excavated. For each passing study and research phase, additional knowledge and experiences regarding the research contexts could be assimilated into guidelines that informed the design of the continued studies. The design of the last, and arguably the most in-depth and entrenched, examinations of educational contexts and games' potential roles within them was heavily dependent on theoretical, practical, and methodological realisations that emerged from the studies conducted earlier in the research process.

The research has thus been conducted in a series of changing contexts, rather than in a singular static one – starting out as a broader, but less in-depth, investigation of several development- and education environments, and concluding in a narrower, but more detailed investigation of fewer environments that served to encapsulate the concept of educational game use in greater detail.

3.2 PURSUING A PRAGMATIC UNDERSTANDING OF EDUCATIONAL GAMES AND GAME-BASED LEARNING

As described briefly in the introduction, and which is repeated several more times throughout this thesis, real-world research on the practical application of games as educational tools is rare compared to analyses of the concept of educational games and game-based learning (Egenfeldt-Nielsen, 2006; Kirriemuir & McFarlane, 2003, 2004; Young et al., 2012). The same rings true in the broader field of educational technology research, where the effectiveness of the technology 'artefact' is examined rather than its integration with its educational context and its users (Egenfeldt-Nielsen, 2010; Young et al., 2012). As an example, a comprehensive literature review of educational technology research conducted in 2010 concluded with the following call to arms:

> "… the next decade will undoubtedly offer unprecedented opportunities for research findings to inform practices for enhancing teaching and learning. To achieve that goal, we encourage researchers to reduce efforts to prove the "effectiveness" of technology, while focusing on conducting rigorous and relevant mixed-methods studies to explicate which technology applications work to facilitate learning, in what ways, in which contexts, for whom, and why." (Ross, Morrison & Lowther, 2010, p. 31)

Producing the type of research that the study of Ross et al. (2010) calls for has been the primary aim of this thesis. There are, however, many challenges inherent in attempting to study any kind of intervention and surrounding system in its real-life context. As organisational systems and environments, both game development and education consist of a myriad of actors and stakeholders with different levels of influence, as well as different characteristics and specialisations. As processes, game development and education are equally complex, each consisting of relationships and working methods that are built upon both a body of globally accumulated and continually expanding knowledge as well as local, irregular solutions created from individual actors' experiences regarding what works best in their own circumstances.

Studying these types of systems and processes can be quite difficult. The researcher needs to employ a wide enough gaze, since non-obvious things in the periphery of a particular intervention being studied may sometimes have a significant impact on how the intervention affects the working context. However, if the researcher does not outline some sort of framework for the parameters of the study, data collection and analysis can become impossibly impractical, and the research outcomes might become nothing more than an unstructured string of shallow observations. Finding a balance between comprehensiveness and depth has been a constant and sizeable challenge in this thesis work. Therefore, at times, necessary concessions have had to be made in order to make the work realistically executable.

As previously described, this thesis takes the stance that educational games cannot be sufficiently understood without the employment of a holistic systems-oriented research approach. To clarify – this thesis does not deny that there is value in analysing and dissecting an educational game as an 'isolated' game or piece of software. Doing so has been a fundamental part of building the field of educational games research, and is a prerequisite to juxtaposing the characteristics of games with pedagogical theory and practice in order to explore the potential educational games *may* have. However, in order to understand educational games' actual impact, potential, or even viability as educational tools, understanding how they exist within their intended real-life context of use is a necessity. Because, while sheer concept analysis is a necessity, real-world studies play an important part in producing research that is applicable when furthering the practices of the intended research recipients:

> "If people were exclusively trained in context-independent knowledge and rules, that is, the kind of knowledge that forms the basis of textbooks and computers, they would remain at the beginner's level in the learning process. This is the limitation of analytical rationality: It is inadequate for the best results in the exercise of a profession, as student, researcher, or practitioner." (Flyvbjerg, 2006, p. 222)

To that end, this thesis relies heavily on a series of case studies that have varied both in their scope and design. The primary motivation for choosing to conduct case studies is based on how they afford the researcher the opportunity to examine a contemporary, perhaps not previously detailed, phenomenon in a complex real-life context (Robson, 2002; Yin, 1984). By conducting a series of case studies, and letting their methodology evolve iteratively according to the used research strategy, different aspects of the educational game 'system' could be examined. When interesting aspects of educational game development or implementation emerged during a study, the scope and method of subsequent studies could be refined in order to examine those aspects in more detail.

In summary, the aim of conducting case studies was to examine educational games' properties and uses in real-world settings. By dividing the entire research process into 'phases' in which different case studies were conducted, various aspects of the somewhat unruly system that educational games constitute could be studied from a variety of angles and with different methods. The reasoning for the choices of methodology and designs of the different studies is outlined in more detail in chapter 8.

3.3 ESTABLISHING A THEORETICAL FOUNDATION

Besides studying initiatives of educational game use as they unfold in real-life settings, an increasingly important aspect of my research has also been investigating the way educational games research is conducted. Following the evolutionary nature of the ARS, the processes behind the conducted literature reviews changed iteratively throughout this thesis project. Initial literature studies were aimed at establishing an overview of past and contemporary work on educational games – be it papers covering their potential as educational tools, their effectiveness, examples of their practical applications, or state-of-the-art reviews.

When this thesis research began, I already had some experience conducting research on entertainment games, serious games, and on game industry practices. Having these earlier experiences meant that the project was not initiated with a “cold-start” and that I had some game design, development, and research experience that informed the direction of my early literary studies.

Initial exploratory literature studies were focused on understanding educational games, and specifically how they differed from what I was previously familiar with from my entertainment games and more general serious games studies. Here, literature that dealt with subject matters relevant to the research aims of this thesis was used as a starting point, and through their reference lists, and by searching for literature using specific terms and problems articulated by the authors, the list of literature grew. The categories that were strengthened as a result of the literature studies, and some examples of references used as the foundation for these categories are:

- Effects and challenges of using games to educate from a practical as well as pedagogical and psychological perspectives: (Blumberg & Ismailer, 2009; Linderoth, 2010, 2012; O'Neil, Wainess & Baker, 2005)
- Design and development challenges and working processes: (Egenfeldt-Nielsen, 2011; Habgood & Ainsworth, 2011; Harteveld et al., 2010; Linehan et al., 2011; Wagner & Wernbacher, 2013)
- Literature reviews that describe the state-of-the-art of educational games, as well as meta-analyses of educational games research: (Backlund & Hendrix, 2013; Egenfeldt-Nielsen, 2006; Kirriemuir & McFarlane, 2004; McClarty et al., 2012; Young et al., 2012)
- Introductory literature to the fields of information systems, technology acceptance, and instructional design: (Alter, 2008b; Avison & Fitzgerald, 2006; Gustafson & Branch, 2002; King & He, 2006; Petter, Delone & McLean, 2012)

Results from the first phases of case studies directed continued literature studies towards information systems and sociotechnical research. As mentioned earlier, it became increasingly difficult to describe current practices of educational game development only through research from entertainment game and educational game studies. While the realisation that information systems, instructional systems, and technology acceptance were useful for my research increased the breadth of my theoretical foundation, it significantly honed the direction of subsequent research, and introduced new elements to investigate during further case studies.

The initial literature studies were thus essentially a means to both strengthen my familiarity with the broad topic of educational games and game-based learning and to better position my own work within those fields as well as neighbouring ones. However, during the later parts of my research process, questioning the epistemological foundation of educational game research became an increasingly important pursuit. To that aim, the intention of later literature reviews was to both continuously update my own understanding of the topic, but also to critically evaluate the premises on which the current understandings of educational games have been built in order to make sense of the discrepancies between what I was seeing in my field studies and what I was reading in research papers.

The theoretical foundation for understanding educational games and educational games research within this thesis can thus be said to be built upon three different types of literature studies:

1. A general inventory of educational game, game-based learning, and serious games research which ensured that this research has a well-defined and novel position within the field.
2. A critical evaluation of previous research that aimed to understand why the problems observed during my field studies still persist
3. Refining and re-examining previously used methodologies in the field, and using previous research from other fields, to guide the refinement of the employed research methods.

Briefly summarised, the first literature review provided an outline of how the field of educational game, and serious game research grew into what it is today. Nonetheless, after some initial field work revealed challenges of working with educational games that the literature seldom covered, the subsequent literature reviews became more focused on understanding why this incongruity might exist, and what types of methods one can employ to study educational games without repeating past mistakes. The general overview of the field of educational games, serious games and relevant neighbouring fields is found in chapter 5, whereas the more in-depth critical examination of educational game research is presented in chapter 11.

PART II

EDUCATIONAL GAMES, THEORY AND PRACTICE

A substantial part of this thesis work has consisted of establishing a solid theoretical foundation from which my own understanding of educational games' properties can be built. It is important to note that the domain of educational games is deeply interdisciplinary, as it is an amalgamation of research found in the fields of game studies, pedagogy and education, information systems, computer science, and sociotechnical systems which all in turn are interdisciplinary in and of themselves. For instance, the field of game studies combines human-computer interaction, user experience design, cognitive psychology, software development, sociology, and many more to create theories and models that can describe what games are, the way they work, and the way players experience and make meaning of gaming activities. This made it difficult to define a precise scope of what types of literature to include, as potential theories or solutions to identified enquiries can come from many different, perhaps unexpected, fields of research. A particular issue or challenge pertaining to educational game use may be solved or described well by using theories or working processes gleaned from information systems research, instructional solutions design, or game design and development research – or, maybe more likely, a combination of them. With these difficulties in mind, this chapter constitutes one of the knowledge contributions of this thesis: an overview of the history and research of educational games, as well as relevant research from the broader field of game studies and other neighbouring fields.

To make the outcomes of these somewhat disjointed literature studies easy to follow, they are divided into four separate chapters. The first chapter provides a brief history of how serious games, educational games, and game-based learning emerged as fields of research and practice. Following this brief retrospective, chapter 5 provides more details of how research within the field has grown and changed. The chapter presents an overview of the different types of research conducted within the fields of educational games and game-based learning. Subsequently, a presentation of some of the arguments related to why games are interesting from a pedagogical standpoint, as well as arguments related to why it may be more problematic than initially thought. Chapter 6 presents some examples of player experience and game design research, and connects it to contemporary research and the practice of educational game design and development. Finally, chapter 7 introduces some concepts and theories from neighbouring fields of research that I have found useful when examining and describing educational game development and game-based learning processes. These four different chapters all converge to paint a complete picture of the theories, actors, and challenges involved in educational game design and development, as well as game-based learning processes.

CHAPTER 4
A BRIEF HISTORY OF EDUCATIONAL GAMES AND SERIOUS GAMES

In this inaugural background chapter, a brief retrospective of how serious games and educational games grew alongside entertainment games as their own communities of practice and research. This retrospective primarily covers how research and practice grew and changed throughout the past six decades. Further details regarding theories and debates surrounding games' potential as venues for 'serious' pursuits is provided in chapter 5.

4.1 THE RISE OF DIGITAL GAMES AND EDUTAINMENT

This retrospective provides a brief overview of how digital educational games, while intertwined with entertainment games in many ways, grew into its own community of practice and research. When talking about the history of the broader field of educational games and its parent field of serious games, it is important to acknowledge that games have been used to present caricatures and abstractions of reality and concepts for "serious" purposes for almost as long as they have existed as a facet of human culture. A popular and recognisable example of this, although far from the oldest, is *Chess*. The instructional history of Chess is believed to reach back to its inaugural roots in India during the 7th century (Kende & Seres, 2006; Shenk, 2007). Chess, while its societal significance and meaning has changed many times throughout its lifespan, is believed to have begun as a way to practice strategic decision-making in the military and improve logical thinking (Shenk, 2007). By representing challenges faced by strategists, Chess aimed to distil real concepts of warfare and make them presentable in a manageable framework, in order to provide players with a platform on which to experiment and train in a typical serious game-esque manner. So while the basic principle of using games for "serious" purposes is not new, the manifestation of the principle through digital games is in comparison quite novel (Djaouti et al., 2011).

4.1.1 THE 1960S AND EARLY 1970S – THE EARLY YEARS

It should also be noted that digital educational games not only grew out of the use of analogue games, but were equally beholden to a pervasive perception that playful activities could (or perhaps should) be coupled with learning, literacy, and other pursuits of childhood development (Ito, 2009). According to cultural anthropologist Mizuki Ito's studies on the history of children's software (2009), educational games were less of a revolution, and more of an expansion of precedents set by children's literature, television, and toys. A rhetoric surrounding 'productive' child's play permeated the early 20th century (Cross, 1997), and was not something that was uniquely tied to games or the use of technology (Ito, 2009). Thus, educational games already had a stable platform from which to take off, as soon as new digital technologies became available.

These new technologies began as a small off-shoot of software engineering, and were made to test and display the capabilities of the technology of the time. *Tennis for Two* (Higinbotham, 1958) and *Spacewar* (Russel et al., 1962) are often pointed out as the games that heralded the medium as we know it today. However, it would take a decade before games were able to transcend the halls of engineering institutions and make their way to the public (Kent, 2001). The Magnavox Odyssey, the first commercially available game system for home use, was released in 1972 and marked the start of games as a potential retail market venture. In the same year, *Atari* engineer Al Alcorn created *Pong* (1972), a coin-operated arcade machine at the time. It is interesting to note that the advent of digital educational games did not linger behind the one of digital entertainment games. *The Oregon Trail* (Rawitsch, Heinemann & Dillenberger, 1971), an iconic title in gaming regardless of educational/entertainment labels, saw its first release in 1971, when it was developed by researchers at the University of Minnesota and put to use in a small school district in the state (Kickmeier-Rust, Mattheiss, Steiner, & Albert, 2011). Thus, the 1970s saw the inauguration of the entertainment game home console- and arcade market, as well as digital educational games. From the moment that the Magnavox took its first steps into the marketplace, interest in games as a craft and commercial enterprise evolved and grew very rapidly. Games quickly went from being a fringe novelty product to a significant global industry mainly consisting of arcade halls, computer games and home consoles.

4.1.2 THE 1970S AND 1980S – GROWING RESEARCH AND PRACTICE

During the late 1970s and early 1980s, educational games became more established as a field of both practice and research. Following the steady proliferation of computers and information technology in homes and work-places, a plethora of projects to bring computers into classrooms, and utilise the affordances provided by these new technologies, were initiated. For example, *The Fifth Dimension* and *Apple Classrooms of Tomorrow* endeavoured to bring computers into schools and after-school clubs in the US (Ito, 2009). In the UK, computer programming classes started being issued, and a national government program to distribute specially developed school computers (The BBC Microcomputer System) to local school districts was established (Kirkpatrick, 2015; Lovegrove & Wilshire, 1997). Similar projects were started in Sweden, where a government funded project to create a computer specifically tailored for use in school settings, COMPIS, was launched in 1981 (Kaiserfeld, 2000). The early 1980s were thus characterised by significant investments put towards getting technology into the hands of educators and school children. Many initiatives were pioneered either by government organisations or user communities and developers that collaborated to achieve positive social change on the wave of the new technology boom (Ito, 2009). The early 1980s is also of etymological importance as the 'edutainment' moniker was first associated with games in 1984 as the game *Seven Cities of Gold* (Ozark Softscape, 1984) was published by Electronics Arts with the buzzword prominently featured in its PR campaign (Cheung, Li & Zapart, 2006; Egenfeldt-Nielsen, 2006).

Interesting to note is that the educational aspects of games and game hardware were important contributors to the proliferation of home computers and the subsequent growth of entertainment games and gaming culture in this important time period. According to Kirkpatrick (2015), the ambiguous purpose of home computers – being a hybrid machine that was both educational (by preparing children for a tech-driven future) and a source of entertainment – incited parents to purchase them, whereas Atari home consoles were mostly framed as entertainment products. Facilitated by this proliferation of computers in schools and homes, the communities and industries around digital educational games started to solidify into a more palpable movement with a stronger sense of direction (Ito, 2009). Educators and developers who saw the potential in new technologies established companies that would go on to dominate the future 'edutainment' market (e.g. The Learning Company founded in 1979, Brøderbund founded in 1980, and Davidson & Associates founded in 1983[2]). Ito, from her interviews with practitioners and educators from the era, categorises the early 1980s as being filled with "a sense of optimism and social mission" (Ito, 2009, p. 38) where the promises of new technologies started to emerge through continuous experimentation and real-world application.

The research surrounding the potential and craft of digital games for education and training started gaining more traction during this decade as well (Egenfeldt-Nielsen, 2006; Habgood & Ainsworth, 2011). An example of this is one of the earliest dissertations on the topic: *What makes things fun to learn? A study of intrinsically motivating computer games* by Malone (1980a). In his work, Malone delved into how and why new forms of entertainment games had potential to be a valuable tool in traditional teaching environments (Malone, 1980a, 1980b, 1981). Academic discourse regarding digital games had been scarce before this point, with only a handful of books and scientific publications (Washburn, 2003), but the 1980s cemented digital game-based learning as a field of research.

This decade also marks an important 'coming of age' for video games as a medium and a culture in its own right, and the home consumer market for computers and gaming machines started growing. While the games industry in the 1970s was highly informed by US software companies and products (e.g. Atari consoles and arcade machines), the rise of home computers outside of the US, and a downturn in the arcade market, saw a shift in the power dynamics and distribution channels of game development and consumption (Kirkpatrick, 2015)[3]. Whereas arcade machines' coin-dependent income model necessitated certain types of designs (Burgun, 2012), the expansion of the home market and increasing variation of technologies broadened the venues for new types of game narratives and experiences (Newman, 2013). The expansion of the home entertainment market through consoles such as the Nintendo Entertainment System, and the increasing prevalence of home computers thus helped expand and diversify the types of stories and challenges provided by games. Developers became increasingly inspired by works of film, literature, new animation techniques, as well as advancements in cognitive sciences and moved away from the pure high-score focused games that previously dominated the market (partly due to the popularity of arcade halls). Games were being given more and more space to tell stories and set challenges that were not solely focused on finding ways of killing the player (i.e. extracting more coins from them). As these influences from other media made their way into games, games themselves started moving away from being a pure computer

[2] Some of the companies' more notable educational titles are:

The Learning Company: the *Reader Rabbit* series.

Brøderbund: the *Where in the World is Carmen Sandiego?* series.

Davidson & Associates: the *Math blaster* series.

[3] It is important to note that while games grew as an industry and craft, games as a "culture" became increasingly narrow and exclusionary – in essence, the 1980s is when games became a male preserve (Kirkpatrick, 2015).

science/software development-based field. A couple of games that exemplify this change are *The Legend of Zelda* (1986), created for the Nintendo Entertainment System, and *Prince of Persia* (1989), created for the Apple II computer. The former was a significant step forward for the medium due to its grand open-world design that allowed players to experience an epic story of a hero's journey (Kent, 2001), and the latter due to its adventure film inspired storytelling, as well as its vivid graphics and rotoscoped animations that depicted human movement with high fidelity and fluidity (Fox, 2006; Mechner, 2011). Thus, the 1980s represent an important decade in the growth of games as a craft and as consumer goods. Increasing affordability, and the availability of home computers in particular, not only opened up game consumption, but also game development, to a broader populous (Kirkpatrick, 2015).

4.1.3 THE 1990S – THE END OF EDUTAINMENT

The emancipation of entertainment games continued and accelerated in the 90s, as the craft of game development continued to distinguish itself from its computer science roots. The field started becoming a uniquely interdisciplinary craft, rather than mainly being subservient to software development and computer science. As the possibilities of what could be expressed with game technology kept expanding, influences from cognitive sciences (e.g. Human-Computer Interaction, experience, and embodied cognition) and the arts (narrative, dramaturgy, visual language, and colour composition) played an increasingly larger role in the creation of games. Perhaps as a result of this convergence of disciplines, the number of academic publications in the area of game development and game studies also increased. The year 1994, in particular, marks an important peak in research interest, as 70 scholarly works in the field of game studies were published that year, a significant increase from the 34 publications in 1984 (Washburn, 2003). To compare the two decades, the number of papers on games published in the 1980s was roughly 43 papers per year, whereas the 1990s saw an average of 62 papers per year (Washburn, 2003).

More importantly for the field of educational games perhaps is that this decade saw severe changes in the edutainment industry's working processes and structures, and a subsequent decline of the edutainment market. While the industry had been growing steadily during the 1980s, the optimism and enthusiasm that characterised the previous decade started to calcify into more rote development practices in service of large-scale commercialisation:

> "As the educational software industry matured through the 1990s, the groundbreaking approaches of educators such as McCormick [of The Learning Company] and Davidson [of Davidson & Associates] were converted into an industry model that is more formulaic than revolutionary. [...] Market demands converted McCormick's constructivist educational philosophy and egalitarian goals of reaching the technologically disenfranchised into a way of profitably delivering curricular content to middle-class families." (Ito, 2009, p. 40-41)

The market for edutainment kept growing steadily until the mid-1990s, at which point it started rapidly declining to later collapse entirely at the turn of the millennia (Ito, 2009; Shuler, 2012). The swiftness with which the market collapsed is hard to overstate. For example, the Learning Company was purchased by Mattel for $3.5 billion in 1998, and was sold for a mere $26.3 million only a few years later (Ito, 2009). There are several descriptions of how and why the edutainment market collapsed (e.g., Egenfeldt-Nielsen, 2011; Ito, 2009; Klopfer, Osterweil & Salen, 2009; Shuler, 2012), and it is often attributed to a combination of factors:

- Decreased computer time in labs due to the internet making computers potent research tools and decreasing the time they were available for gameplay (Shuler, 2012).

- Edutainment games offered many promises, but rarely amounted to more than drill-and-practice games made only to blunt the monotony of repetitive exercises (Egenfeldt-Nielsen, 2011; Ito, 2009; Klopfer, Osterweil & Salen, 2009).
- Edutainment suffered greatly from downward pricing pressures caused by a consolidation of the consumer market for software - edutainment software had to start competing against entertainment games and other CD-based software for shelf space in major retail chains (e.g. Cosco, Walmart, Toys 'R' Us) (Ito, 2009; Klopfer, Osterweil & Salen, 2009; Shuler, 2012).

Edutainment games rapidly started falling behind their entertainment game counterparts in terms of quality and marketing. While entertainment games leveraged technology advances to improve player experiences, edutainment games stagnated (Ito, 2009; Klopfer, Osterweil & Salen, 2009).

After a few turbulent years in the late 1990s, the market for 'edutainment' products receded and the term eventually fell into disuse (Ito, 2009). For a period after this market demise, game companies have been wary about officially associating their titles with educational concepts, even though the game may very well have valuable informative and educational content (Shuler, 2012). Ito (2009) summarises game-based edutainment as an example of "[a] new technology that was accompanied by a set of heightened expectations, followed by a precipitous fall from grace after failing to deliver on an unrealistic billing" (Ito, 2009, p. 10).

Entering the new millennium, entertainment games were growing rapidly as an industry, and games with "serious" purposes were dwindling in popularity (Djaouti et al., 2011; Kirriemuir & McFarlane, 2004). The market shifts during the 90s left the space for educational games in a stagnant state, where they were beholden to structures of commercialisation rather than education, and their intention based on "brand recognition and achievement anxiety rather than on innovation in design and depth in content." (Ito, 2009, p. 42). While some of the rote market structures that educational games became entrenched in are still prevalent, a lot has happened in educational games practice and research since the turn of the millennia. With this brief retrospective as a frame of reference, the remainder of the background chapter describes how current practices and research, within both entertainment games and serious games, have changed since the early 2000s.

4.2 21ST CENTURY SERIOUS GAME STUDIES

After the disintegration of edutainment at the turn of the millennia, new terms and concepts emerged to fill the gap it left behind. One of the more widely recognisable ones is 'serious games', which has its origins in the launch of the Serious Games Initiative in 2002 (Sawyer, 2009). The initiative, which was led by Ben Sawyer and Peter Smith at the Woodrow Wilson Academy, resurrected the 'serious games' term that was originally used in Clark Abt's work published back in 1970 (Abt, 1970; Sawyer, 2009). Abt had used the term to describe how different types of games, mainly card games and board games, could be used for various "serious" purposes. But, for the purposes of the Serious Games Initiative, it was appropriated to mainly describe digital games with purposes beyond pure entertainment (Djaouti et al., 2011).

As opposed to edutainment, the serious games movement is not as deeply ensconced in the strictly educational branch of "serious" game endeavours, and covers a wide variety of purposes that are pursued through the use of games. The broadness of the term becomes clear when looking at the *Taxonomy of Serious Games* provided by Sawyer and Smith (2008), which intended to codify the term's proliferation six years after its inauguration (see Table 4.1). Education, however, remains the most common focus of serious games. In a survey conducted in 2009, 63% of serious games were found to be focused on academic learning, 14% were games for social change, 9% were for occupational training, 8% were within the realm of healthcare, 5% were military applications, and less than 1% were focused on advertising (Ratan & Ritterfeld, 2009).

Table 4.1: The taxonomy of serious games, as presented by Sawyer and Smith, 2008.

	Games for Health	Advergames	Games for Training	Games for Education	Games for Science and Research	Production	Games as Work
Government & NGO	Public Health Education & Mass Casualty Response	Political Games	Employee Training	Inform Public	Data Collection / Planning	Strategic & Policy Planning	Public Diplomacy, Opinion Research
Defense	Rehabilitation & Wellness	Recruitment & Propaganda	Soldier Support / Training	School House Education	Wargames / Planning	War Planning & Weapons Research	Command & Control
Healthcare	Cybertherapy / Exergaming	Public Health Policy & Social Awareness Campaigns	Training Games for Health Professionals	Games for Patient Education and Disease Management	Visualisation & Epidemiology	Biotech Manufacturing & Design	Public Health Response Planning & Logistics
Market & Communications	Advertising Treatment	Advertising, Marketing, Product Placement	Product Use	Product Information	Opinion Research	Machinima	Opinion Research
Education	Inform about diseases / Risks	Social Issue Games	Train Teachers / Train Workforce Skills	Learning	Computer Science & Recruitment	P2P Learning Constructivism Documentary	Teaching Distance Learning
Corporate	Employee Health Information & Wellness	Customer Education & Awareness	Employee Training	Continuing Education & Certification	Advertising / Visualisation	Strategic Planning	Command & Control
Industry	Occupational Safety	Sales & Recruitment	Employee Training	Workforce Education	Process Optimisation / Simulation	Nano/Bio-tech Design	Command & Control

Parallel to the continued growth of entertainment games, the understanding of what serious games can bring to society has increased rapidly since the inauguration of the term. In more recent years, a perhaps more realistic and objective assessment of serious games is also starting to become manifest. Past and current research pointing towards the positive effects of playing games and the potential of serious games is not without its issues of bias. For instance, meta-analyses of research has shown that many studies suffer from low ecological validity, sound methodolical frameworks, and other limitations, but that they still conclude with sweeping statements regarding games' positive effects on players (Egenfeldt-Nielsen, 2006; Linderoth, 2010; Mayer, 2012). This positive discourse might be a heritage from a time when games needed to be actively defended and validated, and games' positive potentials may have been overemphasised as a counter-weight to legislators', censorship lobbyists', and popular media's dismissive or staunchly negative attitudes towards games. However, as games have matured and become cemented in modern culture (Bogost, 2008), it has also become increasingly clear that the terms 'games' and 'serious games' describe very nuanced fields of research and development (Crookall, 2010; Nieborg & Hermes, 2008; Sawyer & Smith, 2008; Squire, 2007). As a result of this, the criticism of serious games has started to become more varied, specific and detailed. Serious games is nowadays understood to be an umbrella term that describes games for learning, training, healthcare, persuasion, motivation, social change, marketing, etc., which has been important in advancing the dialogue around them. Furthermore, as opposed to edutainment, researchers in the field of serious games have more divergent opinions regarding how they should impact society. Whereas edutainment titles mostly became assistive technologies aimed at supporting established educational practices, there are many proponents who consider serious games a subversive force that can reveal flaws of deep-seated institutionalised practices (Bogost, 2008; Laurel, 2003). This movement asks the question whether the difficulty of applying games in educational environments is a symptom of games being a leisure activity unsuitable for such serious contexts, or of the educational environments being constructed in a dated way that prevents participatory, experiential, dynamic, and engaging learning.

As a field of research, serious games often borrow frameworks and theories established in the broader field of game studies, but add additional layers of enquiry regarding how game experiences and game development processes can be directed towards "serious" pursuits (Connolly et al., 2012). However, perhaps as a result of serious games needing to define their own position in relation to its edutainment predecessor and entertainment games, the field also has a strong heritage of ontological research (Djaouti, Alvarez & Jessel, 2011; Djaouti et al., 2011). A lot of scholarly work has focused on describing the ways in which serious games distinguish themselves from entertainment games and other software (Bogost, 2007; Ratan & Ritterfeld, 2009), whether a game with a serious purpose can actually be considered a game at all (Rodriguez, 2006), their potential areas of application (Arnab et al., 2012; Kiili, 2005), and how different "genres" of serious games should be categorised and researched (Marsh, 2011; Mayer, 2012; Raftopoulos, Walz & Greuter, 2015). Since its inauguration, the purpose and place of serious games has thus been continuously scrutinised, questioned, and redefined (cf. Bogost, 2007; Djaouti, Alvarez & Jessel, 2011; Egenfeldt-Nielsen, 2006). Ultimately, these continuous debates have contributed much to the current, more nuanced understanding, of the individual subsets of game types, practices, and research foci that come together to form the entirety of the serious games field.

To summarise, the field of serious games has been in a constant state of transition. The field's infancy was predicated on the demise of the edutainment market, and much of its adolescence has been spent clearing the residue of negativity left by its predecessor. The discourse has begun to highlight not just differences between serious games and edutainment, but also the differences between serious games and the popularised and general definition of games, as well as detailed critiques within the different sub-categories of serious games. The craft of serious game development is starting to be seen not as a subordinate to game development, software development or the development of training, educational, motivational or informational tools, but as a craft in its own right with its own multi-disciplinary challenges (Harteveld et al., 2010). In that way, serious games are doing what entertainment games did in the 1990s – establishing themselves as their own field of research and development with the emergence of theories that, while in part based on theories from neighbouring fields, are specific to the craft and its artefacts. With this emancipation, the potential of serious games has begun to be better defined and, along with it, the practical barriers, which need to be overcome in order to make good on this potential, are starting to unravel (Bogost, 2008; Egenfeldt-Nielsen, 2008, 2010; Young et al., 2012). Design theories and models aimed at tackling some of the barriers that prevent serious games from reaching more wide-spread use are starting to surface (e.g., Harteveld et al., 2010; Kickmeier-Rust et al., 2011; Moreno-Ger et al., 2008; Schoppek & Tulis, 2010). That being said, the interest and proliferation of the serious games term are outpacing the development of generally applicable guidelines which ensure that the potential of serious games (or any of its sub-categories) can be properly tapped into (Connolly et al., 2012) (Egenfeldt-Nielsen, 2010, 2011).

CHAPTER 5
CONTEMPORARY PERSPECTIVES ON EDUCATIONAL GAMES

In this chapter, research and practice within the field of educational games is described in detail. Important to note, however, is that much of the reference material used in the description of educational games in this thesis is often not limited to just educational games, but also includes papers and dissertations that are often directed at the general field of serious games. The reason for having a relatively inclusive scope when choosing the literature to include in the literature study overview is that general serious games research has a lot to bear with regard to discussing educational games, as the latter is a sub-category of the former. This relationship works both ways as well. Material that primarily makes statements about educational games specifically is seldom specifically labelled and limited as being “educational games literature”. This is perhaps because the terminology within the field is somewhat ambiguous, but perhaps also because most commentary made upon the educational potential of games is highly relevant to the majority of genres within serious games. With this in mind, many of the references used are serious games research which contains results and conclusions that are suitable for describing educational games, and, for the sake of the reader, the statements presented here can be understood as statements regarding the field of serious games as well. To point out a specific example, the issue regarding the concept of transfer (Barnett & Ceci, 2002; Rick & Weber, 2009; Shaffer, 2012), which refers to how well knowledge acquired within one domain transfers to other areas of application, is often discussed in serious games literature, but is directly applicable to educational games as well. This type of educational games-relevant, but not specifically educational game labelled, research is described and used throughout this chapter.

5.1 AN OVERVIEW OF EDUCATIONAL GAME AND GAME-BASED LEARNING RESEARCH

Just as the broader disciplines of games and serious games research, educational games is an interdisciplinary field of research and the methodological approaches to studying educational games as a phenomenon are plentiful and influenced by different neighbouring research disciplines (Crookall, 2010; Mäyrä, Holopainen & Jakobsson, 2012). As previously described, game studies have, in the past, had a tendency to rely on methods found in fields perceived to be more established. This has led to certain “identity” issues as few methodologies and models existed that were specifically tailored to be suitable for studying and describing games (Crookall, 2010; Egenfeldt-Nielsen, 2006; Harteveld et al., 2010).

This has, in recent years, been somewhat ameliorated by the development and use of new game-specific methodologies. Nonetheless, there is still some confusion regarding how games can and should be studied (Mäyrä, Holopainen & Jakobsson, 2012), and this befuddlement trickles down to the studies of educational games as well. Depending on what facet of educational games the researcher aims to study, different approaches are of course more or less suitable. For instance, there are psycho-pedagogical approaches that can be useful for identifying learning elements that are present in games or for assessing learning effects that emerge during and around game play, and there are cognitive-psychology approaches that can identify which types of heuristics are being employed during game play or what types of mental challenges certain game mechanics produce. But, as our understanding of games as a medium has increased, more game-specific approaches are starting to surface. This means we have a better grasp of how to evaluate a player's experience of certain game mechanics or audio-visual stimuli, or to identify what elements of specific game scenarios are detrimental or beneficial for player engagement (Cowley et al., 2008; McLaughlin, Smith & Brown, 2010). In educational games, it can be beneficial to employ approaches such as these during different phases of an educational game's lifespan, perhaps to evaluate the quality of the game experience during play testing, or to assess whether the game effectively conveys the learning content appropriate for a particular curriculum through its gameplay. This chapter provides a brief overview of educational games as a field of research, as a development and design practice, as well as educational tools in the hands of teachers and students.

Before delving into more detailed deconstructions of the many facets of the area of serious and educational game research, a brief description of how they can be approach is necessary. In Table 5.1, the commonly found research approaches in the field have been categorised and linked to a couple of specific examples found in educational games as well as serious games literature. A brief description of the aspect of serious/educational games that the approaches usually aim to investigate and a brief commentary on their methodologies are also included. The reason for including more general serious games literature in the summary is that it is, as previously mentioned, difficult to draw a clear line of distinction between the research that is only applicable to educational games and not serious games, and vice versa.

The table highlights the importance of being inclusive to many different types of approaches and methodologies within the educational games discipline. Just as an educational game comprises a range of different disciplines, of which each one adds certain essential characteristics to the final product, each research approach is needed to obtain a complete picture of what goes into the act of making, utilising, playing, and even researching, educational games. As in the cases of the research presented by Kirkley, Tomblin and Kirkley (2005) and Engström et al. (2011), for instance, educational games can be examined as a practical craft. Research methods, such as experimental prototyping and case studies of development projects, can thus yield data that reveals details regarding the processes of educational game creation. Conversely, one can take a more distanced role as a researcher, by not taking active part in the creation of specific artefacts. Examples such as Linderoth (2009, 2010, 2012), Shapley et al. (2011), and many others, tackle the pedagogical aspects of educational games, often examining them through observation and assessments. By either applying specific game titles to educational situations, or by analysing collected knowledge of more "general" gaming behaviours, comparisons are made to behaviours associated with reflection and learning established in pedagogical research, in order to ultimately speak for the validity of games as learning environments.

Table 5.1: A general overview of research foci and methodologies in educational games and serious games research – coupled with specific examples of published research.

Research category	Research examples	Research focus/questions	Methodological approach
Ontological research on serious games and educational games	Crookall (2010) Sawyer and Smith (2008) Ritterfeld and Weber (2006) Squire (2007)	What is a serious game? What categories of serious games are there?	Literature and product surveys. Comparisons with literature and products from other disciplines.
Development of assessment methods	Ennemoser (2009) Kickmeier-Rust et al. (2011) Garzotto (2007)	What tools can we use to better understand behaviour during 'serious' gameplay? How can we assess play activity?	Experimental prototype development of games incorporating assessment methods. Case studies, applying experimental assessment methods to analyse gameplay.
Social constructivism in and around game activity	Dirckinck-Holmfeld and Sorensen (1999) Holmes and Pellegrini (2005) Bennerstedt and Linderoth (2009)	What social constructs arise during, primarily multiplayer, game sessions? How do games affect social interplay, and what are the pedagogical implications?	Observations Ethnographic studies Autoethnographic studies
The design of educational games	Annetta (2010) Bellotti et al. (2009) Harteveld et al. (2010) Malone (1980b) McLaughlin, Smith and Brown (2010) Moreno-Ger et al. (2008) Rai and Beck (2012a) Pereira and Roque (2009)	How can we improve on the design of serious games and educational games? Which game designs suit certain subject matters and methods of teaching? How do you balance engagement and learning content?	Experimental prototype development with play-testing sessions with observations and interviews Design studies, examining the validity of certain design choices through practical, purposeful application
Comparisons of games and pedagogical principles	Annetta, Cook and Schultz (2007) Blumberg and Ismailer (2009) Egenfeldt-Nielsen (2011) Linderoth (2009, 2010, 2012) Gee (2005, 2009, 2011); Gee and Hayes (2012)	What, if any, are the pedagogical benefits of using educational games? What types of learning elements do games possess?	Ecological research that studies the way players approach game tasks Literature comparisons, commonly between pedagogy and game studies Coupling pedagogical practice to specific game characteristics
Cognitive / Psychological processing in gameplay	Alexandersson, Linderoth and Lindö (2001) Ko (2002) Egenfeldt-Nielsen (2004) Lee and Peng (2006)	What types of cognitive processes are being put to use in a particular gameplay challenge? Which types of heuristics do certain games require?	Observing play-sessions Think-aloud methodologies Ecological research and discourse analysis
Learning outcomes and the effectiveness of educational games	Engström et al. (2011) Garzotto (2007) Guillén-Nieto and Aleson-Carbonell (2012) Schoppek and Tulis (2010) Squire et al. (2004)	How effective are games as learning tools? What learning outcomes can be seen from the use of educational games?	Mixed methods used to compare educational games to other educational processes Assessing increased computational or conceptual understanding during play Experimental prototype development and evaluation
Development of educational games	Engström et al. (2011) Eladhari and Ollila (2012) Kirkley, Tomblin and Kirkley (2005) Wagner and Wernbacher (2013)	What does the process of creating an educational game look like? What challenges do the developers and clients face, how can they be overcome?	Experimental prototyping Case studies, following development projects alongside clients and/or developers
Educational games' as tools in their intended context	Alklind Taylor and Backlund (2012) Egenfeldt-Nielsen (2008, 2010) Nilsson (2008) Nilsson and Jakobsson (2011)	What are the properties of the context in which games are being used? What is the role of the teacher/instructor? How does the game fit into the broader organisation context?	Case studies, examining situations where educational games are put to use Observing play sessions and interviewing players are common approaches
Perceptions and attitudes pertaining to educational games	Tan, Neill and Johnston-Wilder (2012) Ruggiero (2013) Wastiau, Kearney and Van de Berghe (2009) Razak, Connolly and Hainey (2012)	What opinions do teachers, students, legislators, and parents have towards using games as learning tools?	Interviews, surveys and questionnaires

The research pursuing more high-concept ontological questions, regarding what an educational game is, often takes an even more distanced approach, and discusses the characteristics of gameplay and learning through a more philosophical and all-encompassing lens. This produces important grand scale theories and a more detailed vocabulary that assist further discourse within the field. The other research approaches, described in Table 5.1, exist within this spectrum of practice, hands-off observation and assessment, and philosophising.

Looking at the examined examples provided in Table 5.1, it is also apparent that qualitative methodologies and mixed methods are common approaches to studying many facets of educational games. However, in a few research areas, such as the evaluation of learning outcomes and the perceptions of games as educational tools, a more quantitative approach is taken, by employing more rigid experiment methodologies and detailed surveys respectively (Schoppek & Tulis, 2010; Tan, Neill & Johnston-Wilder, 2012). A couple of common approaches, with regard to learning outcomes, used, for instance, by Schoppek and Tulis (2010) and Garzotto (2007), are to compare outcomes from educational games with other educational methods or measuring the increasing game proficiencies in students that play educational games (Egenfeldt-Nielsen, 2006).

5.2 GAMES' EDUCATIONAL POTENTIAL

A good place to start when describing the nature of educational games is to look at what gives them their *raison d'être*. From the perspective of many educators and proponents of game-based learning, games are viewed as a medium in which the current generation excels (Bellotti et al., 2009; McClarty et al., 2012). Students are seen navigating game environments with ease while regularly employing various methods of problem solving, and they engage in advanced collaborative efforts and communicate complex concepts to one another during their private gaming sessions at home (Bogost, 2007; Egenfeldt-Nielsen, 2006; Gee, 2003). Seeing students relish in and master activities that are fundamentally analogous to what teachers work very hard to interest them in during their time at school is, of course, a big catalyst for wanting to harness "the power of games" for educational purposes (Kickmeier-Rust et al., 2011; McClarty et al., 2012; Shapley et al., 2011). The basic premise that fuels the ambition to use games for educational purposes is just that observation; games encapsulate the 21st century skills that education should focus on, like advanced problem solving, collaboration, and invention and communication of ideas and solutions in a technology-mediated setting (McClarty et al., 2012; Shapley et al., 2011). Children and young adults seem to eagerly devote several hours per day doing these things on their own in game settings, so let us take these experiences and lift them into an educational setting. Much of the research within the field has been looking at games in the same way. It has focused on scrutinizing these traits of games and explaining if and how games teach, often juxtaposing pedagogical principles with principles of game design (Egenfeldt-Nielsen, 2006; Gee, 2009; Malone, 1980b).

Many researchers support the notion that games possess various laudable educational qualities based on the characteristics that define the medium. This often stems from the understanding that the basic premise unique to the medium is that the player develops mastery within a very specific domain (i.e., the game world he/she currently inhabits) in order to progress and achieve goals presented by the game (Annetta, 2008; Annetta, Cook & Schultz, 2007; Gee, 2003, 2005; Malone, 1980b). Well-made entertainment games are designed with an incremental difficulty increase and scaffolding principles that "ease" the player into the game world initially and then gradually present more tools and opportunities to interact with the world, as well as new problems and challenges for the player to solve (Gee, 2003; Kickmeier-Rust et al., 2011). So, in their essence, entertainment games seem to incorporate the core educational principles of scaffolding and problem-based learning to a great extent and also with great success as players' proficiency in most games increases quite rapidly as they play (given that the game is decently designed and put together) (Annetta, 2008; Annetta, Cook & Schultz, 2007). In addition to this, games are also considered to have a unique way of engrossing the player in a subject matter (Cowley et al., 2008). These are the more common arguments that favour educational games and fuel many researchers' and educators' efforts into understanding, creating, and using them (Linderoth, 2012). Hence, the question that has often been asked is: how can the high levels of engagement that players experience and the immense effort they exert to master a game be channelled elsewhere (Annetta, 2008)?

To give a more nuanced and detailed description of the way games cater to pedagogical principle, the basic categorization of behaviourist, cognitivist, constructivist, and sociocultural learning principles and how they manifest in different types of gameplay is a good starting point. As the understanding of knowledge and learning has progressed, the nature of educational games has progressed with it, and design trends can often be directly connected to contemporary teaching practices (Egenfeldt-Nielsen, 2006). The most common types of educational games have historically been the ones based on behaviourism. Behaviourism is, in essence, the principle of teaching correct behaviour and action through the use of positive or negative reinforcement, and has its origins in the works of researchers like Skinner, Pavlov and Thorndike (Egenfeldt-Nielsen, 2006; Mödritscher, 2006). In the behaviourist paradigm, the internal functions in the mind of the learner are largely irrelevant, and more emphasis is placed on the observable reactions the learner has to external stimuli (Mödritscher, 2006). In an educational context, this could, for example, mean rewarding a student in some way when he/she has correctly solved a number of math equations to encourage persistence in that specific behaviour. A behaviourist approach is suitable for learning through repetition, as correct actions can be repeatedly rewarded and encouraged, and thus desired patterns of behaviour can be reinforced (Egenfeldt-Nielsen, 2006). The relatively straightforward principle of action and reinforcement has made the behaviourist approach common in educational game design in the past, as that is essentially how digital games themselves were designed throughout the 1970s, the 1980s and the early 1990s (Egenfeldt-Nielsen, 2006).

However, while behaviourist educational games have been severely declining in popularity the past decade due to their simplicity and somewhat archaic learning principles (Ito, 2009), they should not be totally dismissed. While it is true that behaviourist titles do not develop the player's conceptual understanding of a certain subject matter, repetition and reinforcement can still be an efficient way of practicing computational skills or developing a positive association to certain behaviours (e.g. calculation or spelling, or healthier eating habits) (Egenfeldt-Nielsen, 2006). During the 1990s, the reliance on behaviouristic principles declined in educational settings and, along with it, behaviourist game titles became increasingly sparse.

The behaviourist perspective of educational game design has since been largely replaced by several other approaches to learning: cognitivism, constructivism and socioculturalism (Egenfeldt-Nielsen, 2006). Cognitivism and constructivism share many commonalities and are primarily focused on supporting the processes being employed by individuals when they develop an understanding of the world around them (Mödritscher, 2006). Cognitivism focuses heavily on the learner and, more specifically, the cognitive schematas that underpin human perception and understanding (e.g. memory, reflection, and meta-cognition) (Egenfeldt-Nielsen, 2006; Mödritscher, 2006). As opposed to the behaviourist model, the cognitive approach is based on the idea of the 'intrinsic motivation' to learn and discover the nuances of a subject matter by self-incentivised exploration (Malone, 1981). Thus, the cognitivist approach to educational games view them as an autotelic process in which the act of learning has purpose in and of itself and should not be encouraged by arbitrary extrinsic rewards. The constructivist perspective has a similar outlook on learning as an intrinsically motivated process, but places more focus on the objects that facilitate the learning process and the learner's ability to construct knowledge on their own based on experience (McLeod, 2003), rather than looking at the cognitive processes of the individual. In terms of gameplay, both cognitivist and constructionist principles tend to manifest in games that encourage exploration and discovery (Egenfeldt-Nielsen, 2006), but they do so for slightly different reasons. A cognitivist educational game incorporates the taught subject matter in the gameplay, and will challenge the player's ability to master the game's vocabulary to solve problems. The problems will be increasingly difficult and further challenge the player's ability to approach the problem and figure out efficient procedures for solving them. Constructivist games do not fixate on incorporating content that accurately represents the taught subject matter into the gameplay to the same extent, and often do not have the same increasingly challenging problem design. Instead, they focus on equipping the player with the tools necessary to express and explore concepts and ideas relevant to the subject matter. Here, the game becomes a vessel for creative expression, where students have the opportunity to build, test, observe and reflect on relationships between objects in the game world and, thus, construct a nuanced understanding of a subject matter:

> "In a constructionist perspective... the challenge is not to design an educational video game with relevant content. Rather, the hard challenge is to facilitate playing that makes the player engage with the material, discuss it, reflect on it, and use the video game as a means for constructing knowledge." (Egenfeldt-Nielsen, 2006, p. 198)

Both the cognitivist and constructionist approach have their own unique challenges and issues. Since they take the more ambitious stance of wanting the player to develop their conceptual understanding of a subject by exploration, discovery, and reflection, the primary issue lies in the transfer of knowledge from the game-world to the real-world (Rick & Weber, 2009; Shaffer, 2012). The game-worlds need to accurately describe the nuances of a subject matter articulately enough to make sure that the player: a) learns correct information that corresponds with cause-effect relationships in the real world, and b) is given the proper set of tools with which to explore the nuances of the subject matter without either being led through a pre-established cause-effect situation that negates exploration or makes them able to just brute-force their way through the game.

Finally, the sociocultural approach to learning advocates the importance of providing a wider context in which learning can take place (Egenfeldt-Nielsen, 2006). In this paradigm, learning and knowledge are considered to only be "real" or occurring insofar as they are anchored in a broader social and cultural context (Hall, 2007). An individual's social and cultural situation will influence the way she/he creates meaning and cognitive representations, and the social and cultural context also provides the forum for discussing, reflecting, and sharing gained knowledge (Grabinger, Aplin & Ponnappa-Brenner, 2007; Hall, 2007). As is the case with constructivism, games that facilitate sociocultural learning processes are required to be open to creative expression and experimentation, but also for socialisation. In this case, the game will serve as a basis for discussion and can contextualise a subject matter in a virtual environment; the content of the game is, however, secondary to the broader educational context in which it is placed (Egenfeldt-Nielsen, 2006). Thus, games of this nature place a lot of onus on teacher participation, as teacher-student interactions are crucial in framing the game experience and content in a correct way.

5.3 GAMES' SHORTCOMINGS AS LEARNING ENVIRONMENTS

Understanding the limitations of educational games has also been an important branch in educational game studies and for our understanding of how games work as pedagogical tools. Whether games can teach at all is often considered axiomatic at this point in time; if we agree that they are systems that can contain and convey information, it would be unreasonable to dismiss the idea that the conveyed information can have some staying power in its recipients. Nonetheless, games as a medium do still have shortcomings that are highly relevant to educational games, and exposing those limitations is important in maintaining a balanced discourse around educational games and game-based learning initiatives. One of the major, more persitent and recently better understood shortcomings that speaks against the educational potential of games is explained by Turkle (1995). From her observations in the game *SimLife: The Genetic Playground* (1992), Turkle distils the problem of knowledge transfer between simulations and reality as an issue of 'opaqueness' in game systems:

> "Games such as SimLife teach players to think in an active way about complex phenomena [...] But they also encourage people to get used to manipulating a system whose core assumptions they do not see and which may or may not be 'true'." (Turkle, 1995, p. 70)

The fundamental critique is that players are seldom privy to the principles behind the oversimplifications and compromises in the functional fidelity of objects that game designers often need to make in order to be able to create the game-world, keep it accessible and engaging, and to minimize hardware requirements. Players are thus only able to construct a superficial understanding of objects represented in games. In addition, their body of knowledge will be (perhaps unknowingly) constructed on a fundament of assumptions and compromises made during the design and development process. The knowledge from games that is then to be transferred to real-world contexts is thus superficial at best, and fundamentally flawed at worst; which in turn means that games have the potential to be faulty, and perhaps dangerous, teaching tools. This problematic concept has since been increasingly ratified by researchers and developers as well (Kirriemuir & McFarlane, 2004; Ko, 2002; Linderoth, 2009; Whitebread, 1997).

An expansion of the opaqueness concept is Linderoth's more recent examinations of skill and knowledge-development in video games (2009, 2010, 2012). While refuting the inherent potential of games as learning environments, which is a proposition supported by many (e.g., Annetta, 2008; Annetta, Cook & Schultz, 2007; Kiili, 2005; Lieberman, 2006) in the wake of Prensky's (2001) and Gee's earlier work (2003), it further defines the chasm between the craft of game development and serious games development. What Linderoth is critiquing is the assumption of there being a "hidden educational grail [in video game design] just waiting to be found and utilized in schools" (Linderoth, 2012, p. 46) and that this belief rests on a certain naiveté regarding the basic tenets of game design. Linderoth (2009, 2012) states that if a game environment is not properly designed to specifically facilitate learning, the players are unlikely to learn anything beyond the manipulation of game mechanics. As many games are designed around the idea of narrative progression, treating the medium as inherently developmental for skills or knowledge is a false assumption as progression can be, and often is, artificially supported in games. Players are often given assistive tools and guidance so that they can traverse through a game without engaging in overly laborious and in-depth performance practice and exploratory learning (Linderoth, 2009, 2010, 2012).

Linderoth (2009, 2012) examines the implications of this issue by applying an ecological understanding of learning to examples of gameplay, and specifically uses the concept of affordances to point out the fundamental differences between good learning environments and good game design. Referring to the works of James and Elaenor Gibson, Linderoth (2009, 2012) states that the idea of affordances is:

> "… that an environment with buildings, nature, different objects, humans and animals offers the individual different ways of acting. These offers are called affordances and they are relative to an organism (relative between species as well as between individuals). Water affords breathing for a fish, but not for a human. A chair affords sitting for an adult, but not for an infant." (Linderoth, 2009, p. 10)

An individual develops an understanding of their affordances by way of exploration and investigation. In the real world, people develop the understanding of objects' affordances gradually by exploration and mastery (Linderoth, 2009). The issue is that games often take authority over identifying and utilising affordance through the use of visual cues, modifying them with power-ups or changing them through other design methods (Linderoth, 2009, 2010, 2012). The players are provided with shortcuts in the game environment that reduce the need for the player to explore, practice and learn, since they can just follow these cues and methods to progress. Linderoth's research is not a complete dismissal of the notion that games can be tools for learning, but it is a clarification that games are not inherently educational. Games need to be carefully designed to teach in order for the player to learn something by engaging with them, and the designs that foster learning may deviate significantly from what is usually associated with "good game design" (Linderoth, 2009, 2010, 2012).

Closely tied into Linderoth's claims is another central issue that is briefly mentioned earlier in this chapter and is often brought up when discussing the pedagogical validity of educational games in general: the issue of knowledge transfer (Tobias et al., 2011). Transfer refers to the transferability of skill and knowledge developed and honed in one particular domain into other domains. Or, more specifically in the case of educational games and serious games – the transfer of skills and knowledge developed in a digital game environment into real-world scenarios (Gee, 2003; Rick & Weber, 2009). The core of the problem is the possibility that the only thing the player learns from playing a game is how to play the game better (Shaffer, 2012). If the skills and knowledge a student has learned inside the game environment cannot transcend the virtual world and become useful applicable knowledge in the real world, the learning activity has, in the end, been a failure, so it is a very important issue to examine closely. This specific issue is especially prevalent in educational games that are meant to function as 'self-contained' systems rather than situated activities. The lack of debriefing sessions and discussions coupled with the game session makes transfer both unpredictable and unlikely. However, the presence of teachers or peers, and opportunities for discussions and reflection, can contextualise the learning content from the game and generalise it so that its real-world application becomes more apparent (Tobias et al., 2011). Transfer is an established concept within psychology that is used to describe the level of generalisability of learned skills or knowledge (Barnett & Ceci, 2002). Knowledge that is closely tied to a very specific domain and cannot be applied to understand concepts outside the domain where the knowledge originated is classified as near-transfer and can be considered as relatively shallow (Shaffer, 2012). Conversely, knowledge that is generalisable and can transcend boundaries to provide insights into several domains is classified as having far-transfer (Barnett & Ceci, 2002).

In the field of educational games, this is a very important issue to tackle, since a lack of transfer renders educational game activities rather pointless. It is also an issue that is not really fully understood at this point in time. While behaviouristic game titles where you practice the swiftness with which you calculate math equations can be considered to build more concise skillsets that are easily transferable, educational games that take on different types of pedagogical principles in their game mechanics can have a more difficult time discerning how gameplay translates to real-world knowledge. To provide a bigger picture, however, educational games and serious games are not the only fields that struggle with this issue as the effectiveness of more traditional educational procedures (e.g. lectures, text-books, and educational films) is being questioned on the same basis. In their extensive deconstruction of transfer, for example, Barnett and Ceci (2002) point out how researchers within the field of psychology still disagree on whether transfer is possible from text-book or classroom instruction after extensive debates spanning more than a century. This is sometimes used as an argument to support the use of game-based learning, as the issues of transfer in traditional educational processes could perhaps stem from the emphasis on students' passive participation and observation, and that the ability to experience subject matters and experiment with them first-hand could be a way to create a deeper rooted understanding of a subject and ultimately support knowledge transfer (Aldrich, 2005; Tobias et al., 2011).

5.4 ASSESSING LEARNING OUTCOMES FROM GAMES

As evident from the diverging arguments posed in previous research, the reasons why games may or may not be good learning environments are numerous and often contradictory, and there are no easy ways to answer how, what, and why players may learn from games. To provide some more empirical grounding for the previously presented research perspectives, this sub-chapter presents an overview of research that examines whether games are good learning environments, and how effective they might be.

Unfortunately, research that evaluates the effectiveness of educational games when they are used in formal educational environments is relatively sparse (O'Neil, Wainess & Baker, 2005; Young et al., 2012), and calls for more empirical studies on the topic frequently crop up in the research community (e.g., McClarty et al., 2012; O'Neil, Wainess & Baker, 2005; Srinivasan, Butler-Purry & Pedersen, 2008). Studies that specifically point out how effective certain games are in certain contexts are not altogether uncommon (Gee, 2011), but they often suffer from questionable methodology and execution (Egenfeldt-Nielsen, 2006; Tobias et al., 2011; Young et al., 2012). Many researchers point out issues with ecological validity in particular, and indicate that the results from studies are rarely generalisable to educational games' usage outside of environments that are specifically constructed for research purposes (Egenfeldt-Nielsen, 2006; Hays, 2005; Linderoth, 2009; Tobias et al., 2011). In short, there is not much one can say with precision or confidence regarding the effectiveness of educational games, but there is plenty to say about the research focusing on examining that particular aspect of them. In an extensive review of research efforts in the field, Tobias et al. (2011) surveyed the research foci and outcomes of 95 studies on the learning effects of games conducted between 1985 and 2011. The results of the study was that the body of research indicates that games hold some promise for the delivery of instruction, but that this conclusion should be used cautiously due to methodological and epistemological issues with the research efforts presented in the examined papers (Tobias et al., 2011). The same critique regarding common conclusions in the field have can be found in other similar research meta-analyses conducted by Hays (2005), Egenfeldt-Nielsen (2006), and more recently in Young et al. (2012), McClarty et al. (2012), as well as Backlund and Hendrix (2013). Young et al. (2012) summarise the issue as being a result of the lack of methods for understanding of how games are actually being used with teachers and students in formal educational contexts:

> "After initial analyses, we determined that, to date, there is limited evidence to suggest how educational games can be used to solve the problems inherent in the structure of traditional K–12 schooling and academia [...] To make substantial progress, we believe that current methodologies must extend beyond their current parameters to account for the individualized nature of game play, acknowledging the impossibility of the same game being played exactly

> the same way twice and establishing that game play may need to be investigated as situated learning." (Young et al., 2012, p. 62)

While the research reviews differ on certain details, a unifying conclusion between all of them is that there is insufficient data to be certain that games are particularly effective tools for learning, regardless of which pedagogical principle is used as a point of reference (McClarty et al., 2012). It should be clarified, however, that lack of conclusive evidence of how games provide interesting learning opportunities as educational tools is not the same as proof that no learning can occur in games – it is mainly a question of what *types* of learning games can foster and under what circumstances one might learn by playing games.

One outcome that most research and literature reviews support in favour of educational games is that there seems to be sufficient evidence to prove that the retention of students' motivation to interact with learning materials is increased when games are used to convey educational content (Hays, 2005; Klopfer, Osterweil & Salen, 2009; McClarty et al., 2012; Tobias et al., 2011; Wastiau, Kearney & Van de Berghe, 2009). As mentioned previously in chapter 5.2, the increased motivation to engage with subject matters and problem solving is one of the fundamental arguments used in favour of the wider use of game-based learning solutions. When evaluating the educational effectiveness of educational games, these motivational qualities thus tends to be given a high priority, and researchers often aim to examine the relationship between engagement and learning in their studies. In practice, this means that research often evaluates learning outcomes in relation to how engaging the learning process has been in the eyes of the student (O'Neil, Wainess & Baker, 2005). Such research is also aimed at discerning differences in the educational outcomes of using game-based learning as compared to 'traditional' educational methods. While differences in long-term educational outcomes are difficult to compare, 'traditional' methods are often declared as being inferior as they are stale and unengaging when compared to game-based learning methods (McClarty et al., 2012). In essence, the promise of educational games as environments where learning can be more engaging and experiential than it is in 'traditional' education has marked out a framework which research in the field often follows, and researchers often conduct studies where the validity of this promise is examined. This framework, however, places the player-game relationship at the focal point of learning processes; a focus that many researchers find problematic due to its narrowness, as it largely excludes the contexts and systems surrounding gaming activities (cf. Alklind Taylor, 2014; Frank, 2012; Linderoth, 2012).

5.5 THE IMPORTANCE OF CONTEXT AND CONTEXTUALISATION IN GAME-BASED LEARNING

In later years, there has been an increasing amount of research taking Young et al.'s (2012) suggestion that game activities "need to be investigated as situated learning" to heart (e.g., Chen, Wang & Lin, 2015; Frank, 2014; Katmada, Mavridis & Tsiatsos, 2014; Ketamo et al., 2013; Saridaki & Mourlas, 2013; Stieler-Hunt & Jones, 2015). This branch of research aims to examine how game-based learning is affected and supported by the context in which gaming activities are carried out. Here, context refers to the setting (e.g. a classroom, a computer lab, or a military training environment) and its components, but also the players' relationships to the setting, the game activity, and to each other. Subscribers to this approach thus view learning as a process that extends further than just sequences of action and stimuli (Linderoth, 2009, 2012). And, as further ratified by Young et al. (2012), this perspective acknowledges that "just as students are not given books and told to learn independently, games cannot succeed as stand-alone solutions to education" (Young et al., 2012, p. 83). So, instead of focusing on details of the 'player-game' relationship, this line of research emphasises that game-based learning is heavily informed by processes that extend far beyond the act of playing the game itself. Context of play and contextualisation of game content is seen as having high transformative potency and can elevate, diminish, or completely change the usefulness and impact of educational games and game-based learning activities.

One of the benefits of examining and using games as contextualised activities is that it has the potential to combat some of the shortcomings of educational games. Providing that the environment and actors involved in game-based learning activities are equipped to support players and elevate gaming processes, issues of fidelity and game system opaqueness (Alklind Taylor, 2014; Turkle, 1995) or transfer between game content and real-world subject matters (Shaffer, 2012) can be alleviated. A 'sound' gaming context may involve the presence of instructors/teachers, debriefing sessions, preparatory lectures, and transmedia solutions that tie the game together with other teaching tools.

In her research on military, game-based training practices, Alklind Taylor (2014) explored such actors, processes, and tools extensively. Alklind Taylor's research shows that while the content of the serious game may provide a set-piece in which players can experience and train for real-world events and scenarios that would be expensive to recreate physically, the processes of debriefing, the preparation of game scenarios, and instructor involvement within and around the game play a crucial part in 'extracting' valuable learning from the game itself (Alklind Taylor, 2014). By studying the interplay between instructors and cadets in game-based training exercises, Alklind Taylor identified a series of factors that significantly alter the success of game-based training solutions. Such factors span from collaborative and interdisciplinary development processes, to designs anchored in learning objectives and pedagogical theory, support to facilitate instructor involvement, as well as the formation of organisational cultures conducive to game-based training and knowledge sharing. In short, Alklind Taylor posits that the content and details of a serious game, as the player perceives them during gameplay, are often subservient to systems and processes surrounding it, when it comes to achieving learning objectives:

> ”[This research shows] several examples of off-game activities which are performed before, during or after the actual gaming activity and affect the end result in profound ways. For instance, debriefing helps learners to de-role or detach from, as well as critically reflect upon, the gaming experience. Without this activity, transfer of knowledge from the gaming situation to the real world is unlikely to occur.” (Alklind Taylor, 2014, p. 218)

Similar conclusions have been reached by other authors in the field of serious games for game-based training. Frank (2014), for example, highlights how the contextualisation of game-based training scenarios can be crucial for avoiding gaming behaviours that are destructive or unconducive to learning objectives. The specific behaviours that Frank is referring to, what he calls 'gamer mode' (Frank, 2014), are caused by a mismatch between a game's representations of real-world objects and scenarios, and the player's expectation of those representations.

> “There is a tension between having a rule-focused interaction and a theme-oriented interaction. There are occasions in which players are mainly using the rules, concerned with winning the wargame and disregarding the theme and the learning objective.” (Frank, 2014, p. 81)

It was found that these issues are reduced if game scenarios are firmly framed as learning or training activities rather than 'gaming' activities. This framing needs to be constantly maintained, and Frank (2014) – much like Alklind Taylor (2014) – highlight how crucial instructors, and other facilitating components around game-based activities, are for ensuring that game-based activities reach learning objectives.

While the works of Alklind Taylor and Frank are directed towards the areas of game-based training and serious games, their outcomes echo ones found in the area of game-based learning in educational games. Many game-based learning scholars postulate that the specifics of where, how, and why games are being played highly influence what the player 'takes away' from the gaming experience (Bourgonjon & Hanghøj, 2011; Chee, Mehrotra & Ong, 2014; Stieler-Hunt & Jones, 2015). In researching how the expectations of teachers and students affect classroom gaming activities and how learning objectives can be pursued through educational games, Hanghøj (2011) identified many patterns similar to the ones found in game-based training practices. Students with plenty of gaming experience were found to approach educational game tasks differently from novice students, and teachers often had to actively contextualise game-based activities and remind students that 'learning', not the act of gaming, was the focal point of the activities (Bourgonjon & Hanghøj, 2011; Hanghøj, 2011).

> "The findings also underline the importance of the teacher in choosing, introducing, facilitating, and assessing the use of educational games, that is in designing the overall pedagogical activities. It is only by aligning the knowledge forms of particular games with students' genre expectations that teachers will be able to set and pursue desired educational goals, which again may ensure relevant ways of translating gaming experiences into meaningful knowledge production within a formal school context." (Hanghøj, 2011, p. 32)

On their own, games contain many elements that are potentially disruptive to reflective and analytical modes of play and for achieving learning objectives However, the surrounding structures and processes (e.g. briefing and debriefing, instructor and teacher involvement, and knowledge sharing between players) can ameliorate those issues. Teachers' ways of integrating games into their classrooms, and their active participation in maintaining students' reflective and analytical stance towards the game content they are experiencing, can be the differentiator between a game being a fruitful educational experience rather than a (as far as learning is concerned) meaningless one (Stieler-Hunt & Jones, 2015). However, in order to assist teachers in developing such processes of integration and contextualisation, organisational practices surrounding game-based learning still need to be more closely examined. Realising and improving the educational qualities of games may not strictly be a matter of improving educational game design practices, but also of establishing settings and processes that can reliably and efficiently elevate, steer, or even transform game content into educational material through contextualisation.

5.6 GAMIFICATION

Before concluding this overview of serious games and educational games, it is important to mention and make a clear distinction between the types of serious games and educational games mentioned during this research, and the now quite popular concept of gamification. Gamification is a term that has been rapidly proliferated in recent years, and much like other terms pertaining to make distinctions between different practices within the gaming community its meaning will vary depending on who you ask; even the origin of the term and its intended use is somewhat unclear. Jakubowski (2014) state that it was coined in 2002, whereas Deterding et al. (2011) state that the first use of the term was documented as late as 2008.

In their paper that investigates the origins of the term, its numerous applications, as well as the lively debate surrounding it, Deterding et al. (2011) define gamification as "the use of game design elements in non-game contexts" (Deterding et al., 2011, p. 10). Gamification in its current state is, in essence, the act of applying a layer of points or other types of rewards to an activity, with the intention of making the activity more enticing and entertaining to its participants. The reasoning behind it is that providing more visible, measurable, and comparable feedback for performing an activity or action will motivate participants, as they receive clear rewards for doing so (Deterding et al., 2011). This is where one point of confusion regarding the term arises, since the term is sometimes used to describe the act of translating an activity into gameplay, for instance, creating a game about music creation, running, driving, or any other pre-existing activity. This is an inappropriate, but understandable, use of the term, since it stands to reason that the translation of activities or themes into gameplay could be referred to as “gamifying” them. More appropriate examples of gamification are corporate programs, such as frequent flyer miles that award points and benefits to loyal customers, or the fitness mobile application *Zombies, Run!* (2012) that applies a post-apocalyptic zombie-infested narrative and digital rewards to players’ real-life running activities. Gamification does not alter activities or how they are performed, but rather attaches layers of rewards and points on top of them in order to change the behaviour or experience of the people performing them.

Gamification has received interest from corporations, educational institutions, and municipalities alike (Deterding et al., 2011). But with the rapid proliferation of the concept, previous scholarly definitions of gamification are starting to become less and less accurate for describing how gamification actually manifests itself in reality. In a wide-spanning inventory of products that claim to be ‘gamification’ solutions (or incorporating gamification into their design), Raftopoulos, Walz and Greuter (2015) found that the term has been applied to a wide enough scope of products to become unruly and difficult to define. The term has been found to be liberally applied on everything from game design influenced corporate solutions (an accurate use of the term), to browser interfaces and workshopping solutions that have little to no incorporation of game design elements (Raftopoulos, Walz & Greuter, 2015). Regardless of how the term is applied, gamified solutions also tend to be somewhat rote in their execution, and Raftopolous et al. conclude that “gamified systems tend to support existing workplace and market constructs (albeit in a more engaging way), rather than create new forms of organisation structures, systems or rules of play.” (Raftopoulos, Walz & Greuter, 2015, p. 14).

Gamification solutions’ tendency of supporting the status quo is often at the core of game scholars’ and practitioners’ critiques of the concept, and gamification is often seen as the antithesis of the qualities that games are meant to manifest. For example, gamification has been argued to bastardise the creative, free-form, and engaging discourses between players and game content, by resorting to what amounts to techniques of routinised behaviourism where extrinsic rewards are employed to promote certain behaviours (Fuchs, 2014; Raczkowski, 2013; Raftopoulos, Walz & Greuter, 2015). Gamification is also critiqued for diminishing players’ agency and creative control, thus distancing the term further from what scholars and practitioners consider games to be:

> “[this is] the greatest conflict between “classical” games and gamification: the former can be played with, while the latter cannot. Playing with games [...] always involves a creative, unpredictable moment. This creativity is at odds with the [deterministic, experimental] approach gamification exhibits towards games and it is necessary to formulate a critique of gamification that has the player’s role in mind.” (Raczkowski, 2013, p. 9)

In essence, the argument is that gamification is perverting the language of games by reducing it to behaviouristic exploitation. Exemplifying this is the various new portmanteaus that have been devised to describe gamification, such as ‘exploitationware’ (Bogost, 2011) (mainly referring to examples of gamification used for corporate interests), which is a somewhat accurate summation of the opinions of many game professionals and academics towards gamification. Gamification is antithetical to the fundamental qualities of games, which is to be inherently rewarding and instilling a strong sense of intrinsic motivation in the player (Habgood & Ainsworth, 2011). Pursuing these values and critiquing gamification may be seen as reactionary or as an ideological crusade to maintain an imagined ‘purity’ of games. Nonetheless, studies frequently show that external motivation is detrimental to enjoyment, performance, retention, and reflection (Bellotti et al., 2009; Guillén-Nieto & Aleson-Carbonell, 2012), so there is reason to find the behaviouristic, deterministic, and experimental approach of gamification problematic.

CHAPTER 6
THE DEVELOPMENT AND USE OF EDUCATIONAL GAMES

This sub-chapter attempts to briefly outline some basic concepts that I find necessary when discussing the development and design of educational games. Whereas sub-chapter 3.2 presents various research regarding the different ways in which games may or may not facilitate learning, this chapter presents a brief overview of how game experiences can be understood and designed, as well as how educational games can specifically be created to cater to learning objectives and educational settings.

6.1 UNDERSTANDING GAME EXPERIENCES AND GAME CHARACTERISTICS

One of the major branches of research in the field of game studies is game design research, which is concerned with understanding the 'anatomy' of games and game experience. As previously mentioned, much of the research done in the field of educational games and serious games use theories from game studies as a foundation. When it comes to understanding the types of experiences educational games can provide, and to later discuss how they can be tied to learning objectives, game design research is especially influential. Research in game design focuses on understanding how specific elements and mechanics of games – their rules and goals, as well as their narrative and fiction - can be arranged, and how they affect the play experience. This is an area of research that has become increasingly popular (Squire, 2007), perhaps as a result of the ontological debate of what games are or are not is starting to quiet down. A few examples of works in this area are *Patterns in Game Design* by Björk and Holopainen (2005), *Flow in Games* by Chen (2007), and the *Mechanics-Dynamics-Aesthetics* (MDA) framework by Hunicke, LeBlanc and Zubek (2004). These works attempt to describe the effects that certain compositions of game elements have on players' experiences, but they do so with very diverse approaches. For the purposes of this thesis, they will thus be used to exemplify the different ways in which game experiences can be understood.

6.1.1 THE MECHANICS-DYNAMICS-AESTHETICS FRAMEWORK

The MDA framework, proposed by Hunicke, LeBlanc and Zubek (2004), is based on the idea that a game experience constitutes a collaboration between a game's designer and its player. The MDA framework divides the elements that make up a game experience, or game encounter, into three components that span the details of the mechanics that make up the game, as well as the more ephemeral nature of the player's experiences and influences on the game. Shortly summarised, the MDA framework separates a game into:

- **Mechanics** in this context refers to the "cogs and cranks" that make up the machinery of the game and specify the rules through which the player is able to interact with it. This could be anything from the rolling of dice, the shuffling of a deck of cards, or the physics of the game world.
- **Dynamics** is the way the mechanics of the game manifest when the game is being played. The meeting between players and the game's mechanics creates dynamics, depending on what they both bring to the game encounter. For instance, a game mechanic can be to allow players to randomly encounter treasures and monsters in an adventure game. This mechanic can give rise to different dynamics, depending on the predilictions and situation of the players. The randomisation might be seen as a considerable obstacle for some players, whereas others might be intrigued by the added thrill of stumbling upon new things in the game.
- **Aesthetics** is the response that is evoked in the player when he/she is interacting with the game. A few examples of game aesthetics are dramatic tension, a sense of 'team spirit', or hopefulness or hopelessness in the face of a challenge. Or, in the example of the randomisation, an aesthetic could be the 'sense of discovery' from unexpected encounters.

This general framework is useful both for understanding game experiences and designing games. For instance, when playtesting a game, the designer or researcher can see what types of aesthetics the game mechanics ultimately invokes in its players. If the invoked aesthetics are not what the designer intended, problematic mechanics can be identified and altered accordingly. Some mechanics might be found to take the game in the right direction, whereas others lead to undesirable dynamics. In the example of a mechanic for randomised encounters, if monsters show up too early or too often in the game, the game dynamic might become skewed towards enduring challenging combat scenarios, which might in turn prove to detract from the aesthetic of unexpected discovery that the designer sought to instil with the mechanic. By paying attention to players' expressions of aesthetic experience, undesirable mechanics can thus be traced, identified, and resolved. Figure 6.1 shows the model accompanying the MDA framework, and the quote from the paper introducing it can serve as a good summarisation of the different types of lenses the framework provides:

> "From the designer's perspective, the mechanics give rise to dynamic system behavior, which in turn leads to particular aesthetic experiences. From the player's perspective, aesthetics set the tone, which is born out in observable dynamics and eventually, operable mechanics." (Hunicke, LeBlanc & Zubek, 2004, p. 2)

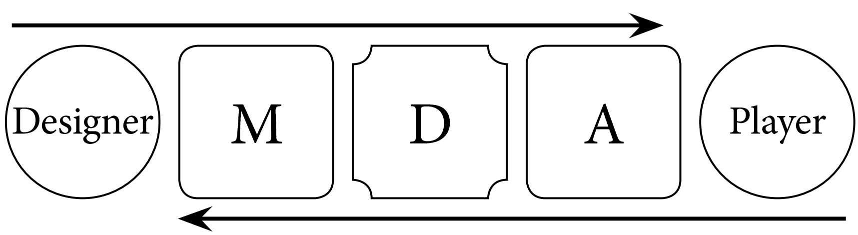

Figure 6.1: The Mechanics-Dynamics-Aesthetics framework as visualised by its authors (Hunicke, LeBlanc & Zubek, 2004).

6.1.2 PATTERNS IN GAME DESIGN

Building on the theory of pattern languages, which has its origins in architecture in the late 1970s (Alexander, 1979), game design patterns (Björk & Holopainen, 2005) categorise describe how the relationship between specific game mechanics dictates the challenges presented, and moods evoked, by a game system. This makes design patterns useful as a tool, both when designing games, or as a language with which to accurately describe them. As the authors themselves describe it:

> "… game design patterns are semi-formalized interdependent descriptions of commonly reoccurring parts of the design of a game that concern gameplay. These concepts allow one to describe how the specific configuration of and interrelation between game components affect gameplay." (Björk & Holopainen, 2006, p. 411)

The general purpose of patterns is to formalise something that is inherently both chaotic and subjective, and subsequently establish a vocabulary to be able to discuss it (Alexander, 1979). To refer back to architecture, a pattern could either be described with a relatively broad scope or a narrow and detailed one. For instance, a broader pattern could consist of the elements that make up an entire city street, a building, or a courtyard – whereas a narrower one could be limited to describing a hallway or the area around a living room window. The patterns in any of these cases would both consist of a description of the relationship between individual components in these scenes or settings and the properties of the components in and of themselves, which ultimately determines the experience that is invoked in their observer. Do the storefronts and their windows, the textiles of their awnings, the climbing vines wrapping in between their brick-work, and their furnishings work together in a way that instils a feeling of cohesive serenity, and does it gel with the atmosphere of the city? Once positive and negative patterns are identified, they can start to be codified and used to construct a vernacular that can be useful to other architects as templates that describe what components, colours, dimensions, and layouts work well in certain situations, depending on the aesthetics you are aiming for. This principle, described by architect Alexander (1979), was a way to make something very organic and subjective into a more systematic form of problem-solving. Patterns are a way to understand why certain things instil a sense of harmony, while some do the opposite, and what steps one could take to avoid or ameliorate bad architectural designs. Björk and Holopainen's (2005, 2006) patterns work very much in the same way, and create a unifying language to describe design elements in games, as well as how they affect the final harmony of the game experience. How does the increasing speed of the falling "tetrominoes" in *Tetris* (Pajitnov, 1984) impact the experience of the game, or how does the finite amount of resources in a *StarCraft* (Blizzard Entertainment, 1998) game affect the pace of the game and influence the way multiplayer matches ramp up in intensity? Just as Alexander (1979) provided general patterns for how window sills and building materials made up the visage of a building, the design patterns for game design described how resources abundance and limitations, trading capabilities, competitiveness and collaboration, elements and methods of randomisation, and other game mechanics made up games. By naming different design patterns, describing the consequences they have on play experiences and what they encourage and discourage players to do, what other patterns they can be combined with, and some examples of where the patterns are already being used in games, the design patterns are also structured into a vocabulary that makes the discussion of game mechanics easier among developers and researchers.

6.1.3 FLOW IN GAMES, AND THE 'THEORY OF FUN'

Another example of how the design of games has been examined is the way psychology has been used to understand game design and player experience. In particular, the popular theory of 'flow' has been appropriated to explain a specific facet of the relationship between a game and its player. In 2007, Chen used the theory of flow or the "theory of optimal experience", which was originally established by psychologist Csikszentmihalyi (1990) to describe how player experience, in large part, depended on the relationship between a game's challenge and its player's level of skill (Chen, 2007). According to Csikszentmihalyi (1990), flow theory can be used to explain why certain types of activities absorb its participants very intensely, whereas others quickly leave the participant bored or stressed. Through rigorous studies conducted on thousands of participants spanning many countries and cultures, Csikszentmihalyi (1990) found that the phenomenon of becoming absorbed by an activity, even to the point of losing track of time and your surroundings, could be narrowed down as dependent on a set of criteria that activity and performer needed to adhere to.

- The activity must have a clear set of goals as well as ways to reach them. This adds direction and structure to the task.
- The task at hand must have clear and immediate feedback. This helps participants negotiate any changing demands and allows them to adjust their performance to maintain the flow state.
- There needs to be a good balance between the perceived challenge of the task at hand and the participant's own perceived skills. The participant must have confidence in their capability to tackle the task at hand.

Chen (2007) compared Csikszentmihalyi's criteria to the dynamics one would find in a well put together game, that is to say a game that has an ability to engage its player to a high degree, and saw that Csikszentmihalyis criteria are a solid template with which to describe the fundamental building blocks of an engaging game. Just like rock climbing, ballroom dancing, the playing of an instrument, or any other activity that has the ability to instil a person with a sense of flow, an engaging game needs to adequately challenge its player. However, it should not feel imposingly difficult, but make the player feel in control and as if he/she has agency in the game world, as well as provide feedback that indicates either successful or unsuccessful outcomes of certain actions to allow the player to adjust their play styles and progress (Chen, 2007; Cowley et al., 2008). If the right psychological triggers could be pushed through these means, a sense of being fully absorbed by the experience of play would be possible. This realisation has had a big impact on game design, both as an object of study and as a craft (Cowley et al., 2008; Sweetser & Wyeth, 2005). Among the stated criteria, the balance between player skill and game challenge is probably the most commonly referred to when flow is discussed (see Figure 6.2).

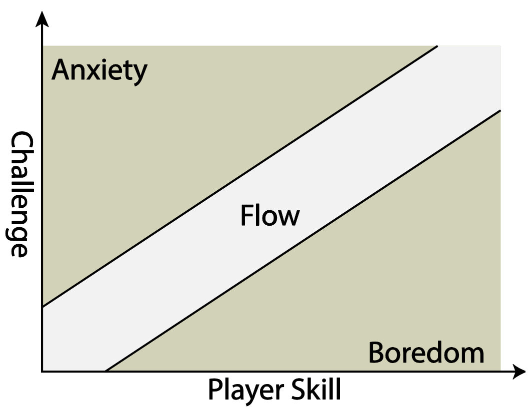

Figure 6.2: The relationship between challenge and player skill, a merger of the diagrams presented by Chen (2007) and Csikszentmihalyi (1990).

Since its inauguration, flow has been used both as a template for the design of good game experiences, not in the least by Chen himself in game titles developed by his studio[4], but also as a tool for evaluating games and why they do or do not engage their players (Sweetser & Wyeth, 2005). Another example that is worth mentioning in relation to flow, is the theory of fun, described by Koster (2005). There are many similarities between the two theories, since they both describe games and engagement from the perspective of human psychology; just as the theory of flow and optimal experience, the theory of fun attempts to describe why people are engaged by certain things. Koster (2005) describes fun as a sensation that arises from comprehension and mastery, and as a product of the human brain managing to decipher the patterns of a game challenge. Games that manage to remain fun for the player for a long duration of time are games that constantly reconfigure the patterns in the game in some way and push the players' ability to continuously develop their understanding and mastery of the game (Koster, 2005). Conversely, games that players quickly lose interest in are the ones that either present incomplete or incomprehensible patterns or puzzles, or are too easily mastered and do not introduce any new configurations for the players to master (Koster, 2005).

These are but a few examples of how the study of game design, and by extension the study of players, is inspired and influenced by research in scientific fields that at a glance can seem far removed from the games medium. Patterns try to codify game components to create a language with which to describe them and their effects on the game experience better. Flow in games takes a psychological approach to understand how the proportions of challenge severity and player skill affect play experience, while the MDA framework looks at how game experiences and encounters are created from collaborations between their designers and their players. The various approaches these different scholars and professionals have taken, in order to understand the anatomy of games and player experience better, is a good indicator both of how complex the interrelationship between games and their players is, and the breadth of knowledge that goes into designing games. These different perspectives return further on in the thesis, but then in the context of how they fit into the creation and understanding of educational games.

6.2 THE PROCESSES INVOLVED IN GAME CREATION

Before moving on to describing how educational games can be designed and developed, an overview of the processes and actors involved in creating games can be useful. When discussing the realities of educational game development and use, it is important to also acknowledge that game development projects are very complex, and at times quite messy and "alchemical" (Irish, 2005). Similar to how many different perspectives are needed in order to describe games and their effects on players, and to understand their educational potential, a wide array of expertise is needed to create them. For a long time, game development has been a somewhat chaotic process, but in later years it has become increasingly structured (Hagen, 2010, 2012). An indicator of this progress is, as pointed out by Hagen (2012) in his research on creativity and ideation in game development processes, the increasing number of books written on the subject. Hagen found that approximately 113 handbooks were published between 1984 and 2010, and that 102 (or 90%) of them were published after 2002 (Hagen, 2012).

[4] Jenova Chen co-founded *thatgamecompany* together with Kellee Santiago. Thatgamecompany created critically acclaimed game titles such as *Journey* (2012), *Flower* (2009), and *Flow* (2006).

Game creation is nowadays seen as a process that unifies programming, animation, modelling, concept drawing, writing, game design, sound design, music composition, and many more disciplines (Irish, 2005). Game development thus requires an understanding of computer science, art, design, and psychology, and dives into different specifics and sub-categories within each of those fields, depending on what type of game is being created. This last caveat is also frequently reiterated in handbooks on the subject, as the expertise needed in any given development project does vary greatly, and it is impossible to stake out a definitive catch-all description that would adequately describe the way all game development studios work (Hagen, 2012; Irish, 2005). In order to slightly simplify the descriptions, I will describe some of the more common type of roles that are commonly found in game development studios, what they contribute to the development process, and then briefly describe a few common structures of game development projects. While the descriptions here are very simplified by necessity (writing about each role in detail would be a thesis in and of itself), this general background is important for the end purpose of this thesis, as the development of entertainment games guides the practice of serious game and educational game development to a great extent.

The specific role of the designer in a development project is hard to describe. It is easy to think of the designer as only being an idea generator, but that is far from the case. In *The Art of Game Design*, game scholar and designer Jesse Schell describes the designer's duties as "designing game play, conceiving and designing rules and structures that result in an experience for players" (Schell, 2008). So, while the designers of a game certainly do generate ideas, they also need a firm understanding of what can feasibly be executed in a project, how to interpret feedback from play testing and make changes to the design, and also understand why games work the way they do and what types of design decisions lead to what types of experiences and play dynamics (Rollings & Adams, 2003; Schell, 2008). The duties of a designer can be understood through the previously described theories of Game Patterns, MDA and flow, as designers need a firm understanding of how different mechanics affect the play experience and how players interact with games and each other. As with roles in the other disciplines, designer roles in larger projects are sometimes dispersed over several specific design tasks, such as level designer, gameplay designers, multiplayer designer, interface designer, etc. (Irish, 2005).

Story writing has historically had a rather low priority in game development, and it is quite rare for development teams of small to medium size to have an individual solely devoted to writing stories. The reasoning behind the low priority of writing is reflected in the definitions of games described earlier. The story of the game is rarely a necessity, but rather an added extra layer on top of the game mechanics. However, story and scripted dialogue is an integral part of many games, and some form of writing will go into almost all types of development projects. In bigger development projects, writing is commonly something that is done early on in the production of a game, as changing or adding new recorded dialogue, or adding new story events and scenes late in development is a cumbersome process (Irish, 2005). In smaller development teams, writing is often a task carried out by the game's designer, and a story often emerges naturally as the game mechanics and dynamics are being invented.

Graphics, as a general discipline categorisation, entails anything that is connected to the visuals in a game, and can be separated into modelling, animation, concept drawing and design, and many other subcategories within each of these monikers (e.g. modelling, texturing, lighting, environmental artist, asset creator, 2D- or 3D artist, etc.). In 3D development, the objects that are to inhabit the game world are all made through a sequence of the following tasks:

- Modelling: creating the geometry of the object, in essence providing a mathematical specification of shape and appearance properties that is readable by the computer
- Skinning, texturing, and UV-mapping: treating the visible surfaces of the model, specifying its texture and colours, how light plays with it, and how it reacts when it is stretched and moved if the object is animated.
- Rigging and animating: if there is an animated object, it needs to be rigged and given a “skeleton” and joints that both dictate the articulation of the object and give the animator an easy way to specify how it articulates. Animating is done by manipulating the skeleton rig, and creating animation patterns for specific events (e.g. punching, crouching, etc.).

Bigger development studios sometimes take a conveyor belt approach to graphics creation, where each stage of the creation process is handled by a specialist. In smaller studios, the process is usually handled by one artist, or shared between a smaller group of artists. In recent game production, alternative means of animation, such as procedural animation and motion capturing, are becoming increasingly common in bigger studios, making it possible to produce vivid, life-like results rapidly (Shirley, 2005). The creation of 2D graphics can look entirely different, depending on the game. Here, objects and characters are, in certain cases, drawn and animated to be inserted into the game without the step-by-step process of modelling and creating the skeleton for the object/character. This makes the process akin to the one used in traditional animation, except objects are made individually to be independently movable and manipulated in the game world.

The role of a sound designer can either be to create special effect sounds and ambience, or compose the game’s soundtrack. While sound still often has a lower priority in game development projects, the value of good sound design is not to be underestimated. Unlike graphics, which are usually produced through a longer sequence and can pass through multiple hands during development, sound effect creation is a more contained and straightforward process. With regard to the “mood” of the sound, it can either be influenced by the visual style of the game, or the rest of the game can be influenced by sound (Schell, 2008). Whichever route is chosen, a congruent and harmonic experience is the end goal (Irish, 2005).

The role of a programmer in a game development project is generally to implement and collate ideas and created assets from designers and artists into a functional piece of software. Depending on the project, the programming can entail anything from low-level coding and the creation of a game’s entire ‘engine’[5] from scratch, or more high-level coding in a pre-existing game engine.

These different approaches task the programmer’s skills quite differently. Creating a game engine for a project requires data manipulation at a very deep level, whereas high-level (high-level in this case refers to the “distance” from the computer’s base functionality being worked on, not the level of quality or difficulty of the work) primarily tasks the programmer’s understanding of the engine and how it can be manipulated in different ways. Any decisions regarding the mechanics of a game and the properties of objects in the game world will likely need a programmer’s attention in some way during development. In addition, unless the game is very simple and is made in one of the more accessible game

[5] A game engine is essentially the software framework that makes a game function. It includes the foundational descriptions of the properties of different objects and how they interact with each other. Physics, artificial intelligence frameworks, rendering graphics, and light properties are examples of engine features.

engines that are available, a solid grasp of programming is essential to make a development project feasible. It is hard to overstate this, but for the uninitiated an important thing to realise is that every type of object in a game world needs to be specifically directed and told how to function. If ready-made engines or other types of middleware are not being used, this is especially laborious, as even basic universal constants relevant to the game need to be coded from scratch.

Beyond the more clearly defined roles already mentioned, there are a couple of other positions that are usually found in game development studios, and those are leads, directors and producers. Leads are roles that are specific to each discipline in a development project, and the lead is essentially tasked with keeping track of the progress their development team is making. When studios grow to larger sizes, having one person that is knowledgeable enough in programming, design, and graphics to understand and keep track of the needs of the development team, and how they need to collaborate with members from other disciplines, is neither feasible nor practical. Hence the need for leads that works closely with their own development teams. Having a lead programmer, designer, and graphic artist is essentially a way to keep the flow of information between development teams in larger game studios more structured and manageable. Whereas a lead commonly has an administrative function, directors are in charge of keeping the tone of visuals, audio, and design intact and make sure that the game feels harmonious and consistent. Like leads, directors can be working with specific aspects of the game, or have a more general role. The producer is, just as they are in other types of media development, the person in charge of making sure that the entire game production process is progressing smoothly, often including the promotion of the game, legal protection of the game, and communication with external partners (e.g. publishers) (Irish, 2005).

As a general rule of thumb, all of the roles described here will be represented in some capacity in any game development project. However, a role may not always be confined to a single person, and vice versa. In smaller development studios, roles are often far less specialised than those in the studios creating the bigger block-buster titles. In teams of less than 10 people, different roles are often merged and attributed to one person, and some roles can be omitted altogether, depending on the game being created.

With regard to development processes, many different methods are available and utilised in the industry, a lot of which have their origins in software engineering (Ampatzoglou & Stamelos, 2010). A unifying component of the processes used in game development is that they take a flexible and iterative approach to development, which is to say the game is built in incremental instalments, each of which has more features implemented and refined than the last. The purpose of these types of processes, referred to in software engineering as agile or iterative processes (Pressman, 2005), is to give the developers an opportunity to change directions and omit or add new features during development, compared to seeing the game only when it is already almost completed very late in development, as is the case with prescriptive development processes (Eladhari & Ollila, 2012; Salen & Zimmerman, 2004). The agile process gives the developer a chance to see and evaluate the progress and the quality of the game early on in development, as a primitive first version, or a prototype, of the game is produced rapidly, and later incrementally refined. The process and its benefits are summarised by Salen and Zimmerman as:

> “A rough version of the game is rapidly prototyped… [it is] played, evaluated, adjusted and played again, allowing the designer or design team to base decisions on the successive iterations or versions of the game. Iterative design is a cyclic process that alternates between prototyping, play testing, evaluation, and refinement.” (Salen & Zimmerman, 2004, p. 11)

While these ways of production are flexible, it is difficult to predict how product development will progress in the long-term, and, due to this, iterative processes are also prone to delays (Pressman, 2005). However, as put in their guidelines on prototype development for games researchers, Eladhari and Ollila (2012) state that since it is almost impossible to foresee how all the components of a game will resonate together, it is a necessity to keep some leeway so that the team can adjust the game during the its process cycle in response to play-testing. Flexible processes are thus a cornerstone of game development, and delays in production are often par for the course.

6.3 EDUCATIONAL GAMES AS DESIGN CHALLENGES

The process of designing a game is a crucial aspect of the process of developing a game. However, while the two processes are intertwined, they are far from synonymous. Game development processes concern the challenges one faces during the act of realising a game concept. For example, challenges regarding how to ensure that the programmers and graphic artists can work together smoothly, how to work with agile development processes, or understanding how the requirements from a client are interpreted and handled throughout an educational game development project. Questions pertaining to the design of a game are, however, focused at investigating the characteristics of the game, how its rules affect the relationships between players in the game, or how the theme of the game affect how a player perceives it (refer to sub-chapters 6.1 and 6.2 for a more detailed explanation of game design and development). This sub-chapter provides a description of different approaches to the design of educational games, which is to say different approaches to conceptualise the mechanics of the game and balance all the elements that go into the educational game experience.

The design of educational games is interesting in that it is a practice which is torn between the challenges of designing a good game and the challenges of designing a good conduit for educational content. In short, good educational games have to take player engagement into consideration, while also contain content that is appropriate for the subject matter being taught (Aldrich, 2005; Egenfeldt-Nielsen, 2011; Harteveld et al., 2010). To this day, very few educational game projects get the mixture exactly right (Harteveld et al., 2010) They either result in a game that may provide a lot of enjoyment but has dubious educational elements, or the opposite; a game that is packed with accurate and detailed educational material, while the gameplay instils disdain rather than engagement (Klopfer, Osterweil & Salen, 2009).

In order to make the discussion in this chapter more manageable, I have divided the approaches commonly taken in educational game design into four camps: the learning-in-gameplay camp, the gameplay-in-learning camp, the gameplay-first camp, and the learning-first camp. This classification has taken inspiration from Egenfeldt-Nielsen's (2006) overview of the research and educational uses of educational games. It should be noted that the presentation of these camps is somewhat simplistic and does not do justice to all the nuances that can be found in the research and practice of educational game design, but hopefully it can provide a solid and brief introduction to key practices found in the discipline.

The *learning-in-gameplay* camp focuses on how learning content can be tied to gameplay elements to solidify a connection between engagement and learning during an educational gaming activity. The basic tenet is that if the characteristic that generates engagement and motivation in a game are synonymous with what the player is supposed to learn by playing it, efficient and intrinsically motivated learning can occur (Annetta, 2010; Squire et al., 2004). This approach can be considered a response to the early critique of educational games that questioned whether progressing through a game actually meant learning anything other than game mastery, regardless of the game's trappings. The critique is still often quite relevant to many educational game titles, but was particularly so during the edutainment era where the fun of the gameplay was often very separate from the learning aspects of a game. For instance, it was not uncommon to see games that just interspersed regular school exercises (e.g. solving math equations, vocabulary exercises, geography quizzes, etc.) with some gameplay elements found in popular entertainment games (Egenfeldt-Nielsen, 2011; Habgood & Ainsworth, 2011). What the learning-in-gameplay approach does to ameliorate this is to pay closer attention to how the subject matter can be translated into gameplay mechanics, and understanding that not all types of game mechanics are appropriate for certain subject matters (Habgood & Ainsworth, 2011). For instance, subjects, such as social studies or biology, that trade heavily on understanding broader concepts and correlations between factors rather than computational skills, are probably not a good fit for a game with strict linear gameplay that inhibits free experimentation, but perhaps requires an open game environment where these concepts can be explored in depth.

The *gameplay-in-learning* camp sees the game as something you fit into a larger educational context, and thus the game's design needs to accommodate for this in different ways. In essence, these types of educational games often place much emphasis on the social aspects and context surrounding them and figure out ways to work with those elements in tandem with the educational game artefact (Bennerstedt & Linderoth, 2009; Egenfeldt-Nielsen, 2006; Garzotto, 2007; Nilsson, 2008). This approach acknowledges that perhaps not all aspects of the learning process can or should be contained within the game packaging, and that there is much to gain by making the student pause and step out from the "gaming" frame of mind, in order to discuss, analyse, and reflect upon the material they have been presented with inside the game world (Crookall, 2010). These periods of reflection and deliberation can be encouraged in many different ways, and responsibility is often placed on the teachers to be involved in the gaming activities, so that they can coach and lead the classroom discussions that are facilitated by the students' shared experiences in the game (Alklind Taylor & Backlund, 2011; Annetta, Cook & Schultz, 2007; Shapley et al., 2011). The game *Global Conflicts: Palestine* (Serious Games Interactive, 2007) is an example of this practice. *Global Conflicts: Palestine* is packaged with a teacher manual that explains what the students are experiencing in different parts of the game, and how the teacher can guide the discussion appropriately after each gaming session. In the game, the student takes on the role of a journalist in the Israel-Palestine conflict and is tasked to research and write about different types of scenarios in one of the more turbulent locales in the conflict. As the student sees events transpiring and interviews people from both sides of the conflict, the game encourages the use of physical note-taking, so that the students are taken out of the virtual world during their sessions. In essence, educational game designs that follow the gameplay-in-learning approach try to implement mechanics into the game that encourage deliberation and reflection. This can be achieved by implementing intermissions and points of interruption in the gaming activity, or by requiring that the student uses knowledge they have received outside of the game world (perhaps from a conjoining classroom discussion) to solve certain challenges (Egenfeldt-Nielsen, 2010).

Proponents of the *gameplay-first* camp are of the persuasion that in order to create a good educational game title, one needs to always prioritise engaging gameplay when facing a dilemma between trying to provide verisimilitude, granularity, and accuracy of the represented subject matter or create engaging gameplay scenarios. In this camp, there is a lot of emphasis on the aspect of educational games that is essentially the point of using a game to teach rather than a book or film, i.e., the interactivity and experiential aspects that games and gameplay provide (Annetta, Cook & Schultz, 2007). The gameplay-first approach can be suitable in situations when you want to raise some awareness of a certain subject matter, but are not too concerned with the outcomes of the gaming activity beyond that point. The educational game can, in these situations, be an entry-way for students to start becoming interested in some subject that they previously were not inclined to investigate at all (Ruggiero, 2013). However, since the gameplay is highly prioritised some, follow-up with the students to discuss the finer details of the subject matter and to make the activity more educational becomes necessary. An example of this approach is the game *Testament* (Immersive Learning, 2010), a game developed in Sweden to be used in bible studies. The developers were approached by the Church of Sweden which saw games as a potential way to raise interest in youths to learn more about events and notable persons from the Bible (Engström et al., 2011). In Testament, the player can experience iconic events depicted in the Bible by taking on the mantle of an angel that help recognisable biblical characters through these events by fighting evil-doers head on. The game has high production values and is designed to be an engaging and fun experience through game mechanics inspired by the popular game series *Diablo* (Blizzard North, 1996-2015). However, the game also contains biblical icons and lines of scripture that players delve into, if they want to gain more substance and background regarding the events portrayed in the game (Engström et al., 2011). In conjuncture with gameplay sessions, the teacher can then also follow up with the students to discuss experiences and contextualise the game events to Bible passages and events. In that way, this paradigm is similar to the gameplay-in-learning one. The primary distinction lies in the heavier emphasis on using gameplay to introduce and raise interest in a subject matter, and, while learning outcomes may certainly occur in these types of games as well, they are not as studiously defined and planned out as in gameplay-in-learning designs.

Finally, the *learning-first* camp prioritises the representation of learning content over gameplay quality. As opposed to the gameplay-first approach, this one is seldom concerned with how the gameplay intersects with the learning content, the learning content is the focal point and the gameplay is added as a layer on top of it, often just as an attractive packaging of the content. This was a common occurrence in the edutainment era and educational games designed in this way are often pejoratively referred to as “chocolate-dipped broccoli” (Bruckman, 1999; Habgood & Ainsworth, 2011) or “chocolate-coated cod liver oil” (Sharp, 2011). This approach to educational game design seldom results in successful products, and it is most often found in projects where developers are uncertain of how to combine the wishes and ambitions of a client with engaging gameplay features (Klopfer, Osterweil & Salen, 2009). In such situations, a developer is often prone to prioritise the client’s requirements for inclusion of learning content over interesting gameplay ideas, and it can result in games that recite information regarding a subject matter at length, interspersed with some minor gameplay elements. This is not to say that learning-first designs are only products of miscommunications between game developers and educators. They can often be found in products where certain types of elements commonly found in games are superimposed on learning activities (Habgood & Ainsworth, 2011). Here, one can imagine a math curriculum being executed in a game environment where the students solve math equations just as they would if they worked with a school book, but they are awarded with points or badges, or they receive some minor gameplay challenges, such as time-limitations, in an attempt to maintain their motivation for the subject matter. This school of thought often suffers the critiques towards educational games mentioned earlier, where the game elements and challenges are disconnected and quite superfluous to what the student is intended to learn. In many titles, the gameplay can be so understated in the design that it is difficult to justify calling it an educational game at all, instead of just an e-learning tool or instructional software (Egenfeldt-Nielsen, 2011). The design method is also, for this reason, sometimes associated with the gamification movement, which is currently a hot topic of discussion, as it is widely critiqued by many researchers for relying too heavily on extrinsic rather than internal motivation (Bellotti et al., 2009; Bogost, 2008; Guillén-Nieto & Aleson-Carbonell, 2012). Bruckman (1999) summarises this paradigm as an attempt to make learning processes more pleasant by "add[ing] pretty graphics and breaks to play more fun games, which have nothing to do with the content that kids are supposed to be learning" (Bruckman, 1999, p. 75).

Each of these four approaches to educational game design each has its benefits and shortcomings, and can be suitable in different types of educational contexts and situations. Certain design styles have risen and fallen from popularity throughout the years, both as our expectations of games change and how pedagogical processes change (Egenfeldt-Nielsen, 2006). The design approach used by a developer can also vary between individual development projects depending on the intended audience for the game (similar to how it changes in entertainment game development) (Klopfer, Osterweil & Salen, 2009). As exemplified by all the different approaches to educational game design, the central variable differentiating design methods is how they handle the dilemma of balancing educational content and gameplay. Some of the approaches sympathise more with the educational side of the spectrum, and others veer more towards just focusing on engaging gameplay (Engström et al., 2011), but the more successful approaches that have been gaining traction in later years are the ones that place themselves somewhere in-between. A good example of how the discussion regarding the learning and gameplay dilemma has evolved throughout the decades is the model of *Triadic Game Design* developed by Harteveld et al. (2010). While not specific to educational games (it originated from research within the broader field of serious games), it encapsulates the difficulties a developer faces when setting out to make a game with an instructional purpose. In an extensive design study of a serious game's development process, Harteveld et al. (2010) developed a design philosophy that help developers tackle the challenging task of designing a game according to client-imposed requirements. The design philosophy provides some insight into how complex the task of designing a serious game is. The requirements of educational or other "serious" outcomes present developers with 'design dilemmas', since some requirements can be contradictive to certain types of designs that are sound according to philosophies of entertainment game design (Harteveld et al., 2010). The philosophy specifies play, meaning, and reality as the three crucial aspects that need to be present in any serious game, and describes the dilemmas one faces when balancing the three against each other (as seen in Figure 6.3).

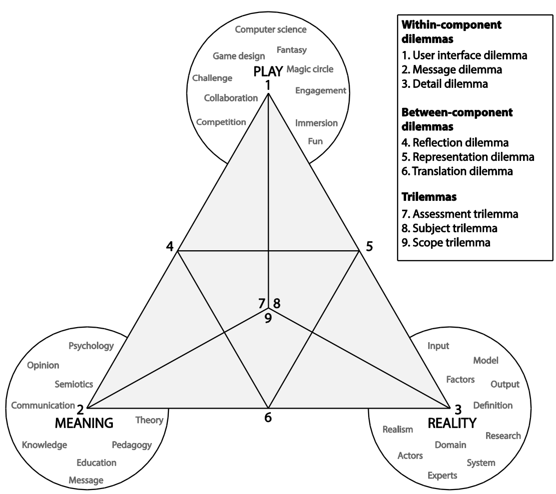

Figure 6.3: The Triadic Game Design model, as described by Harteveld et al. (2010).

In the model, the challenges mentioned in the descriptions of the four camps of educational game design are described in more detail. For instance, when a serious game designer attempts to make the game experience meaningful as well as engaging, the designer faces the dilemma of how opportunities of reflection and analysis can be included while also making sure that the pace of the game maintains engagement or the flow of the experience. Such a dilemma needs to be considered, and a good compromise or deliberate concessions on one of the aspects need to be taken. So, depending on the design approach one subscribes to when creating serious games, one would be faced with different types of dilemmas (or in the case of the Triadic Game Design model, “trilemmas” as well). For instance, a game situated within the gameplay-first paradigm would be occupied with challenges found in the ‘play’ section of the model, whereas a game developed with the gameplay-in-learning approach would be concerned with the dilemmas and trilemmas found between the three primary poles of the model.

A broader description of these values and how one can strive towards them in the design of an educational game is also given by Egenfeldt-Nielsen (2011), who categorises the challenges of making a good educational game into the challenge of integration, the challenge of motivation, and the challenge of focus. In this particular work, Egenfeldt-Nielsen (2011) summarises the previous research within the field of educational games and contextualises it with his own experiences as both a researcher and developer. The integration challenge refers to the importance of connecting the gameplay challenge closely with the learning goals of the play activity, as previously mentioned in the learning-in-gameplay description. This is coupled with the importance of making sure that the challenges of the game are intrinsically motivating to the students. This is to say that the willingness and eagerness to understand and master the game better, and thus also understand the learning content better if such motivation is tied to the game challenges well, needs to be the driving force behind the learning process. According to Egenfeldt-Nielsen (2011) and many other researchers, this is an area where educational game design can benefit from borrowing theories found in entertainment game design and educational psychology (Blumberg & Ismailer, 2009; Ennemoser, 2009). The challenge of focus pertains to the challenge of making sure that the game does not contain superfluous gameplay that detracts from the learning at hand. This is a difficult concept, but in essence it is of grave importance that the gameplay is stripped down to the necessities that are needed to convey the learning content in a challenging way. With a lack of focus, too much valuable classroom time can be lost on students being occupied with irrelevant gameplay activities. A comparison here could be a history text-book in which long paragraphs explaining the writing process of the book are interspersed between paragraphs that actually discuss historical events. While the author’s perspective and process may be interesting, it does not bring much to the table with regard to teaching students about history. It instead wastes a lot of the students’ time by having them learn about the specific text-book itself rather than history. Educational games can fall into the same trap as well. They can contain many gameplay elements that are not conducive to understanding the taught subject matter, but are only valuable for being more informative or making a player better at playing that specific educational game. These challenges are perceived and tackled differently in each of the different design approaches. For instance, the learning-first approach often prioritises the conveyance of the subject matter more than the motivational aspects of educational game design. The challenges described by Egenfeldt-Nielsen’s (2011) have been identified and examined by other scholars as well. For example, Linderoth (2009), Nilsson (2008), Malone (1980b), and Habgood and Ainsworth (2011) have described the challenges involved in of integration and motivation in educational games, and the works of Blumberg and Ismailer (2009) and Westera et al. (2008) describe the importance focusing a game’s design on the bare essentials.

6.4 DEVELOPING GAMES AS EDUCATIONAL TOOLS

In contrast to how the educational value and design of educational games have been under scrutiny by many researchers through several decades, deliberations on the processes through which they are developed have been comparatively sparse (Kirkley, Tomblin & Kirkley, 2005; Klopfer, Osterweil & Salen, 2009). While different design approaches have been invented and put to use to provide new ways of balancing engagement with learning, little progress has been made in finding sound methods for the development of educational games; especially in regards to developing them to be practical and useful in educational settings. As described earlier, discussing the design of games is useful for examining their inner workings and how different game elements can fit together to create an experience. However, merely understanding this aspect of games is like understanding how ingredients come together to make a delicious meal without knowing the process of mixing them together, which cooking utensils to use, or even how to set the table for people to enjoy it once it is done.

The lack of a sound “cooking” process and the effects of ad-hoc and haphazard development practices can be made clear by juxtaposing the willingness and efforts to embrace educational games and the resources spent creating them, with the number of successful applications of educational games being used in formal education. Previous research has frequently found that teachers are not averse to using digital games as part of their curriculum. In a study conducted in 2009 (Wastiau, Kearney & Van de Berghe) that included over 500 teachers from 27 European countries, 70% of the teachers polled already had some experience using games in school activities, 60% of the teachers not yet using games were interested in doing so, and only 10% of the polled teachers believed that games had no place in schools. Coupled with the fact that educational games have been pursued both in research and development for over 40 years (Egenfeldt-Nielsen, 2006), and the increasing amount of game titles, publications, conferences and development efforts in later years, it would be reasonable to expect more well-established, successful applications of the concept (Egenfeldt-Nielsen, 2010; Klopfer, Osterweil & Salen, 2009). While games are evidently being put to use in some classrooms today, the prophesised impact of educational games has not yet been as significant as many hoped or anticipated. Lately, more research efforts have been put into understanding why that is, and much research points to the lack of the developers’ “cooking” skills (Egenfeldt-Nielsen, 2010; Klopfer, Osterweil & Salen, 2009), but also to a certain lack of “eating” skills among teachers as well (if the analogy is to be stretched futher) (Egenfeldt-Nielsen, 2008; Ruggiero, 2013; Wastiau, Kearney & Van de Berghe, 2009).

In sub-chapter 6.2, the situation for entertainment game development is briefly examined and described. To reiterate, the development processes used during entertainment game development are still hard to generalise, as different studios and communities have different traditions of practice that they have tailored to their own working situations and specific types of projects (Hagen, 2009, 2012; Irish, 2005; Rollings & Adams, 2003). For instance, in his dissertation dealing with how design decisions were instigated and kept intact during big game development projects, Hagen mentions that entertainment game developers tend to cling to ad-hoc practices they have developed for themselves, and that also change slightly between projects (Hagen, 2012). When it comes to educational games and serious games, developers have additional pressures and requirements that their end product needs to adhere to once they are finished (Macklin & Sharp, 2012), and we still do not really understand how this affects the development processes of these types of games (Annetta, 2010; Morgado, 2013; Morgado, Manjón & Gütl, 2015).

The same is true from the educators' perspective. There are few described processes regarding how games can be implemented into classrooms and learning activities, and many schools struggle with supplying even the basic technological infrastructure to reliably support game-activities in classrooms (Egenfeldt-Nielsen, 2008; Klopfer, Osterweil & Salen, 2009). Beyond issues with technological infrastructures, there is also the issue of teachers needing to know how to integrate educational games into their curriculum.

CHAPTER 7
RELATED FIELDS

The differences between formal and informal contexts (as defined in sub-chapter 2.3) affect every phase of almost any type of software intervention's lifespan. As previously stated, the differences and implications of formal and informal areas of application are not well documented in games literature. However, the fields of Information System (IS) research and Instructional Solutions Design (ISD) both contain several theories that are highly applicable to the area of educational games, and can thus be useful here for describing the differences between informal and formal settings.

In ISD specifically, instructional solutions are divided into three categories based on their application: classroom-oriented, product-oriented, and systems-oriented solutions (Gustafson & Branch, 2002). The context of application affords different facilitating conditions as well as constraints on the developed instructional solution (Alter, 2010; Gustafson & Branch, 2002). Typically, a classroom environment entails the presence of a tutor or teacher (Gustafson & Branch, 2002). This can affect the design constraints of the artefact significantly, as there is an authority present that can provide guidance and compensate for any ambiguities or shortcomings of the software (Alter, 2010).

While ISD research is useful for understanding design, development, and the application of instructional solutions, IS research provides valuable systems-oriented insights into how those solutions impact the flow of information in organisations. IS research covers systems at both a macro- and micro level, both examining how a system's broader components fit together (e.g., Alter, 2008a, 2008b; Alter, 2010) and how individuals affect and are affected by newly introduced solutions (Davis, 1989; Venkatesh et al., 2003). In combination, IS and ISD research become potent tools for understanding the properties of formal organisational environments and how to handle the more complex interactions between users and systems in such environments. For this thesis, the two fields are used to better understand how the introduction of games into educational organisations affects working processes, and, conversely, how teachers and principals affect the impact of the game solutions.

7.1 INSTRUCTIONAL SOLUTIONS DESIGN

Instructional system design is a field of research dating back to the 1950s (Gustafson & Branch, 2002; Tennyson, 2010). Instructional systems design research involves finding systematic approaches to developing and using training tools (physical as well as digital ones); most current methodologies devised on the subject are variations of the Analysis-

Design-Development-Implementation-Evaluation (ADDIE) approach (Gustafson & Branch, 2002; Molenda, 2007).

- **Analysis** is the early needs assessment and goal specification for the instructional solution. What does the client need, or what does the consumer want? What are the shortcomings in performance that we can alleviate with an instructional solution, and in what ways can we design and implement it?
- **Design** means translating results from the analysis into measurable and workable terms, essentially describing what the final product/solution will look like. The team classifies the type of learning that is to take place and the specific learning activities for the users. The team also decides on the type of media platform that is suitable for conveying the instructional material.
- During **development** the team executes their ideas as they are specified in the design phase. The nature of development will be very dependent on what type of product/solution the team has chosen, and can range from the preparation of physical course material for an instructor to the creation of training software.
- The team then **implements** the developed product/solution into its intended environment. For example, they provide instructors with the developed course materials, or distribute an executable of the developed training software.
- Finally, the team **evaluates** the performance of the product/solution. Evaluation usually either takes a formative or summative approach; formative meaning that data is continuously collected to identify where revisions are needed (which can lead the team back to reanalysing or redesigning parts of the instruction), and summative meaning a final evaluation of the effects and overall worth of the instruction.

Much like the process of game development, instructional system design and development is a complex, flexible, and creative process that varies somewhat between projects and companies. However, many of the models created to describe ISD take an approach that is both iterative and non-linear. For example, while the foundational principle of ADDIE model appears somewhat linear in its layout, it is understood to be an iterative and flexible process. Evaluation, for example, is not necessarily the culmination of the process, but rather a constantly present component of reflection (Figure 7.1 is an example of a common depiction of the model) (Moore, Bates & Grundling, 2002).

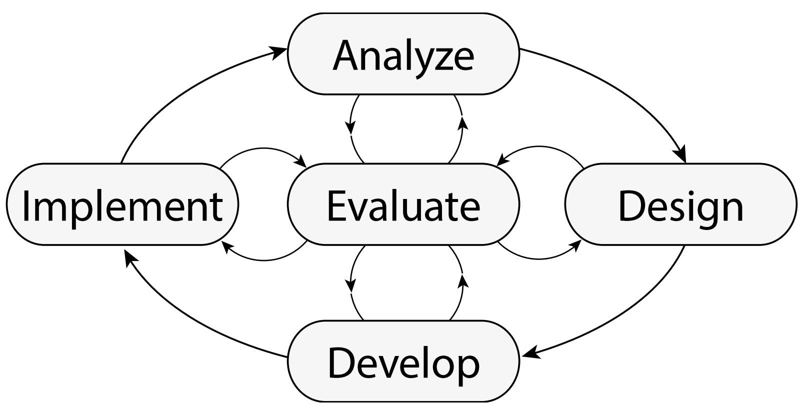

Figure 7.1: The ADDIE model as it is visualised by Gustafson and Branch (2002).

Similar to the situation with the field of educational games, the practice and theories prevalent in the field of instructional systems are also highly affected by research trends in educational psychology (Mödritscher, 2006). Due to this, there are behaviourist, cognitivist, and constructivist ways of approaching instructional design, and there are different models that accommodate each of these paradigms (McLeod, 2003; Tennyson, 2010). As mentioned in the educational games overview in chapter 5, the educational paradigm of behaviourism places emphasis on teaching through encouraging proper responses and behaviour with positive stimulation (Mödritscher, 2006). To support this teaching approach, learning objectives need to be divided into smaller, incremental steps of knowledge acquisition that are sequentially linked together, ensuring that proper problem-solving behaviours are learned step-by-step (McLeod, 2003). This also means that progress in learning can be judged on how well the learner has progressed through the sequence, which provides metrics to evaluate both the learner and the instructional system being used. In practice, instructional system designs that follow the behaviourist model for learning primarily manifest in the instructional activity being divided into a hierarchy of small, incremental tasks, and in repetition and rehearsal (Tennyson, 2010).

Finally, another important aspect of instructional system design and development processes is that their structures need to be highly goal-oriented; the requirements placed on instructional solutions depend on their context of use to a great extent, and no single model can sufficiently describe a design process with every possible use context in mind. In their comprehensive survey on instructional system processes and their resulting products, Gustafson and Branch (2002) summarise and divide the field into three distinct categories: classroom, product, and systems-oriented designs. These categories are based on the typical environments that instructional systems are usually developed to exist in, and the functions they are intended to perform. The details of the design processes involved in creating the system will change depending on which category it belongs to. Typically speaking, a classroom environment entails the presence of a tutor or teacher who is in the vicinity of the users of the software. This places fewer responsibilities on the developed solution, since an authority is present who can provide guidance and compensate for any of its shortcomings or ambiguities. For this reason, a system for classroom instruction is often considered to be the least complex with regard to instructional system design. Product and system-oriented instruction, however, is more troublesome. As opposed to the classroom as the location of execution, these types of instructional systems need to be able to perform independently to a much greater extent. The product-oriented instruction solutions can, for example, be modules that are distributed to a wider audience, but are to be used in the context of a specific activity (e.g. to teach users about a new tool, product, or procedure). The systems-oriented instructional solutions are often bigger all-encompassing solutions with many components aiding the instructional goal, and can, for instance, be entire distance learning courses or degrees programs. Each of these types of instructional solutions requires its own design and development approach, and few models beyond the base-line ADDIE model are widely applicable; the project scope needs to be identified early, and an appropriate model needs to be chosen. This issue has been the focus of Gustafson and Branch in many of their publications (2002), and the classroom-product-systems categorisation serves as a way to alleviate some issues with ambiguity in what different instructional system models can and should be used for.

All in all, instructional system design is a very broad field, as instruction is a concept that can manifest in many different ways. There are many similarities between instructional systems and educational games as fields of research and practice, although they stem from somewhat dissimilar backgrounds. Both fields have struggled with ambiguity in their terminology, which has resulted in the creation of several taxonomies, e.g., Sawyer and Smith's taxonomy (2008) as well as Egenfeldt-Nielsen's categorisations of educational games (2006) in the area of serious games, and Gustafson and Branch's (2002) as well as Tennyson's (2010) categorisations in the area of instructional system design.

7.2 INFORMATION SYSTEMS

Information systems (IS) is a field of practice and research that spans back to the early 1950s and has since its inauguration experienced several paradigm shifts (Petter, Delone & McLean, 2012). As is often the case, the field began primarily as a craft, but as practitioners sought to understand and optimise their working processes, a field of research started emerging. Alter has defined theories and models both to describe how to conceptualise the function and place of software systems in organisations, as well as how they incrementally take shape and the process of maintenance (Alter, 2006, 2008a, 2008b, 2010). In addition, Alter has presented frameworks both to understand the ways these types of systems fit into broader organisational contexts, as well as the way they take shape, are maintained, and evolve during their design and use (Alter, 2008b, 2010). For example, Alter's (2008a) Work Systems Framework describes the components of an IS as existing in a broader frame of infrastructure, environment, and its strategies (Figure 7.2).

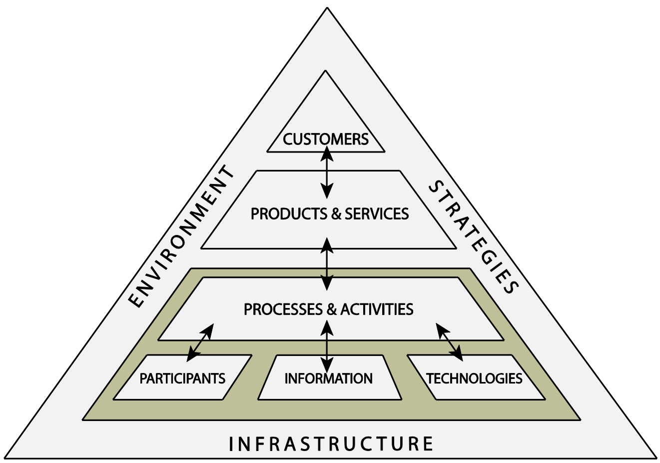

Figure 7.2: The Work Systems Framework as proposed by Alter (2008a, 2008b). Systems in organisations influence, and are influenced by, the broader organisational context and its actors.

The relevance of this type of IS research to the subject of this thesis is, much like instructional system design research, the way utilitarian and purposeful systems fit into broader contexts, and how this influences their design and development. Throughout the development, evaluation, and maintenance of an IS (regardless if you are discussing it from an information or working system point of view), requirement analyses and collaboration with stakeholders are crucial (Avison & Fitzgerald, 2006). In Avison and Fitzgerald (2006), these aspects of information systems are described from a practitioners perspective. Much like Alter (2010), Avison and Fitzgerald (2006) view information systems as something that can exist in several different ways in an organisation. They firmly state that regardless of how specific the function of an IS is in an organisation (e.g. the specificity of its area of application inside a corporation), its design and development need to be accommodating of the organisation as a whole. If the IS is too focused on supporting a small part of an organisation, it may lead that specific part to operate to the detriment of broader strategies and environment of the organisation at large. This may seem obvious, but it is tempting to simplify and distil the requirements and functions of a system within smaller boundaries. As Avison and Fitzgerald put it:

> "Decomposing complex structures is the accepted approach in a scientific discipline, but information systems concern people and organisations as well as technology, and the interactions are such that in these human activity systems it is important to see the whole picture. The human components in particular may react differently when examined singly than when they play a role in the whole system." (Avison & Fitzgerald, 2006, p. 51)

So, the IS is not only a product made for a specific purpose, but is also itself a product of how it will be used. This reiterates the importance of viewing IS as constantly evolving objects rather than static solutions, thus sharing similarities with instructional system design and development (Gustafson & Branch, 2002). But, it also emphasises the importance of the human components of an organisation. Avison and Fitzgerald (2006) recognise that the end-users of an IS are both unpredictable and not beings of pure logic, which can manifest in everything from positive influences that improve the IS, to resistance to using it and even sabotage. When faced with a new IS, users can feel that they are being burdened with extra labour as their working routines are being changed, or they can feel as though the freedom and independence their working situation affords them are compromised. These are pressing issues that seldom make themselves known before a significant amount of resources has been spent to design, develop, and implement the IS. The execution of the IS certainly plays a crucial role in how it will be accepted by the intended users, and competent design can alleviate some of the issues with user acceptance (Pai & Huang, 2011). However, a more efficient and accurate method to increase acceptance is to have the IS design and development process open to meaningful user participation:

> "User involvement should mean much more than agreeing to be interviewed by the analyst… This is 'pseudo-participation' because users are not playing a very active role. If users participated more, even being responsible for the design, they are far more likely to be satisfied with, and committed to, the system once it is implemented." (Avison & Fitzgerald, 2006, p. 81)

This sort of user participation can be included in IS development in several different ways. A good description is provided by Mumford (1983), who presents three different ways of being user inclusive: consultative participation, representative participation, and consensus participation. Consultative participation is the simplest form of user participation, and borders on the 'pseudo-participation' mentioned by Avison and Fitzgerald (2006). It does, however, separate itself by not only limiting consultation of the users to interviews performed during early stages of the design process, but keeps the users involved throughout the process and encourages feedback that can be used to redesign the IS, both during early tests and after implementation. This type of participation is common and comes natural to most IS developers, but in comparison to other participation approaches it is at a relatively low level. Representative participation takes it a step further, by including representatives from the user-group in the design and development process of the IS. Here, the users are not only consulted for feedback on the system, but actively contribute to it throughout development, either through design decisions, requirement analysis and statements, and by providing the development team with insights into the realities of the context in which the IS is going to be used. Finally, consensus participation is the more democratic and all-inclusive of the three methods. This process has the drawback of being significantly slower than non-democratic ones, as design decisions cannot be made as quickly, but benefits the process as decisions will suit the users well and the users can feel a sense of personal investment in the project; hopefully making them more accepting of it in the end.

These types of human factors of organisations constitute but one of many different categories of ‘situational factors’ that affect information systems. As a term, ‘situational factors’ broadly refers to properties of developers, users, organisations, and markets that affect an IS throughout its lifespan (Bloom & Hautaluoma, 1990; Clarke & O'Connor, 2012; Silvius & Stoop, 2013). They are present in the construction of requirements made by organisations and end-users in the shape of infrastructural concerns (e.g. available hardware) and legislation or other externally enforced considerations (e.g. safety considerations, international standards, and market dynamics) (Silvius & Stoop, 2013). They are also present in design and development processes in the shape of team sizes, personnel experience, project budgets, and properties of the context of application (Clarke & O'Connor, 2012). Finally, they are also present and influential in the processes of integrating and using the IS in its organisational setting, in the shape of users’ experience of working with technology, user preferences, technological infrastructures, and support services available in the organisation (Abugabah, Sanzogni & Poropat, 2009; Bloom & Hautaluoma, 1990; Silvius & Stoop, 2013). Situational factors are both numerous and highly variable in their characteristics and significance to IS development and use; some are abstract (e.g. attitudes, experiences, and organisational cultures), whereas others are more practical (e.g. hardware availability, budgets, and software quality) (Clarke & O'Connor, 2012; Silvius & Stoop, 2013). In a literature review aimed at collating the different types of situational factors that affect the development of information systems, Clarke and O'Connor (2012) identified 44 different situational factors (with 170 related sub-factors) of eight different classifications.

Given their variety and abundance, situational factors’ interrelation to one another and the way they affect the ultimate effectiveness and success of an IS can be hard to pinpoint (Silvius & Stoop, 2013). The authors that were referenced, in relation to the topic here, for example, all lament the lack of general frameworks that describe how situational factors come together to ultimately and practically affect the development and use of an IS (Abugabah, Sanzogni & Poropat, 2009; Bloom & Hautaluoma, 1990; Clarke & O'Connor, 2012; Silvius & Stoop, 2013). It is, however, clear that the development of a software solution involves aspects far beyond the design and production of the software artefact; the experience of clients, developers, and end-users of an IS, as well as the usefulness of the IS itself, will be influenced by a wide range of factors external to the software itself (Abugabah, Sanzogni & Poropat, 2009; Clarke & O'Connor, 2012; Silvius & Stoop, 2013).

7.3 USER ACCEPTANCE AND APPLICATION OF NEW TECHNOLOGY

In order to further understand what users look for in a piece of technology, we can turn to research on technology acceptance. Technology acceptance research is of relevance to all fields that have been mentioned in the background chapter, as it can be used to understand how users adopt technology into their everyday lives, or into their working environment or business. With entertainment games, utilitarian aspects of the technology might not play much of a role when it comes to ‘acceptance’. Instead, personal enjoyment, taste, and monetary factors are more important factors when new entertainment games, and the technologies associated with them, are acquired (Venkatesh, Thong & Xu, 2012). For instructional systems, however, acquisition and use is more motivated by utilitarian factors (Venkatesh et al., 2003). Unlike leisure technology and software, instructional systems are sought out by organisations or individuals by necessity and in an effort to seek out utilities that can have a positive impact on its users (King & He, 2006; Venkatesh, Thong & Xu, 2012). They are also used in mandatory or strongly guided contexts (e.g. in corporations, schools, or healthcare). These differences have a significant impact on what a user expects from new technology and what it needs to achieve to be accepted. A common approach to explaining the peculiarities of technology acceptance is to use the Technology Acceptance Model (TAM), as proposed by Davis (1989) (Figure 7.3). TAM is widely utilised in the field of IS research, and while it has been modified and expanded upon by many researchers since its inception it has remained a staple for predicting user acceptance of technology interventions (King & He, 2006; Pai & Huang, 2011). In particular, what the TAM does well is draw connections between users' perceptions, attitudes, and intentions and how they actually embrace technical solutions in practice, once they are implemented.

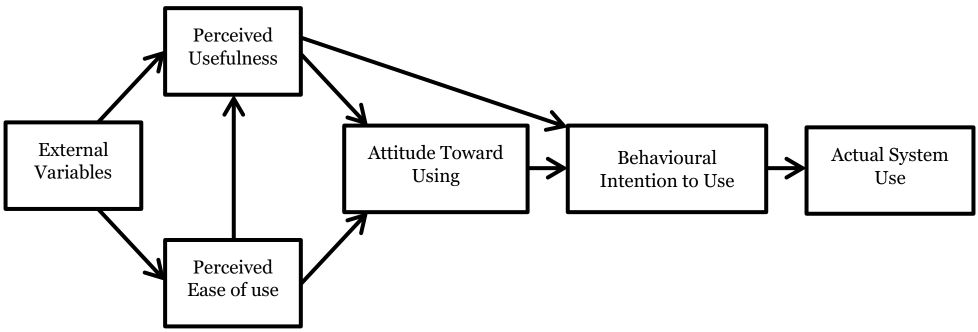

Figure 7.3: The Technology Acceptance Model (TAM) proposed by Davis (1989). A user's intention to use and actual usage of new technological solutions depend on how much it is perceived to aid work processes in relation to how much extra work effort it adds.

What Davis's (1989) research suggested, which has been ratified by many researchers since (e.g., King & He, 2006; Pai & Huang, 2011; Venkatesh et al., 2003) , is that the users' initial perceptions of how useful, and easy to use, new technology is, strongly influence their intentions to use it, which subsequently dictates actual use. However, while TAM established the causality between perceptions and intent, and actual use of new technology, the user was still treated as a 'black-box'. You could understand what their perceptions regarding a piece of new technology were, but not what characteristics of a user influenced those perceptions (Pai & Huang, 2011). This has been ameliorated in new expansions of the TAM model, such as the new model provided in Venkatesh et al. (2003). In this relatively recent work, the TAM was revised to mainly include more sociological elements to describe what factors influence a user's perceptions of usefulness and ease of use. In their research, Venkatesh et al. (2003) placed heavier emphasis on the nuances of the specific user by, taking gender, age, experience, and voluntariness of use into consideration as important factors for technology acceptance. The effects of these factors are also in a mutually influential relationship with the organisational and social variables partly described in the original TAM models (but then in more vague terms, e.g. 'external variables'). The correlation between all these aspects of organisations, users, and technologies is presented in Venkatesh et al. (2003) as a new model called the *Unified Theory of Acceptance and Use of Technology* (UTAUT) seen in Figure 7.4.

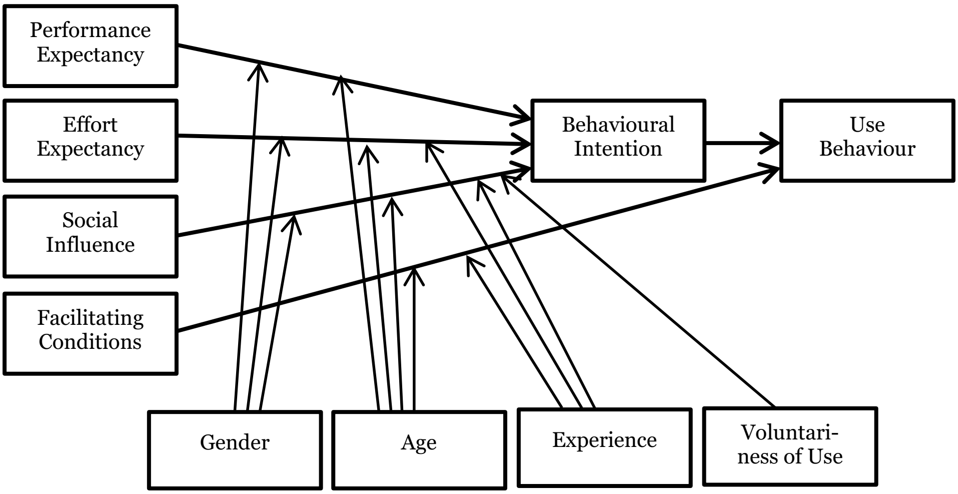

Figure 7.4: The UTAUT Model as proposed by Venkatesh et al. (2003) complements the variables affecting intention of use and use behaviours from TAM with more specific details of the users and of the context in which the technology is applied.

The UTAUT breakdown explains attitudes, intentions, and actual use as a result of expectations and social and organisational influences, which in turn is influenced significantly by the personal traits of individual users. As in TAM, expectations of technology performance (e.g. productivity effects) and effort (e.g. how difficult the technology will be to learn and use) still play a crucial role in acceptance (Venkatesh et al., 2003). These expectations are primarily based on gender, age, and previous experience of the users. For example, young males are found to have more task-focused expectations with regard to performance. Their primary concern tends to be how new technology will affect their work productivity and they are not as concerned with the effort it takes to use the technology (Venkatesh, Thong & Xu, 2012). Social influences, on the other hand, are affected by all four user aspects. Here, other users' opinions toward the technology play a crucial role alongside gender, age, and experience. Previous research has concluded that older users are more susceptible to others' opinions, but that these effects are also highly dependent on the individual user's experience (Pai & Huang, 2011). So, the four user characteristics do not always accumulate to change attitudes and intentions in one particular way; they can also lessen, enhance or otherwise influence each other. Another important addition in the model is the users' perception of 'facilitating conditions' present in their organisation. Facilitating conditions can be seen as a sub-category of the concept of 'situational factors' that primarily focus on the organisational conditions and support structures that users believe to be directly relevant to their own integration and use of the new technologies. The impact that facilitating conditions have on users' acceptance and use of new technology interventions is highly informed by individual users' level of expertise and working experience; a user's confidence in their own working processes and experiences of working within the organisation influences their faith in the organisational infrastructure, and the ways in which they choose to integrate new technology into their working processes (Venkatesh et al., 2003). A distinguishing aspect of the facilitating conditions factor is that it does not significantly affect intention of use, but rather affects the actual use behaviour directly. The reason for this is that intentions of use are reliant on the user's performance and effort expectancies on the new technology (e.g. "how easy is it to use, and how will it help me?"), which later translates to use behaviour (Venkatesh et al., 2003). Facilitating conditions capture the elements that are not captured by the social influences on user expectations, such as training provided by the organisation, which affects use behaviour directly (Venkatesh, Thong & Xu, 2012). The peculiarities of the interrelationship between all the components described in the UTAUT are too numerous and complex to sufficiently describe here, but the model is a useful tool for explaining the factors that affect users' acceptance of new technologies. In the concluding chapters of this thesis, the importance of understanding the user is reiterated once again, but then in the context of educational games that are developed for educational contexts.

PART III

CASE STUDY METHODS AND EXECUTION

The methods and aims of the research conducted within the auspices of this thesis have, as described in chapter 3, evolved iteratively following an over-arching abductive research strategy. The research question pursued at the start of my research relates to how games are designed and developed, how games can and are being used in formal educational settings, and how that process can be improved through more pedagogically- sound design choices. Subsequent research aims focused more on understanding the properties of formal education and game development from a systems-oriented perspective (rather than a more delimited software artefact perspective). The following part of the thesis describes how this transition progressed and how it is reflected in the design of the conducted studies.

Chapter 8 describes the reasoning and theoretical foundation for the methodological choices made throughout the various case studies conducted during this research. To make the processes and outcomes of the case studies easier to follow, they are separated into a series of research 'phases', and the designs and results of each phase are presented individually. The first two phases (presented in chapters 9 and 10) involve case studies focused on exploring and examining the broader processes and challenges involved in the development and use of educational games. Chapter 11 presents a brief meta-analysis of educational games literature, which I conducted to become better equipped for understanding observations made during the first two research phases, and for planning my third, and final, phase of case studies. The research conducted during phase three (presented in chapter 12) involve more in-depth case studies that examine the working processes involved in integrating and using game-based learning in formal educational settings.

CHAPTER 8
RESEARCH METHODOLOGY

As previously mentioned in chapter 3, the choice of relying on case studies during this thesis was informed by the aims of investigating the development, implementation, and use of educational games and game-based learning in real-world settings. Investigating the properties of organisational settings, as well as working processes and integrations of interventions in those settings, is something that case studies are particularly useful for (Flyvbjerg, 2006; Robson, 2002; Yin, 1984). To that aim, case studies have been the primary method of research throughout this project, although the specific approaches of conducting them have changed somewhat along with the previously outlined changes of research queries. Case studies are, according to Yin (1984), "preferred when studying contemporary events, but when the relevant behaviours cannot be manipulated." That is to say, case studies are potent when it comes to describing not fully fleshed out phenomena in their real-life context. Yin further points out organisations and their working procedures, as well as the processes of intervention implementation and their impact, as especially ripe targets for case study research (1984, p. 19).

However, while case studies are a potent means of understanding the function and application of games in their intended context of use, conducting good, rigorous, case studies is a difficult craft. Case studies are also subject to many misconceptions; some of which attribute them with overly positive or negative characteristics (Flyvbjerg, 2006), and some that misconstrue their actual purpose in scientific enquiry (Yin, 1984). One frequent misappropriation of the case study strategy is that it is used as a platform from which the researcher gets to, *carte blanche*, 'tell it like it is' (Yin, 1984). That is, of course, not the purpose of case studies, or the privilege they are meant to afford. Although case studies, as opposed to laboratory experiments and surveys, are characterised by un-routinised data collection, they still require purposeful and structured execution. Due to the sometimes chaotic circumstances in which case studies are conducted, the structures of case studies and qualitative enquiry are more akin to a set of core values and procedures, rather than pre-designed and static routines and researcher behaviours (Golafshani, 2003; Mason, 2002; Yin, 1984). The looser structures and the emphasis on researcher flexibility are made necessary due to the lack of control that the researcher has over the examined phenomenon. Since the point of conducting case studies is to examine a phenomenon in its real-life setting, manipulating and controlling the setting and the behaviours of actors would be antithetical. Instead of manipulating properties of the environment to produce reliable data, the researcher needs to pursue validity through other means. For example, understanding interventions in complex systems requires the employment of multiple methods of data collection, in order to create a reliable account of the system's properties and the impact of the intervention. Interviews, participation, observation, or surveys do not fare particularly well if they are relied upon as the sole method of data collection, as a singular method is highly susceptible to researcher bias and may miss an important aspect of the researched context (Gibbert & Ruigrok, 2010; Mason, 2002; Robson, 2002). However, when used in tandem, they can synergise to paint a comprehensive and nuanced picture of the complex phenomenon and context being studied. To ensure that my understanding of the system in which educational games are a component, the studies I have conducted attempt to construct a 'full body of evidence' (Yin, 1984, p. 24), by combining a couple or several different methods of data collection and using them during several case studies that involved multiple actors.

The way in which different case studies and methodologies are combined in this research, is easiest described by relating it to a few specific examples of serious games research that shares similarities with my own: Harteveld et al. (2010), Nilsson and Jakobsson (2011), Egenfeldt-Nielsen (2008), and Alklind Taylor (2014). These studies exemplify a few of the most commonly used methodologies in the research of educational games and serious game design: questionnaires, interviews, participation and workshops, and observations. In many cases, for instance when evaluating how an educational game affects social aspects, user engagement, and teaching processes, a combination of these methods, or a 'methodological triangulation' (Patton, 2002), is usually employed to create a more comprehensive understanding of the studied phenomenon (e.g., Alklind Taylor & Backlund, 2011; Egenfeldt-Nielsen, 2008; Garzotto, 2007; Harteveld et al., 2010). Interviews and questionnaires are frequently employed in an effort to catch thought-processes surrounding educational game activities, or as a means of debriefing and contextualising data collected during play-session experiments. For instance, interviews can capture the opinions of clients (e.g. teachers, students, or legislators) regarding what they think of educational games and the qualities they expect to see from their use (Ruggiero, 2013; Tan, Neill & Johnston-Wilder, 2012), whether they feel an educational game fulfilled their expectations (Egenfeldt-Nielsen, 2008), or how a group of players or teachers perceive their performance in a play-session (Alklind Taylor & Backlund, 2011; Nilsson & Jakobsson, 2011). In the specific examples of Nilsson and Jakobsson (2011), and Egenfeldt-Nielsen (2008), interviews are used as a supplement to observation and quantitative assessments of learning outcomes from using educational games. Egenfeldt-Nielsen (2008) performed a study where a game was implemented into a classroom context to teach a specific subject, and observed how the teachers and students experienced this process. From the observations, it was possible to identify where the game fell short as an educational tool or was cumbersome to use in the educational environment, and contextualise these observations with student and teacher interviews. This is a relatively common research approach; interviews do not provide particularly reliable datasets during these heavily researcher-influenced case studies, but they can be helpful in contextualising gathered data, or to inform subsequent data collection using other methodologies (Robson, 2002).

The Nilsson and Jakobsson (2011) study utilised observations in a similar way. Observations of the use of games in educational situations were used to gather data regarding player behaviours and game performance. Interviews were then subsequently employed to make sense of the data gathered from observations. The interviews also served to minimalise the impact of researcher bias with regard to interpreting the data, by obtaining the users' perspectives on why the game was used in a certain way, whether or not players found the game engaging, or how they experienced their various collaborations and projects inside the game. Harteveld et al. (2010) took a slightly different approach, and worked together with their subjects to a greater extent. In their study, they developed a serious game together with subject matter experts and users. Through iterative play-testing and workshops, where they discussed design decisions with these research subjects, they were able to identify the challenges and dilemmas that arise during a typical serious games development project.

Finally, Alklind Taylor's research on instructors' roles in a serious games application (2012; 2014; 2011) combines all of the above approaches into one cohesive and comprehensive study. Alklind Taylor's work started with field observations that served to familiarise her with the context she was researching. After reflecting on these observations, and examining them against literature on the topic, the research could progress into more in-depth participatory studies. The initial familiarisation phase served to provide a broader 'lay of the land' and helped identify the factors that seemed strongly influential when it came to the success and impact of serious game applications. With this as a foundation, a methodology for continued, and more in-depth, observations was constructed and subsequently put to use in participatory observations. When the results of the participatory observations, which involved both actors that engaged with serious games applications directly and the different stakeholders involved in creating them, had been compiled and analysed, the research concluded with validation through member checks. By following a strategy where research was initially exploratory and broad and subsequently iteratively honed to investigate certain identified factors of serious game application, a broad and complex system could be researched, both comprehensively and in-depth.

The studies conducted during my own research used a similar approach to mix-method research designs, where one of the methods coupled together was to unveil a problem or venue of inquiry and another served to contextualise and map out its underlying details. The methods of this thesis work, interviews, participant observation, and audio recordings of game-based learning activities, and the core values and procedures followed during their execution are described individually below. The details of the execution of these methods are later revisited in the descriptions of the study designs employed during the different research phases (in chapters 9, 10, and 12).

8.1 DESIGNING FOR RESEARCH VALIDITY

Evaluating the validity of qualitative research requires the use of measurements specifically designed to address the peculiarities of naturalistic inquiry. Qualitative research has historically had a tough time arguing for its scientific value and distinguishing itself from more 'traditional' forms of scientific inquiry (e.g. quantitative research and experimental studies) (Patton, 2002; Robson, 2002). Traditional and quantitative scientific approaches either work with large sample sizes or controlled conditions for data gathering. Thus, their validity primarily stems from how variables are operationalised, how the respondents or samples are handled, how the conditions of experiments are established, and the researcher's objectivity throughout these processes. This has certain advantages, but the necessity of distilling variables down, so they can be processed *en masse,* also means that it can be difficult to gather detailed data about individual respondents (Patton, 2002). Qualitative research, on the other hand, focuses on "inquiry into selected issues in great depth with careful attention to detail, context, and nuance" (Patton, 2002, p. 227). That is to say, qualitative research deals with smaller sample sizes, but gleans a lot of detailed and nuanced data from them. As qualitative research deals with smaller sample sizes, the importance of distilling variables to make them manageable is reduced. This, in turn, decreases the need for predetermined and static methods of data gathering, which can open up interesting venues of inquiry that might have been overlooked when employing a quantitative approach.

The differences in both purpose and procedures mean that qualitative research needs to be judged on different criteria than quantitative research and experimental methodologies. According to Lincoln and Guba (1985), the quality of qualitative research lies in its dependability (its use of a structure that informs the researcher's actions in the field) and its authenticity (honest reflexivity regarding the perspective through which the phenomenon is studied) (Patton, 2002). Following these values, Lincoln and Guba established four criteria on which qualitative research validity can be judged: credibility, dependability, confirmability, and transferability (Lincoln & Guba, 1985). Transferability relates to external validity, whereas the other three criteria primarily relate to internal validity.

8.1.1 EXTERNAL VALIDITY

Since this research relies heavily on a relatively small number of developers, educators, and students, it is important to discuss its external validity. The chosen research approach mainly opens itself up for two avenues of critique; the low number of cases studied raises the question of the conclusions' general applicability (generalisability), and the broad research scope of some of the case studies raises the issue of research accuracy.

Generalisability, that is to say the extent to which research conclusions reached from one study can be considered applicable to other contexts, is a difficult proposition for qualitative research processes in general (Mason, 2002; Robson, 2002; Shenton, 2004). According to Flyvbjerg, qualitative case studies in particular often receive harsh critique for their lack of generalisability. However, this critique stems from positivistic preconceptions of the generalisability of scientific results, i.e., 'proponents of the natural science ideal' (Flyvbjerg, 2006, p. 224). As qualitative research focuses on nuanced and detailed examinations of a small number of cases, judging its merits in terms of generalisability is not particularly useful (Shenton, 2004). Determining whether it is statistically likely that the outcomes of a qualitative study are generally applicable to a larger population is highly unfeasible (Shenton, 2004). Game-based learning research encapsulates these aspects of qualitative research well, as it usually involves studies both in specific contexts and with uniquely developed interventions and tools. The outcomes of a study, where an educational game is used in a classroom setting, for example, can be heavily tied to details of the particular game being used, as well as the properties of the classroom into which it is put. During the study, the researcher may have played an important part in integrating the game into the context of use as well, giving the context even more unique properties that are influenced by the characteristics of the involved researcher. In other words, the research and its conclusions become strongly connected to variables that are unique to the particular case, and it is unlikely that other contexts will share many similarities with it. Given these constraints, the general applicability of research outcomes from qualitative research is discussed in terms of transferability instead of generalisability. Whereas generalisability is a measurement of whether research results from a population sample can be expected to be applicable to the entire population, transferability is a quality that depends on descriptive clarity and transparency:

> "To allow transferability, [good qualitative research] provide sufficient detail of the context of the fieldwork for a reader to be able to decide whether the prevailing environment is similar to another situation with which he or she is familiar and whether the findings can justifiably be applied to the other setting." (Shenton, 2004, p. 63)

In Shenton (2004) and many other scholars' view (e.g., Golafshani, 2003; Lincoln & Guba, 1985; Patton, 2002), transferability is not an inference of general applicability made by an author. Instead, it is a research quality that allows readers to decide whether findings gleaned from a particular case can be applied to a different one.

For this thesis, transferability has primarily been pursued through transparent and honest accounts of researcher involvement during the different case studies. The case studies in the later phases of the research are also accompanied by 'thick descriptions' (Geertz, 1973) that detail the intentions and properties of the actors involved in the studies. As described in more detail in chapter 11, research on educational games and game-based learning is often highly reliant on the construction of 'artificial' educational environments. This research is no exception, and my own involvement in the different cases has likely been highly influential in the outcomes of the research. This is an inescapable side effect of conducting these types of qualitative studies, and not only an issue found in educational games research:

> "Critics of the approach are concerned about researchers getting over-involved with the people being studied, perhaps disturbing and changing the natural setting, and hence compromising the quality of the research." (Robson, 2002, p. 186)

To combat these issues, I have kept detailed accounts of my role in the different cases, and have continuously encouraged the teachers and developers that I collaborated with to evaluate my involvement as well. The documentation and the different stakeholders' reflections have then been used to contextualise the different game-based activities within the researcher interventions that were necessary to make the activities possible. The thick descriptions also serve to give the reader enough of an understanding of the involved actors to comprehend what informed their meaning-making during the studies, and how my involvement with them may have influenced those processes.

8.1.2 INTERNAL VALIDITY

Whereas external validity is the concern of whether research is applicable outside of a studied context, internal validity is a concern of the trustworthiness of the research, and the rigour with which it was conducted. In other words, internal validity depends on whether chosen research methodologies are appropriate for studying the chosen phenomenon and the rigor with which the methods were employed (Mason, 2002). As mentioned previously, the internal validity of qualitative research comes down to three criteria (Lincoln & Guba, 1985; Patton, 2002; Shenton, 2004):

- Credibility – is the phenomenon under scrutiny being accurately and truthfully presented?
- Confirmability – do the findings of the research emerge from the data, or are they more dependent on the researcher's own predispositions?
- Dependability – is the research procedure and context presented in a clear and transparent way that enables future researchers to understand the circumstances of the conducted study?

These criteria can be pursued in several different ways. Mason (2002) posits that discussions and evaluations of a research method's internal validity start with questioning why the used research method is appropriate for investigating the chosen research question. In essence: why are the chosen method and its epistemological baseline suitable for examining the subject in question? Or, when contextualised in my own research: if I believe "how do organisational components, processes, and actors found in formal education affect the development and use of educational games?" to be a valuable research question, is my process of using iteratively refined interviews, observations and participations in development and education contexts appropriate for finding an answer?

As previously mentioned, the pursuit of a comprehensive understanding of the effect, and effectiveness, of an intervention within a system is a complex research endeavour. Too narrow a research scope and methodological toolkit can miss important peripheral processes in the system, and being overly inclusive can make data management impossibly laborious and constrain research to shallow observations. The way I have tried to manage the scope and methods used in the pursuit of my relatively broad research question has been to slowly adjust them based on previously gathered data. Examining all the cogs of the machinery, which span from developers' working processes to teachers' and students' gaming activities, cannot be done with one cursory glance. That is why this research relies on several research phases that each come together to produce a comprehensive overview of game-based learning and educational games. This process has had several advantages when it comes to ensuring internal validity, as it incorporates methodological triangulation to study the chosen phenomenon, and several opportunities to validate research conclusions and re-visit them during different cases.

The process' natural coupling with validation, or 'member checks' (Bitsch, 2005), has been useful when maintaining credibility throughout the research. By continuously returning to research participants and presenting them with research findings, I have hopefully reduced the risk of grossly misinterpreting data. The research has also pursued heightened credibility through triangulations, as the researched phenomenon has been studied through multiple different research methods employed during multiple different case studies with various participants. Relying on a singular case, or a singular method of data collection, leaves qualitative research susceptible to sampling and interpretation biases (Bitsch, 2005; Yin, 1984). Utilising a variety of participants as data sources and various data collection methods to study the same phenomenon reduces these issues.

Confirmability has also primarily been pursued by validating research outcomes through reflecting them back to educators or developers. Outcomes reached in the first couple of years of research, for example, were incorporated into questions for subsequent interviews with different respondents. Having an entirely different respondent ratify conclusions from previous studies has been used to indicate that those conclusions are not the result of researcher predisposition.

Dependability parallels the concept of 'reliability' used in quantitative studies and relates to the replicability of findings. It can be a difficult criterion to fulfil in qualitative research, due to the close coupling of research outcomes and the unique context of the research (Mason, 2002; Shenton, 2004). As discussed previously, quantitative studies differ significantly from qualitative studies in that their validity is tied to the rigour, objectivity, and appropriateness of their chosen methods of data collection and analysis (Mason, 2002). In qualitative research, perhaps especially when the abductive approach is employed, methods are by necessity more flexible:

> "In a quantitative context, changes of methods and techniques would jeopardize reliability. [...] On the contrary, changes in hypotheses, concepts, and even the focus of a research project are a sign of a maturing and successful research process in a qualitative context." (Bitsch, 2005, p. 86)

Since things are an inherent part of qualitative research, dependability has little to do with static routine and control over the research environment. Instead, ensuring dependability, while remaining flexible and open to change, comes down to authentic and transparent documentation of how the hypotheses, enquiries, and methods have changed throughout the research process (Mason, 2002). To pursue dependability in this research, I have tried to provide honest and comprehensive accounts of how and why the research aims and methods changed throughout the research process (see sub-chapters 9.1, 10.1, and 12.1).

8.2 STUDY DESIGNS

With the general procedures and values followed to ensure the dependability, credibility, and transferability of this flexible research process as a backdrop, the specifics of how the different studies were designed can be described in more detail. As this thesis work does not rely on a singular study, presenting the methodology in a concise way is somewhat difficult. While the research continuously employed the same general research methods, the changes made to account for new findings and experiences make the methods used early on in the research distinctly different from the later ones. With this in mind, the different studies and their design are divided according to the three primary 'phases' of the research process in which they were conducted. The division of the research process into phases was done by drawing associations between the different research steps and Yin's (1984) description of case studies as being either *exploratory*, *explanatory*, or *descriptive* depending on their purposes (shown in Table 8.1).

Table 8.1: Categories of case study purposes and brief comments on the application of the case study types in this research are provided. The definitions of the case study categories and their roles in scientific inquiry are based on descriptions by Yin, as collated and related to qualitative research in Baxter and Jack (2008) and applied to information systems research in Schmidtbauer, Sandkuhl and Stamer (2013).

Category	Definition	Application in this research
Exploratory	"This type of case study is used to explore those situations in which the intervention being evaluated has no clear, single set of outcomes." (Baxter & Jack, 2008, p. 548)	Examine what the processes involved in educational game development and use entail. For example challenges for developers when designing and marketing products and themselves, and the nature of formal educational organisations as an audience.
Explanatory	"This type of case study would be used if you were seeking to answer a question that sought to explain the presumed causal links in real-life interventions that are too complex for the survey or experimental strategies." (Baxter & Jack, 2008, p. 547)	Examine how the identified challenges manifest during the integration and use of educational games, and how the realities of formal education exert pressure on educational games' performance and accessibility.
Descriptive	"This type of case study is used to describe an intervention or phenomenon and the real-life context in which it occurred" (Baxter & Jack, 2008, p. 548)	Document and describe the system of educational game use in formal educational settings in detail. Focused on identifying and describing the ways that the intervention and the organisational setting affect each other

The phase division breaks down the description of the methods and their application in chronological order, with the intent to show how the study designs changed due to experience acquired and conclusions reached throughout the research process. Describing the research process as a sequence of phases is perhaps misleadingly reductionist. The iterative changes of direction and focus that occurred during the research were certainly not the results of distinct eureka-esque moments of inspiration or revolutionary events that concluded one phase or started another. It was, as mentioned several times during this chapter, all a result of a slow and incremental evolution. However, in order to make the continuously transforming research process easier to detail, it is compartmentalised into phases that are characterised by the particular methods of inquiry I followed and the approaches I used to do so. Figure 8.1 visualises the broader methodological characteristics of each phase, the enquiries they manifest, and their role within the overall research strategy.

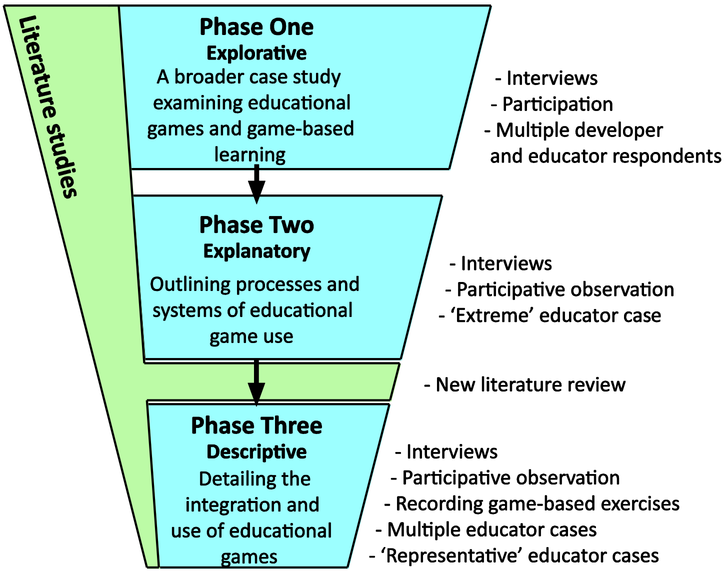

Figure 8.1: Outline of the different phases of the research. The research progressed from broader exploratory studies towards more detailed explanatory and descriptive ones. The literature studies were expanded between the second and third phase, in order to further explain identified discrepancies between educational games literature and practical application.

As previously mentioned, the research was initiated with an exploratory approach meant to reveal the broad outlines of educational game development and use, by employing a relatively open and flexible line of enquiry and a broad range of respondents. The initial phase was focused on an exploratory examination of attitudes, rationales, working processes, and experiences of developers and educators. These questions were influenced by observations made in my own research that predates this thesis work, when I had attempted to implement a game in a formal educational setting for an experimental study (presented in Berg Marklund, Backlund & Johannesson, 2013). While the focus of the study was to examine whether children collaborate differently in virtual and physical environments, an important personal realisation was the unexpectedly laborious and complicated process of setting up a relatively rudimentary system to play games in a school environment. The explorative study conducted in phase one was essentially an effort to gather practitioners' experiences of and perspectives on educational games as business ventures, creative endeavours, and educational tools, in order to generate ideas and hypotheses for future, more in-depth and detailed research. During phase two, the details of the more prevalent patterns identified in phase one were examined and explained through a case study employing interviews and participatory observations to study a small-scale project where an educational game was implemented and used in an educational environment. The results of these studies were collated into the first thesis written during this project (see Berg Marklund, 2013). The first thesis compiled the initial knowledge contributions regarding some of the bigger discrepancies between the realities of game development and business, and the practical realities of working processes and constraints caused by the practicalities of formal education.

As shown in Figure 8.1, a more extensive literature review was conducted before the third phase began. Literature studies were an important element throughout the research process, but observations made during the first two research phases revealed the need to re-examine the methods and epistemology of previous research. Briefly summarised, the first two phases revealed that educational games made for formal educational scenarios (like K-12 classroom use) face significantly different constraints and possibilities than 'traditional' games whose settings consist of the game artefact and its players' interactions with and within it. The aim of the new literature review was to examine how these differences were detailed in previous research, or whether they were detailed at all. The less formalised literature studies conducted throughout the thesis work had hinted at a knowledge gap within this area, but a more structured literature review needed to be conducted to examine the knowledge gap more closely. This literature review thus served as a way to refine the methodology of my continued research in phase three, as I could position it more confidently in relation to previous research and construct it in ways to alleviate issues found in previous studies.

The final phase of the research process expands upon the contributions of the previous thesis and examines their validity in more representative cases than the ones studied previously. As stated in Table 8.1 and Figure 8.1, the focus of this research phase was to describe the working processes involved in integrating educational games in a formal educational setting, as well as designing and conducting game-based activities, in more detail. Whereas the previous phases and literature studies had excavated the contours of educational game development and use, this phase focused specifically on experiencing, detailing, and understanding the constraints and possibilities imposed and offered by formal educational settings (e.g. how they impact teachers' working situation and impose demands on how games can and should perform during game-based learning).

Several different case studies, with various respondents, were conducted over the course of the three research phases (summarised in Figure 8.2). Overall, the research included a total of nine different developers (with varying working conditions and levels of expertise), three different principals (who all worked within the same school district), one 'head of pedagogical development' in a Swedish municipality, and seven different teachers. Furthermore, two different open workshops with teachers were hosted during the early phases of the research. The first workshop was held at a Danish high school together with a group of ten educators, and the second was held in Sweden together with a different, larger group of twenty participating educators and an experienced educational game developer. However, these workshops were too unstructured regarding participation and setup to provide concise contributions to the research aims. I have still opted to mention them as parts of the research process, because they provided a venue for the dissemination of results and opportunities to discuss research outcomes and educational games with larger groups of educators from many different municipalities. More details regarding all of the core research participants can be found in the chapters that describe each research phase in more detail (i.e. chapters 9, 10, and 11).

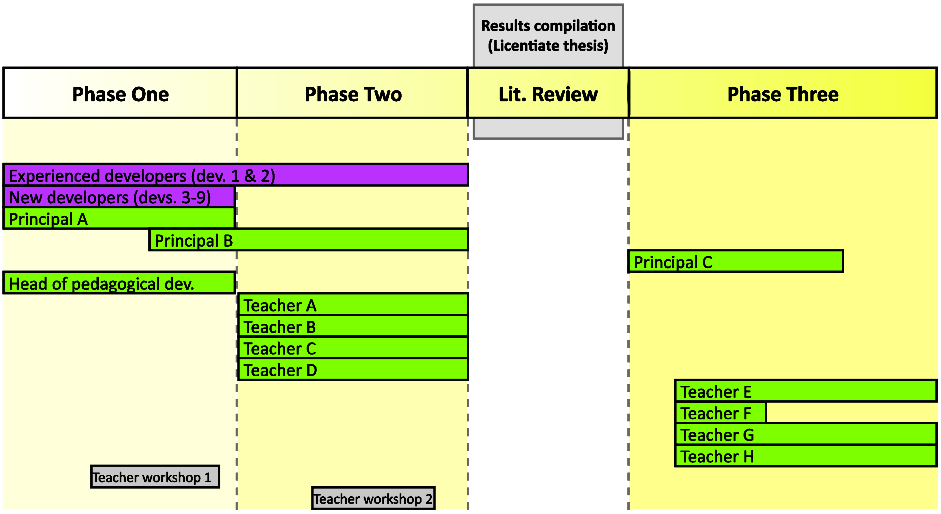

Figure 8.2: The distribution of research respondents throughout the different phases of the thesis. Principals were usually involved in game-based learning projects before I started working with the teachers, which is why Principal B and C's participation does not directly match that of the teachers. The experienced developers transcended phases by being occasionally used for results validation during phase two.

8.3 ETHICAL CONSIDERATIONS

The research conducted during this thesis has followed the general ethical guidelines provided by the Swedish Research Council in the report *Forskningsetiska Principer inom Humanistisk-Samhällsvetenskaplig Forskning* [Principles for Research Ethics in the Humanities and Social Sciences] (Vetenskapsrådet, 2002). According to the research council, field research dealing with human subjects needs to be designed according to four primary ethical requirements:

- *The information requirement*: the researcher shall inform the ones affected by the research project of its purpose.
- *The consent requirement*: respondents and subjects have the right to control the extent of their own participation in the research.
- *The confidentiality requirement*: information regarding all research participants shall be given the highest possible degree of confidentiality, and be stored in such a way that un-authorised people cannot access it.
- *The data use requirement*: information gathered regarding any individual can only be used for research purposes.

These four requirements were followed throughout each of the studies conducted during this thesis work. They did, however, have different relevancy levels during the different research phases, as data gathering methods and types of research subjects changed. During the first phase with the developer and educator interviews, the ethical considerations were fairly straight-forward. The purpose of the interviews, and the way data would be gathered and processed for research purposes, was made clear when the respondents were first contacted. After the interviews, the names of the respondents as well as their places of work, the produced game titles, or game studio names were anonymised.

The ethical considerations when working within classroom environments were naturally much stricter, as doing research involving children is always a sensitive topic, and as a wider range of data gathering methods were used. Principals, teachers and, more importantly, parents were informed of my research intentions and involvement in the school before I stepped into the classrooms. Teachers also brought up the project for discussion during parent-teacher meetings, and pamphlets with information about me, my research, and the game we were going to use during the game-based curriculum were distributed to the students' parents. The distributed pamphlet also described how students' identities would be anonymised, as well as the specific methods of data gathering and processing that were going to be used. In order to limit the amount of potentially sensitive information I would be gathering from the students' gaming activities, no photos or video recordings were used during the exercises, and the studies relied solely on interviews as well as audio recordings and participant observations of classroom activities. The students themselves were also informed that recording devices would be used during the exercises. Furthermore, I was the only one with access to the audio recordings of interviews or classroom activities (which was also stated in the information given to participants). The collaborative nature of the studies conducted in phases two and three also made it possible to ask involved educators how they felt about the progress of the research, and if there was anything that made them uneasy about the research approach being used. And, which is probably needless to say, the data was not presented, made available, or sold to any commercial entities or any third party.

CHAPTER 9
PHASE I: EXPLORING THE PROCESSES OF DEVELOPING AND PURCHASING EDUCATIONAL GAMES

The exploratory nature of the first research phase manifests in two ways: the large number of respondents involved in the case study and the focus of the research enquiries on broadness at the expense of depth. Here, the goal was not to fully map out and scrutinise small details of the working processes of game developers and educators. Instead, the participation in various projects and interviews with different types of respondents aimed to produce a general overview of educational game development and use. This phase lasted approximately a year, and was – as is the case with all research during this project – coupled with continuous literature studies. The phase primarily served to examine the following aspects of educational game development and application:

- How educators and developers perceive educational games (and educational game development).
- What working processes are involved in creating educational games, either in collaboration with a specific client, or towards an open market?
- What parameters do educators and developers use to evaluate games as being educational tools or as games respectively?

The case study included both educators and developers, which entailed that I continuously alternated between these two groups of respondents during the research process. This interplay allowed the two "poles" of the study to inform each other. Attitudes and procedures discovered during interviews and meetings with developers could be used to inspire the design of the interviews conducted with educators, and vice versa. The multi-method approach and the inclusion of several perspectives on the same phenomenon have been good ways to tackle that challenge and have produced empirics that can be used to answer the stated research question. Nevertheless, considerations need to be made regarding the method's primary shortcomings: reproducibility and generalisability.

9.1 CASE AND STUDY DESIGN

The intention of the early explorative studies was to cast a wide net to examine opinions, attitudes, experiences, and working processes on either side of the educational games field, and thus included many different types of developers and educators who were working with educational games in some capacity.

The studies on developers included a total of nine companies that covered a wide spectrum of developer profiles. To make them distinguishable during further discussion, the profiles are listed in Table 9.1. Their relative differences to one another are categorised in Figure 9.1, on the basis of two key parameters that I have found useful when analysing the research results:

- Experience (x-axis): the amount of development experience of the company, based on the amount of time the company has existed and the number of titles that have been produced.
- Background (y-axis): refers to the type of foundation and experiences upon which the company is built, some of the participating developers have a background in the education sector, some are more experienced in game development, and a few are somewhere between games and education.

The motivation for using these particular parameters is that previous studies have shown that these factors greatly influence how development processes are carried out (Tan, Neill & Johnston-Wilder, 2012). Several additional characteristics of importance, such as country of operation, were omitted for the categorisation. The studied companies were only spread over a relatively small geographical area that has similar company and work cultures, hence, these parameters were deemed less significant, in comparison to the effects of the two chosen ones.

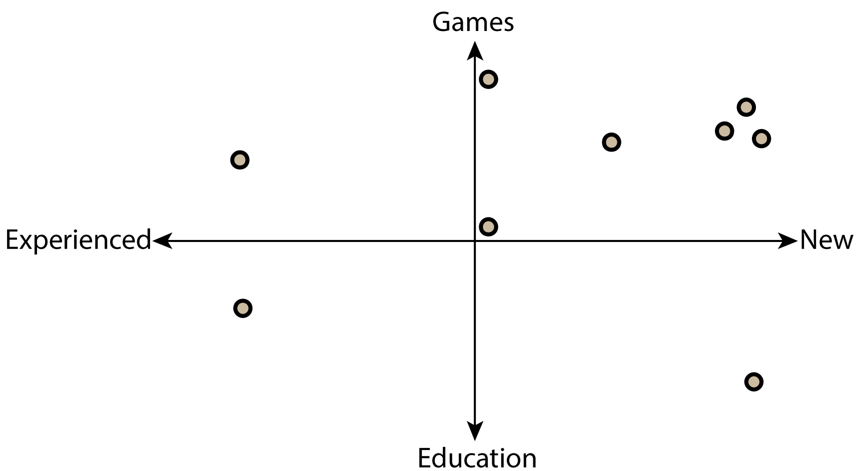

Figure 9.1: The distribution of developer respondents, according to development experience and their company profiles (i.e., if they considered themselves educators or game developers).

The categorisation allows for the placement of the developer respondents on a grid where the vertical positioning indicates *types* of experience (or, background), and the horizontal positioning the *amount* of experience. As shown by the figure, the case study included a wide spectrum of developer profiles. A combination of the resulting empirics from the studies should thus be representative of a wide range of practices in educational games. Nonetheless, even though the combination of respondents covers a wide range of educational game development situations in general, the small number of samples makes a too broad generalisations of practices impossible. For that reason, the categorisation also serves to delimit what type of educational game developers that the research conclusions regarding development praxis are transferable to. It is also important to keep in mind that the relationships described are relative, and are mainly a way of categorisation to distinguish the companies from one another. This is especially important to remember when considering the 'experienced' companies, since they do not signify the absolute pinnacle of skill within the field, but are instead the most experienced relative to other developers included in the case study.

The developers were studied either for the purpose of gathering opinions and attitudes towards educational games as a practice, or to witness their development processes as they were happening.

Table 9.1: Profiles of developers used as case studies, coupled with the purpose each developer had in the bigger context of my research as well as the methods used with each of them.

Developer	Profile	Purpose	Method
1: Experienced1	Established educational game development company	Gather opinions and experiences from an established educational game developer	Semi-structured interviews Structured interviews
2: Experienced2	Established educational game development company with founders from a pedagogical background	Gather opinions and discuss experiences and predictions from an established educational game developer	Semi-structured interviews Structured Interviews
3: Semi-experienced1	Semi-experienced developer of games and animations for children	Following a company's process of designing an educational game for an external client	Semi-structured interviews
4: Semi-experienced2	Semi-experienced developer publishing on the AppStore, new to educational games	Following a start-up company's process of designing a game for an external client	Semi-structured interviews
5: New1	Start-up company, previously solely focused on entertainment games	Follow a start-up's first experience with educational game creation for an external client	Semi-structured interviews
6: New2	Start-up multimedia company, creating a point-and-click educational game	Follow a start-up's first experience with educational game creation for an external client	Semi-structured interviews Consultation
7: New3	Start-up multimedia company, creating an entertainment game franchise, examining possibilities of educational games as a new marketing venue	Follow a start-up game developer exploring educational games as an alternate venue for products	Semi-structured interview Participatory research
8: New4	Start-up company, mainly focused on games for the AppStore, new to educational games	Follow a start-up's first experience with educational game creation for an external client	Semi-structured interviews
9: New5	New developers with pedagogical experience embarking on an educational game project	Participate in the initial process of ideation and design, starting from a pedagogical perspective	Participatory research

When it came to surveying the education side of the educational games, an even lesser number of respondents were used, and interviews only include two principals and one 'head of pedagogical development'. The discussions focused on the processes of acquiring new technologies, such as educational games, and integrating and utilising them in classroom exercises. As the respondents all had positions as decision-makers at their schools, the interviews provide insights into what it is that motivates educational organisations to acquire new educational technologies, what criteria they base their evaluation of educational tools on, and what experiences they have of integrating new technology into classrooms together with teachers.

The educator respondents also differ from one another in several ways, and were more difficult to codify into a framework of a couple of parameters. A listing of the types of educator respondents is shown in Table 9.2. Another differentiating factor between the developer and educator respondents' roles in the case study was how interviews were structured and conducted. The developers had specific projects and contexts on which to base their answers, therefore, as an interviewer, I did not need to introduce any particular hypothetical scenarios to stimulate a discussion. The educators needed some more guidance when the interview continued into the subject of educational games. However, this was never the starting point of the interviews; general instructional technology and its place in education was usually a point of entry for initial interviews.

Table 9.2: Educator respondents, described according to their professional roles and their general work profiles, as well as the purpose the studies served in the thesis.

Role	Profile(s)	Purpose	Method
Principals: **Principal A** **Principal B**	Principals of different departments in a school with students aged 6-14	Gather opinions and discuss the general viability of educational games from educator's perspectives – e.g. administrative, technical, or ethical concerns of using educational games	Semi-structured Interviews
Head of pedagogical development	Working in educational development	Discuss the pedagogical reasons for and against using educational games	Semi-structured Interviews

Important to note, here, is that Principal B was also an active subject and participant in the studies conducted during the research in phase two. This specific participant was thus interviewed during two of the research phases. The first interview with Principal B was a more general discussion of educational games, and its outcome will be found in this chapter. Interviews conducted during phase two discussed more specific details of the game-based learning project that was at the centre of the conducted case study, and their outcomes will be presented in chapter 10.

9.1.1 INTERVIEWS

Interviews have been the most frequently utilised research tool, serving several different purposes during this thesis work. Initial interviews were primarily explorative and involved a (relatively) large number of developers and educators, in order to examine attitudes, experiences, and working processes with regard to the use and development of educational games.

Interviews varied in length, lasting between 30 minutes to an hour. All interviews followed the general research strategy of exploring opinions, attitudes, experiences, and the working processes of educators and developers, but the specific questions asked and the themes of the discussions varied somewhat, depending on the respondent. Questions put to educators and those put to developers differed from each other, but the individual interviews within the two subject groups differed as well. The priority was to examine what types of attitudes and processes exist, what the thought processes behind them are, and how they impact developers' and educators' work with educational games. It is important to note that the purpose of these studies was not to produce any sort of statistical analysis of how prevalent certain attitudes or working processes are among educators or developers.

For some of the respondents, follow-up interviews were held to ensure that their statements were not misrepresented or misunderstood. This was mostly done with educators, as they were in general more “reliable” respondents, in the sense that they were not in transition between different kinds of projects. Follow-up correspondence was also conducted with the developers Experienced1 and Experienced2, where statements were clarified or elaborated upon.

All interviews were conducted face-to-face with the subjects and were either documented through audio recordings or notes taken during the interviews. The interviews followed protocols specific to the different categories of subjects, as exemplified below:

INTERVIEW PROTOCOL USED IN INTERVIEWS WITH EDUCATORS

1) What are you looking for in new educational tools such as educational games? What are the parameters you immediately judge their viability on?
2) What current experimentation in new educational technology is being conducted at your institution?
    a) [Sub-categories signify follow-up questions] Why are you examining these new solutions (what benefits are you hoping to attain), and what results are you seeing from using them?
3) Have you seen any changes in the way teachers consider technology and games as potential educational tools?
    a) Are there any particular concerns making them wary?
    b) Have you seen any specific positive changes?
4) In your past experiences of implementations of new educational tools, what would you say the factors for success or failure are?
5) How do new educational tools change your own working processes and those of teachers?

PROTOCOL USED IN INTERVIEWS WITH DEVELOPERS

1) What made you gravitate toward the market of educational games?
2) In what way does creating an educational game differ from other types of development projects?
    a) If the subject is knowledgeable in game development – how is it different from developing and marketing entertainment games?
    b) If the subject is knowledgeable in education – how is it different from creating or marketing more ‘traditional’ educational tools?
3) What, in your opinion, makes a successful educational game?
    a) Are there any specific components necessary for an educational game to be successful?
4) In your experience, what values are held in high regard by your clients?
5) Conversely, what values do you regard highly when it comes to educational game development?
    a) If the priorities held by you and your clients differ, how are those differences overcome? How does it change the design and development of the educational game?
6) Are there any common misconceptions among your clients towards educational games, and how do you handle those?
7) How do you market yourself and your products, how do you find your clients or make sure that potential consumers find your games?
8) How does the process of conducting business in the educational games market differ from other markets (e.g. entertainment games)?

9.1.2 PARTICIPATION RESEARCH

The participatory aspect of the studies conducted during this phase was highly unstructured and, as a result, suffered from disjointed and ad-hoc documentation. Consequently, this part of the research is not treated as data that contributes to answering the research questions posed in this thesis. However, the experiences of educational game development and use gained during the participatory work informed the shape of the continued research, which makes it important to at least provide a general outline of how it was conducted.

The wide variety of respondents included in this phase of the research made it difficult to establish formalised procedures for my work with them. This was compounded by the short time periods of the educational game projects that were studied and the inconvenient locations of the development studios of the various respondents. These factors limited the participation with most respondents to a few design and project planning meetings (usually 30-60 minutes long) that were exclusively conducted face-to-face at the developers' or educators' offices or schools. The typical meetings consisted of a run-down of the goals of the educational game project the developer or educator was involved in, and a discussion regarding how the educational game or game-based curriculum could be designed to achieve those goals. For newer developers, I also contributed some development and design guidelines. For most respondents, the participation aspect of the case study remained somewhat superficial, as interactions were limited to only a few meetings. Some of the developers and educators, however, invited me into their working processes to a much further extent, and I was able to participate in their projects and provide feedback throughout their working processes. Regardless of the extent of the participation, the studies all followed the same general guidelines.

When working with entertainment game developers who were now dealing with educational games, introductory discussions focused on examining how they approached these two different types of development projects. When working with developers who have educational games as a significant part of their business and company profile, the participation was more focused on discussing their working processes, not necessarily in contrast with other types of development. The work conducted together with educators took a similar approach, but educational games were naturally approached from a different perspective. In meetings and workshops with educators, my role essentially became the one of 'game expert'. Design meetings with educators concerned discussions of how games could be made to suit their curriculum demands or how they could be used to solve particular challenges their schools and students were facing.

Due to the lack of formalised procedures during the participatory parts of the studies of this phase, there is thus an unfortunate lack of documentation of the conducted workshops and design meetings. Beyond the notes taken during the semi-structured interviews (described earlier), the continued collaborations were largely undocumented, and are thus not relied upon for the conclusions of this research. However, the collaborations were an important part of the early research, as they helped inform the design of studies in subsequent research phases, by revealing aspects of educational game development and use that I was previously unfamiliar with.

9.2 CASE STUDY RESULTS

During the studies in the first research phase, the broader contours of the work and thought processes that developers and educators employ in their work with educational gameswere revealed. The studies also revealed some of the practicalities that made educational games challenging prospects for both developers and educators, such as resource limitations and difficulties communicating the nature of their work to one another. The results are introduced with a brief summary of the common topics of discussion during the interviews and a description of the contexts in which the subjects were interviewed.

9.2.1 EDUCATORS

As previously mentioned, several different roles at different organisational levels where included when studying educational games in education. The hierarchies in the educational organisations were well defined, and the responses and direction of discussions would differ between personnel in different positions in the organisations. The common topics of the interviews with the educators were:

- Their motivation for wanting to understand or use educational games in schools and what they think educational games and technology can add to educational process-es.
- The challenges and concerns that complicate the use of educational games.
- What elements they consider crucial for educational games to function well in their school or organisation.

These three topics of discussion will be recurring for each category of subjects in the presentations of empirics below. All quoted statements from educators are translated from Swedish to English.

INTERVIEWS WITH PRINCIPALS

Principals are the educators that work within specific educational institutions at a management level. During the studies, two persons with such roles were interviewed (Principal A and Principal B). One of them was interviewed on four occasions spread over a school year, largely independently of a game-based learning project. The second was interviewed on three occasions, once in the embryonic stages of a game-based learning project and the other two times during the execution of said project. Here, Principal B's responses to the first interview are used, whereas the responses more specifically tied to the conducted game-based learning project are presented as results of the phase two study.

The main motivator for investigating educational games, according to the interviewees, is recognising the necessity of catering to their students, using a platform that is familiar to them, which will hopefully increase academic effort. Principal A explained that technology has become increasingly ubiquitous in society and students are becoming increasingly proficient in using it, and are starting to expect the possibilities technology affords them to be available in most everyday situations. Education is no exception to this, and one of the respondents expressed that teachers now 'have to' start familiarising themselves with the types of technology students frequently use, in order to reach them. That motivation drives the use of most instructional technology in schools, but when it comes to games specifically, it is more a question of catering to very specific student cases where traditional educational means fall short. While information technology, in general, is regarded as a tool that can foster more efficient teaching (e.g. by making lectures or assignments available online) and communication with students and parents, games are seen as a different type of technology use that may capture the elusive sense of motivation and will to learn that schools often struggle with.

Whenever new educational tools or solutions, whether technical or not, are considered for use in their school, there are a series of categories that guide the appraisal process. Early appraisal is guided by:

- Curriculum appropriateness
    - Does it fit into current curriculum scheduling?

    - Does it adhere to the values emphasised in current curriculum updates?
- Resource requirements, taxation on infrastructure
    - How does it affect teachers' work load in relation to each class?
    - Do we have the technological infrastructure to keep the system functioning smoothly?
    - Do we have the necessary teacher competencies to make the system useful and beneficial from a pedagogical perspective?
- Up-front investments
    - What does the system cost?
    - What is the process of implementation like?

These factors are compared to other available educational means, and decisions regarding whether new tools should be implemented are judged on whether they can add some value to the educational process, without disproportional investment.

In previous efforts of implementating instructional technology in their schools, 'pioneers' have played a crucial part when it comes to capturing the acceptance and enthusiasm of teachers of using new technology solutions. These pioneers often have previous experience and expertise of a new tool (e.g. games or other software) and can ensure that the necessary infrastructure is present in their classrooms, so that the tool can be used well. So it is often a case of nurturing the enthusiasm and drive of teachers willing to embark on these types of experiments, as it can push the envelope for the school's capabilities and the competencies an individual teacher gains during these types of projects often spread to other teachers:

> "There needs to be a certain drive there beforehand. It's common [for teachers] to rely on tradition rather than inventing new things, you're already overworked and have a lot of demands. But, if the drive of using games is already there it's important [that we] provide them with ways to explore it." Principal B in interview

This being said, both Principals B and A state that there are a lot of new technologies that could be beneficial in educational settings that have not yet been explored; educational games is one example of fringe technologies that are starting to be explored more and more in recent years at their schools. One reason that new technologies have seen somewhat limited application thus far is the afformentioned resistance when it comes to teachers' acceptance of new educational tools. The resistance often boils down to concerns of added workload, but also trepidation about relinquishing control of educational processes. Both subjects spoke specifically about the risk you take as a teacher when adopting 'opaque' tools, which modern technology often is, into your classroom. To clarify the concept, an opaque tool is a device or solution, the inner workings of which is not visible or understandable to the users. In essence, you use the opaque tool and see the results and outputs it provides, but you do not know the processes it went through to produce them. This is a big hurdle to overcome for technology to be accepted among both teachers and principals. Principal A expressed it as "a change in culture where you relinquish understanding and the control that comes with it in favour of accessing new types of actions."

A considerable deciding factor when it comes to investing in new educational tools is also the amount of funds available and the educational tools' expected performance. Principal A specified that the budget for teaching materials in Swedish schools is allotted per individual student, starting at 1000 SEK (~115 €) per calendar year for students up to grade 6 and increasing to 1750 SEK (~200 €) per student in grades 7-9. The budget needs to be divided among all the subjects an individual student takes in a calendar year, which means that purchased tools should preferably be proven to fulfil high requirements of longevity, efficiency, and added learning benefits. With funds being limited, spending them on new educational games, which are often not particularly easy to use, difficult to maintain, and have unproven effectiveness in regards to learning outcomes, can be a risky proposition. The educational game would thus need to be inexpensive to purchase, or be able to promise good educational outcomes to compensate for a higher price tag.

However, even though these challenges still exist, the subjects felt that they are constantly making headway in developing their internal infrastructure, both with regard to teacher competency and technology availability in their schools. By various new implementations of technology in the classroom, the collective knowledge and experience of the teachers at the schools are steadily increasing, and new experiments with new tools are continuously performed by teachers (e.g. releasing lectures on YouTube). Therefore, the resistance and barriers to technology acceptance are slowly evaporating, but are currently still aspects to be considered when contemplating the implementation of more advanced instructional technologies such as educational games.

INTERVIEW WITH HEAD OF PEDAGOGICAL DEVELOPMENT

A 'head of pedagogical development' is a person with a high degree of knowledge within pedagogical practices and educational psychology. They are distinctly different from principals in that they work in municipalities, or as consultants and lecturers, and are not bound to a specific role in an educational institution, but are more in charge of general competence development and evaluations of teaching practices within or between organisations. During the studies, one such person was interviewed on two separate occasions. The topic of discussion was how educational games and instructional technology fit into the progress of pedagogical practice in general, but did not concern specific educational game examples. The interviewee's in-depth understanding of the discussed subject matter also led to referrals to previous research and studies to a greater extent, than educators in other roles.

Two themes were particularly prevalent during these interviews: the process, effects, and current status of instructional technology being assimilated into educational institutions; and the arguments for and against pursuing educational games based in educational theories and current issues schools are facing.

The assimilation of technology was described as a process that has gone through a series of stages; starting with reluctant inclusion, becoming a superfluous addition to the school experience, and currently approaching a stage where they can be considered as a more solid support for educational processes. Here, a model proposed by Puentedura (2009), a speaker that made frequent appearances at educators' events, was specifically highlighted (Figure 9.2)[6]. The interviewee had encountered the model when discussing the issue of technology assimilation with teachers, and found it useful to explain what they should strive towards when using instructional technology in general.

[6] The referral to Puentedura's model can in itself be seen as emblematic of a larger problem within the development of pedagogical processes (at least in the Swedish education system), as his work has not been subject to scientific scrutiny or peer-review, but is still generally accepted and presented as scientific work. The only sources through which I could find Puentedura's work on the SAMR was podcasts and lecture slides on the authors own website.

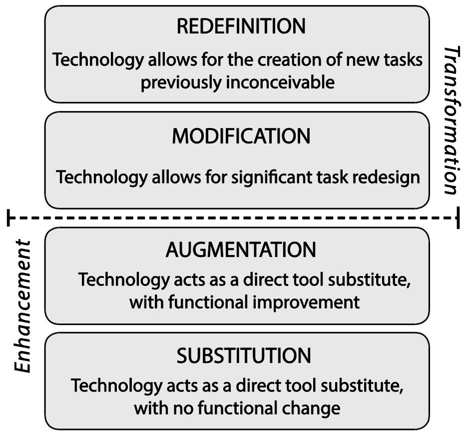

Figure 9.2: Puentedura's *Substitution Augmentation Modification Redefinition* model (2009), explaining the different levels of technology use in education.

So, the model can be seen as a description of previous attitude changes among teachers, and where attitudes need to be heading to truly start making instructional technology useful and impactful in educational contexts. The point made by Puentedura (2009) is that there is a wide spectrum of how instructional technology can be used in formal education. Merely looking at technology as a substitution of or even augmentation to current practices may be limiting the potential of the possibilities technology has to offer, since you are always considering and comparing its utility in relation to previous practices. Currently, the interviewee considered formal education to be at a point where technology has an augmenting effect on pedagogical practice, but that educational games offered the experimental and experiential elements that would make task modification and redefinition possible. As stated by the subject, the possibility to be in charge of, and interact with, the components of your learning, rather than primarily being a passive receptacle for it, is a direction that should be lauded and pursued, and holds much potential to solve several issues the educational system is currently facing.

Continuing on the subject of why it would be beneficial to pursue educational games, motivation was a commonly recurring topic. In this context, the respondend reiterated the statement made by Principal A: educational games were seen as a potential way to engage students whose interest was difficult to stimulate through traditional classroom instruction. The interviewee pointed to specific issues with keeping intrinsic motivation intact throughout a young student's educational progression, and that previous studies, as well as their own experiences, indicated that intrinsic motivation was declining dramatically in children as they approached high-school studies. One part of this many-facetted issue can be the previously mentioned passive role a student has in many educational situations. As children grow older, the educational practices often become increasingly more formalised along with more rigid curriculum demands, and motivation often decreases as a result. The active participation in learning provided by educational games was once again pointed to as something that could alleviate this issue, and as a reason to pursue them as a part of redefining the nature of many educational tasks.

A final note that often emerged during the interviews was another conceptual tool that had been used to discuss learning and what instructional technology in general needs to model itself on was 'The Big Five', which is a summarising categorisation of the abilities that educators aim to help students develop:

- Analytical ability
- Ability to communicate
- Meta-cognitive thinking
- Information processing
- Conceptualisation

These five core abilities are a summation of a much more detailed list of abilities that schools need to nurture in students through their educational activities, and, by extension, they are educational guidelines that educational games need to adhere to in some way as well. The interviewee added that a single educational game does not need to cater to all of them, and that is not a requirement demanded from other educational tools either, but one or some of them need to be nurtured in the game experience.

As a final note, the interviewee also stated that the use of technology in schools is becoming one of the most prioritised subjects of debate during events he had been attending. There was a general shift of attitudes from *if* information technology should be accepted and used in schools to a greater extend, to *when* this assimilation could take place and how it should be done in the best way possible. There was still some wariness regarding instructional technology in general and perhaps more so when discussing games in particular. But, the conversations had a generally optimistic tone and the subject was approached as an important challenge to understand and overcome, rather than something to be feared and avoided altogether.

9.2.2 DEVELOPERS

When looking at the empirics from studies on developers, it quickly became apparent that there is a big difference between what experienced and new developers have to say about the craft. To reiterate, the studies included two developers who have worked with educational games exclusively for more than three years, and are thus considered as being 'experienced'. The other developers have varying degrees of experience working with entertainment game development. Most of the newer developers are incubator companies that have previously done small releases of games for mobile devises or were, at the time, still working on finishing their first titles, but they were all new to developing educational games for specific clients in education. An early observation during the interviews with these developers was that they primarily considered educational games as an alternate source of income and a way to fund their other development projects. With educational games still being an attractive buzzword, many government/regionally funded projects are carried out to allow developers and educators to explore the concept in various ways. Receiving grants from these types of projects can be a good source of income for start-ups in an industry in which it is otherwise difficult to reach financial stability. This meant that the developers found it difficult to balance the development of their companies' "core" titles and the educational games for the project.

The common topics of discussion during the developer interviews were:

- Their relationship with their clients; how did they find their client and in what way did they communicate and collaborate with each other?
- How did they handle the learning requirements put forth by their clients?
- How did educational game development differ from the types of development projects they were previously accustomed to?
- Their own ambitions with educational game development; why did they become interested in them and what did they hope to achieve with them?

To make the results of studies with developers more manageable, I have sorted the empirics into categories based on the context in which they were gathered. Most of the studies were conducted with developers who were carrying out the entirety of an educational game project at the time. This made the interviews and the participatory research more focused on a specific game concept, while their attitudes and processes could be studied as they progressed through the projects. Other studies, primarily the ones with the more experienced developers, did not concern a specific project. These were instead more focused on general state-of-the-art discussions, both in the context of how their companies operate in general, and how they look at the challenges of creating educational games after having experienced it themselves.

STUDIES CONDUCTED DURING DEVELOPMENT PROJECTS

The educational game projects were structured so that the developers were matched with different types of clients from the educational sector. During workshops at the start of the project, the clients presented their ideas and what type of educational game they wanted from the project, thereafter the developer and client discussed the ideas and codified them into a game concept. The developer had two months to execute the idea, which made design simplicity crucial and led many of the projects to aim for creating a prototype or proof-of-concept rather than a fully-fledged game.

During the initial interviews with the developers, a common difficulty they were dealing with was that their clients were not very familiar with games as a medium, which led to some difficulties in the early discussions of the projects. The intensity of the issue varied somewhat between the different projects. Some of the clients were described as having no real understanding of what could be created during the limited amount of development time, or even a particularly good grasp of what a game is. Others were familiar with games that were popular among their students and wanted something similar, but with added educational elements. For some of the developers, however, early talks revealed that their clients had insufficient knowledge to make collaboration to a greater extent possible. These projects began with the developer struggling to obtain more reasonable requests from their clients. Other developers with more specific requests (e.g. make a game with similar elements as another popular title) could immediately start working on the challenge of fitting educational elements into the game concept they had been given as a reference.

Developer New1 was one of the developers that worked with a popular title as a frame of reference. This was also one of the developers that seemed to collaborate well with their client and had the opportunity to discuss learning goals and ambitions for the project at length with them. The developer explained that some of the client's bigger concerns were to make sure that the game appealed to girls as well as boys in their class (the age of the target students was 8-10 years). Some suggestions were proposed regarding what would be considered appealing or un-appealing to them. For instance, boys were considered to be more interested in competition, whereas girls would be more interested in collaboration or more mutually encouraging experiences. Requests such as these helped the developer steer development somewhat and, since a popular game title served as the frame of discussion, they could rapidly discuss specific design ideas with their client. One particular extra request that New1's client wanted, which was not the case with the other projects, was that the game could be played by the students outside of school, as an extracurricular educational activity or "homework".

In stark contrast to this was the project assigned to developer New2, as the client in this project was perceived as having very grandiose and misguided ambitions with the project that made early communication difficult. Beyond the unrealistic scale of the project, the client also had a limited understanding of what could be achieved in a game environment or what can or should be conveyed through the medium of games. This led to a frustrating situation, both for the developer and the client, and the communication between the two was described as being difficult, as they had two separate ways of considering the project and a different understanding of the medium of games in general. At the end of the project, the developer explained that they had to concede to the will of the client, because they did not think they were in a position to renegotiate and completely revise the client's requests. This had led to the creation of a product that New2 was unhappy with and a stressful development process, since the developer could not realistically cater to the requirements of the client.

When looking at the projects that New1, New2, and New3 were involved in, a pattern also emerged regarding what role their games were going to play in the educational context. All of the developed games were intended to embody the entirety of some traditional educational process. For example, in the case of New1, the game was intended to provide motivation, convey the subject matter, and provide assessments of the students' progress. In the case of New2, which was perhaps the most severe, the game was intended to replace an entire lesson plan for a course lasting several weeks and contain introductory material, course guidance, and student assessments. The observation here is that the game was seldom approached as a part of a sequence of educational activities, and was more often seen as something that could either be a stand-alone extracurricular activity or replace a course altogether. Another observed pattern was that technology availability was rarely a topic of discussion during interviews. This meant that at the end of the projects there were several issues: some schools were not able to use the developed games, due to technological issues, the distribution of the games to schools was difficult, and, in some cases, the games had been developed for the wrong types of platforms. This differed somewhat to the approach taken by the semi-experienced developers; they frequently referred to their games as being a part of a bigger educational process. Semi-experienced2 specifically indicated how they wanted their game to facilitate classroom discussions and collaborations. This developer also wanted their game to primarily serve as a platform that students could use for exercises and to experience problem-solving together, but that the primary learning would probably occur during reflection and analysis of the game sessions that would take place in the classroom afterwards.

The case of New5, a project in which I had a more participative role, was quite different from the others. This project was not conducted in the same way as those of the previously described respondents; it was initialised and conducted solely by the developer. This developer had a strong background in both the practice and theories of educational processes and learning, but less experience of game development. The inspiration for the project came from seeing how games could cater to students whose engagement was difficult to maintain with traditional educational means; the goal was to create an educational space where these students felt in control and skilful. As opposed to other development teams, this developer approached the project with the goal of appropriating an already existing game title so that it would be more easily usable in schools. The project was thus focused on creating a service for schools, based on the game, rather than creating their own game. During project meetings, discussions initially involved understanding the game and what made it fun and engaging for students, and how these elements could be made more accessible for teachers and usable in classroom settings. When they had moved beyond discussions of the game's mechanics and design, much of the dialogue concerned what they needed to add to the game to make it usable for teachers in classroom contexts. The questions were often pragmatically oriented, focusing on how they could make work assessments easier for teachers, as well as how lesson plans could be distributed to students inside the game and also shared among other teachers. All in all, with a solid game that was considered to contain educational potential to build on, New5 focused specifically on how to add elements that would make the game more usable in formal educational contexts. Nonetheless, an important concluding note is that this developer, as experienced educators, had little understanding of the process of game or software development. Elements were discussed on the basis of what they would provide to the users when implemented, but the way such elements would actually be implemented and constructed was largely untouched.

STUDIES CONDUCTED OUTSIDE OF SPECIFIC DEVELOPMENT PROJECTS

The two experienced developers included in the study had differing backgrounds. Experienced1 primarily had background experience in game design and development, while Experienced2 had a strong background in education. Their background experience was frequently evident in the points brought up by the developers, which seems to have a clear influence on the way they both approach educational games as a craft.

With Experienced1, matching subject matters with appropriate game mechanics had been a common way to approach educational game projects. Listening to what the clients wanted, and using their own knowledge of games to find suitable mechanics that could accommodate the client's requirements had been a good way to keep development projects focused and to facilitate communication with clients. The bigger projects they had been working on all emphasised educating and assisting the teacher as well as the students. Hence, they developed instruction manuals for teachers that suggested ways of using the games in the classroom, which were delivered alongside the actual game artefact. One aspect prioritised by the developer was maintaining the core experience of the game in their products and not letting the educational content take precedence, if it infringed too much on the elements that made the game engaging. Choosing a known game concept or genre in early talks with clients helped towards this goal as well, as knowing what elements are crucial to make a game engaging made it easier to identify where compromises could or could not be made in the pursuit of including educational goals.

The experienced developers brought up similar points to one another, when it came to the financial aspect of creating educational games. Each of these developers aimed to work with educational games without project grants, and had been moderately successful in doing so for quite some time. Experienced2's business model was built on finding educational institutions to purchase their finished products. Experienced1 had taken this approach in some cases as well, but had more frequently attempted to find customers that wanted to make their own customised educational games, and who could commission them from the developer. For the latter approach, finding clients that want to commission games is a difficult proposition, and the developer was often forced to solicit projects rather than wait to be contacted by interested parties. Experienced1 had also made attempts to create prototypes and games to show to clients who could benefit from them (for example, showing a prototype of a math game to principals or teachers), but it was still difficult to find clients who could support the costs of entire development projects. A similar approach was used by Experienced2, but they had found ways to make that business model work a bit more reliably. Their background in education made it easier for them to describe the benefits of their game to teachers, thus making it easier to sell. They also had specific strategies to make sure that their core product could work well in schools, by offering workshops and seminars where they educated teachers in using it, and thus building up their own audience. Experienced2 stated that they had already reached a large audience with their educational game, but that merely selling game copies had not been enough to maintain long-term profitability. This had encouraged them to think of the game as the core of a broader solution, but that it was not the entirety of the product they would offer. Their core product was not specifically niched to be used in a particular school subject either, and was marketed as being adaptable and usable for teaching many different subject matters. Rather than focusing their efforts on improving the game itself, their focus was instead to construct support services and solutions around the game to show existing and new customers different ways of using the game in classrooms.

On this topic, Experienced2 pointed to several aspects they considered made an educational game successful. Specifically, a game needs to provide 1) accessible means of lesson assignment, 2) ways of monitoring the play sessions, and 3) ways of assessing student progress and involvement in activities inside the educational game. These three specific aspects had been found to be highly valued by teachers they had worked with previously. Furthermore, both experienced developers also emphasised the importance of seeing an educational game as a tool existing in a broader classroom context. The game does not have to provide a thorough explanation of the subject matter, or all necessary contextualization and reflection regarding what the game activity is supposed to teach the player; teachers are present in formal educational contexts and it is important to involve them in the gaming activity. The teacher can serve an important role in setting up educational game activities and can discuss the content of the educational game with the students, before, during, and after the game session. Here, Experienced2 also emphasised the need to help educational institutions implement their game into the teaching environments, and had hosted workshops and maintained continuous online interactions with teachers to make sure they would find the educational game useful. This in itself was an interesting and unifying characteristic of both experienced developers, as they made significant efforts to cater to teachers, rather than solely focus on making an experience that would be compelling for students. Here, both developers took a similar approach, by basing their product on well-known game concepts, to ensure an engaging experience, and then focused on implementing tools, explanations, and instructions that would make the game more accessible to teachers. For Experienced2, this entailed being very specific about how their game would fit into a classroom context, with explanations of how to prime students for game sessions, how teachers could participate during game sessions, and how to discuss the session afterwards, to encourage reflective and analytic play by their students. Experienced2 acknowledged (just as Principals A and B did during interviews) the importance of supporting the teachers that were passionate and experienced in using games for educational purposes, as they were instrumental in introducing educational games to their colleagues. Experienced1, however, was more focused on creating functional educational games based on their clients' requirements, and certainly understood the importance of making their games accessible to the teachers that were supposed to be using them. However, they did not specifically mention any bigger agenda of growing their audience in schools and making schools more familiar with games beyond that.

CHAPTER 10
PHASE II: EXPLAINING THE MISMATCH BETWEEN EDUCATIONAL GAMES AND FORMAL EDUCATION

After phase one, several contradictions were found between the way educators and developers worked and the challenges they were facing as organisations and creative businesses respectively. For instance, educators were working under constraints, both in terms of resources (e.g. available working hours, hardware, and money) and organisational guidelines (e.g. established curricula and routinised assessments), which developers find difficult to accommodate. The constraints that individual teachers, or specific educational institutions, work under also make them a very different consumer of games in comparison to entertainment game consumers. Some of these differences, compared to the investments that developers need to make to create educational game products, make the fundamental viability of the educational games market questionable. With this as a starting point, the research progressed into examining the process of using games in a formal educational setting:

- What steps comprise the process of integrating educational games into a formal educational setting?
- What challenges might a teacher encounter when integrating educational games into their classroom?
- How can learning goals be integrated into game-based classroom activities and how can progress towards those goals be assessed?

It is also important to note that this phase should be considered as a transitory period of the entire research process, and that it served to change the research from primarily being based on more ‘passive’ participation on my part to being more grounded in direct observations and participatory methods. While the first phase of studies primarily used the experiences of educators or developers as the lenses for the examination of the working processes surrounding educational games and game-based learning, this phase served to provide opportunities to examine them through more direct entrenchment.

10.1 CASE AND STUDY DESIGN

The case study for this research phase was set in one classroom where *MinecraftEdu MinecraftEdu* (TeacherGaming LLC, 2012) was put to use in a special education and special language learning class dedicated to students between the ages of 9 and 14. *MinecraftEdu,* which is a modification of *Minecraft* (Mojang, 2011), keeps the core gameplay of *Minecraft* game intact, but adds some functionalities to make it easier to use in an educational setting (e.g. a server management tool, simplified installation, and special 'teacher commands' that make classroom exercises easier to manage). The study was conducted over a six-month long process, starting in November 2012 and ending in June 2013. The selection of the case for this study comfortably fits within the definition of an 'extreme case' (Patton, 2002, p. 230), as its properties constituted what I would consider 'ideal circumstances' (Robson, 2002, p. 182), or at least highly favourable, for educational games integration and use:

- The student-teacher ratio was favourable (in some cases 1 teacher or assistant per student and, at worst, 1 teacher per 4 students) and distinctly different from the ratio found in the average classroom environment.
- Not many formalised curriculum demands were placed on student progress and no strict timelines for the achievement of certain learning milestones.
- The demands placed on the educational game software were low and highly focused on student engagement rather than learning outcomes.

As such, the selected case was a safe and non-demanding petri dish in which to examine how an educational game can be integrated into a type of formal educational environment; although the 'formal' part was toned down somewhat, due to the characteristics of the classroom and curriculum. The school highly prioritised the students' engagement with school subjects and, in most of the student cases, increased engagement superseded explicit learning outcomes as the primary goal of the project activities. Heightened student engagement is one of the few promises that educational games seem to deliver somewhat reliably (Guillén-Nieto & Aleson-Carbonell, 2012; Sabourin & Lester, 2014). This case can thus be considered an "open goal" for a game-based learning project. With that in mind, this case study is not used to draw any major conclusions regarding the effectiveness of the game software as a learning environment. However, regardless what outcomes of the project are prioritised, the project still entails processes of implementation and the use of the educational game itself. Thus, the case still presented an interesting opportunity to conduct more direct, participative observations of the processes involved in the implementation and use of an educational game in a formal educational setting. The collaborations with a large number of teachers, pedagogues, and administrative staff also provided an opportunity to examine how educators perceive educational games and how they conduct game-based learning activities. In essence, the studied environment provided an 'extreme case' where "a new approach [was] tried under ideal circumstances, to obtain understanding of how it works before its wider implementation" (Robson, 2002, p. 182). As this research phase was initiated during the second year of this thesis work, this extreme case study served as a way to partially explain the cause of the discrepancies between developers and educators that the studies in the previous phase had started to uncover. It was also a platform for testing and refining the methods I used to conduct classroom-based research, which would be important in conducting the later larger-scale study (presented in chapter 12).

The studied case was set in a small classroom in which both special education classes (which focused on mathematics and Swedish and English reading, grammar, and spelling) and native language learning classes for younger bilingual students at the school had their lessons. Since the classes were very small, and given the sensitivity of personal information in these types of cases, little else can be said about the student cohorts. The classroom setup consisted of two desktop computers and two additional laptops that I had provided to facilitate gaming exercises with several simultaneous players. During certain exercises, a teacher would contribute yet another laptop so that more students could play together, or so that I or the teacher could actively participate as players during the gaming sessions. The number of available computers in the classroom thus oscillated between four and five.

The project was organised by a group that had monthly meetings where students' progress was discussed, previous learning objectives were examined and new ones were established, and the possibilities of implementing them in game-based activities were discussed. Besides my own participation, the 'core' working group comprised a principal at the school and four teachers (shown in Table 10.1). One of the teachers also worked as an IT administrator at the school, whereas the other three teachers worked at the school's special education department. Occasionally, informal discussions were also held with additional special education teachers and teachers' assistants, where details and needs of specific students were discussed. However, the project planning and its over-arching goals were established during the meetings with the core working group.

Table 10.1: Participants in the case study conducted in phase two.

Role	Profile(s)	Purpose	Method
Project supervisor: **Principal B**	A principal managing working teams of teachers engaged with students aged 6-14	Discuss the organisational structures surrounding the integration and use.	Semi-structured Interviews
Collaborators/Teachers: **Teacher A** **Teacher B** **Teacher C** **Teacher D**	Teachers and teachers' assistants interested in exploring how educational games can assist their students' interest and performance in school subjects.	Partake and discuss the processes of integration and using an educational game into school activities.	Semi-structured Interviews

The specific school subjects that were the aim of the game-based learning project varied between individual students in the special education class. Students had certain subjects with which they struggled or had little interest in, and the teachers' hopes for the project were to increase the students' enthusiasm for engaging with those subjects (varying from language subjects, mathematics, and social sciences). The bilingual students were exclusively focused on expanding their grasp of the English language, by practicing their vocabulary, reading, and comprehension skills. The needs of the students varied significantly between individuals, meaning that a lot of specific care had to be taken so that game challenges were designed to accommodate for each and every one of them.

As previously mentioned, the student-teacher ratio was a far cry from what one usually encounters in the average public school classroom. During their regular school days, teachers usually had a small number of students that they worked with (varying from 1-4 each), and some students also had personal assistants on certain days of the week. With me included as a participant researcher, the teacher-student ratio was distorted even further.

10.1.1 INTERVIEWS

Throughout the project, the involved principal and teachers were interviewed both individually and in group settings. While interviews held during this phase involved a fewer number of respondents, the longer collaborative nature of the project made it possible to conduct more frequent and numerous interviews. Due to my own entrenchment into the working processes and the studied context, the interviews could also be anchored in specific observations during the project's execution and experiences that were shared with the working group.

As the interviews were conducted in relation to a collaborative project, the questions posed through the interviews were heavily informed by the project's progression and observations made during the conducted game-based activities. The highly context-reliant nature of the interviews led me to the decision not to conduct them according to any guiding protocols (unlike the interviews performed in the previous research phase). Beyond a few cornerstone questions (e.g. "how do you feel the project has progressed since our last meeting"), the progress of the project and the shared experiences served as the main talking points, and thus changed between meetings.

During the six-month long project, the teachers and the principal were all interviewed once at the outset of the project and again at its conclusion. As previously stated, there were also regular group meetings during the project. Once a month, the teachers and I would meet to discuss the project's progress and plan our continued work, and on a bi-monthly basis the principal would also join in during the meetings. It should also be noted that many smaller informal and unplanned discussions and meetings also took place throughout the project, which helped inform and supplement my understanding of the studied environment and its actors. I would occasionally correspond with team members to clarify questions regarding the project or the tools we would be using, or project discussions would also arise at times when I simply randomly met participants at various times around the school.

The group meetings and interviews were primarily documented through my own notekeeping. During discussions, I would take note of the primary topics of conversations and summarise what the different team members contributed to the conversations. The focal points of the documentation were different ways in which the team expressed either negative or positive attitudes regarding our working processes or the way the educational game had performed, or whether they had any queries regarding how the game could be used differently (e.g., whether it would be possible to include new subject matters into the game-based curriculum). The group meetings were also an important part of the case study's participant observations, as they gave me an opportunity to play a role in the process of planning, creating, and conducting a game-based curriculum.

10.1.2 PARTICIPANT OBSERVATION

Throughout this project, I took on a participatory role akin to a teachers' assistant during all the game-based exercises, and as a game/technology assistant and consultant during group meetings in the interim (e.g. during hardware and software maintenance and miscellaneous class preparations). In the initial stages of the project, I supervised the acquisition of game software and hardware for the classroom. Through my participation, the school was supplied with extra resources in the form of hardware (two laptops) and game licenses for every computer in the classroom. Thus, I can be considered to have been given the main responsibilities for establishing a game-ready technology infrastructure. While the game-based exercises were designed together with the participating teachers, I also played a large role in creating the game content necessary to conduct the exercises.

During the project, weekly game-based exercises were conducted. During the game-based classroom activities, I would be present as a teachers' assistant to help teachers and students start up the game and connect to the class's game server. I would also help tutor students both in how to play the game and in subject matter details, and participate in classroom discussions. Between the game-based exercises I would, as mentioned previously, participate during group meetings and help teachers discuss ways to design game-based exercises. I also conducted hardware maintenance and implemented any new exercise designs into the game to ensure that the tools the teachers needed during the game-based curriculum were accessible and functioned well.

The participant observations, similar to the interviews, were documented primarily through taking notes during and surrounding game-based classroom activities. Due to the sensitive context of the study, I omitted any type of recording during classroom activities, and, as with the notes kept during interviews, I would write down events and developments that I found interesting in regards to educational game implementation, use, and play.

10.2 SECOND PHASE CASE STUDY RESULTS

This sub-chapter describes the more participatory research conducted in collaboration with a team of teachers over the course of one term at a municipal school in Sweden. As previously mentioned, this study served to examine educational games and game-based learning in an 'extreme case'. In many ways, the conditions for the study favoured the use of an educational game (e.g. a balanced teacher-student ratio, few students to design tasks for, and relatively relaxed learning objectives). Although the conditions were not representative of most regular classroom environments, the case still provided an opportunity to examine the many different sides of educational game use (e.g. teacher working processes, student reception and tutoring, the process of technology integration, and the design and execution of game activities tied to learning objectives). As such, the study served as a means of examining the 'contours' of the processes and challenges involved in educational game integration and game-based learning, rather than describing them in full detail from a more representational scenario of bigger classroom integration.

As previously mentioned, this case study should be viewed as a transitional phase in my overall research process. These studies were, in essence, a preparation for the bigger, more in-depth ones conducted in the final phase of this thesis work. While this phase contributed to a better understanding of the different types of working processes and constraining or facilitating factors found in an educational organisation, the extreme nature of the case severely limits the usefulness of the research outcomes. Nevertheless, this phase is still an important part of the thesis, as it contributed valuable knowledge that informed how the subsequent studies were conducted.

10.2.1 INTERVIEWS

During the initial interviews conducted during this study, teachers frequently ratified the statements made by subjects interviewed in the previous research phase. Somewhat in contrast to the broader issues brought up by other interviewed actors (e.g. developers and principals), however, the teachers' concerns were, in general, more practically oriented and connected to practical concerns of working with classes and students. Common themes of discussions in intial interviews were: how the game could be started up during class; how they could be sure that they knew what was going on in the game and assist their students; how they would be able to evaluate student performance; and how to ensure that the games adhere to the requirements of the national curriculum. In spite of these baseline concerns, however, the teachers also said that they were very interested in trying to use games in their work. They also stated that colleagues had also expressed interest in the idea when the subject was discussed in their institution. Teacher A had already, to a minor extent, used games for classroom exercises, and was interested in examining ways of doing it more extensively. Overall, the teachers felt that the issue of acceptance towards games as something worth pursuing in education were not as prevalent as they were just a few years ago. When discussing the subject, Teacher A stated that "there's not many doubts whether you can learn something [from games] or not" that he could see, but he added that there are still many concerns regarding how feasible it is to actually utilise them in educational environments, given the many practical issues they bring to bear.

The principal and teachers also ratified the view of the head of pedagogical development (see sub-chapter 9.2.1) who felt that using new educational tools, such as educational games, will require redefinitions of classroom education. Teacher A stated that "[as a teacher you think] I'm the pedagogue, I'm conveying the knowledge. I think it is important to rethink that hierarchy." A different way of approaching education with educational games, he continued, was to consider the teacher the facilitator and director of student driven activities – giving students the tools, environment, and the seed of knowledge that students need to start learning on their own through collaborations and explorations in educational games. However, Teachers A, B and C also stated that teachers being the sole providers of challenges and educational tasks would likely lead to unsuccessful educational game uses, since it would both increase the workload for the teachers and also that it limits the students' sense of actively directing, and participating in, their own learning activity. In a larger class of students, devising exercises that cater to everyone's level of proficiency would be unfeasible, so aiming to provide a flexible environment where students have more control would be a more sensible alternative.

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Teachers A, B, and C frequently made similar statements regarding what it would take for educational games to make their way into their own school environments as the principals did in the phase one interviews. Principal B noted that it was primarily a matter of establishing a "stable environment for using the educational games", but also a matter of developing teachers' understanding of educational games through spearheading initiatives in schools. With "spearheading initiatives" – that is to say initiatives that facilitate a few teachers in developing their competencies in using educational games, rather than having more universal training for the entire staff – examples of success could be facilitated to show other teachers how educational games can be used in certain subjects. This would also serve to give a school an injection of educational game expertise that can be spread to other teachers from within the organisation, making the change something that would happen on the organisation's own terms and with their own traditions in mind, instead of depending on an external actor. According to Principal B, such initiatives worked well since they served both as a resource-efficient way of 'testing out' new teaching techniques and tools, and engaged teachers by putting them in control of the design and implementation processes. Top-down initiatives, where new techniques and tools are 'pushed onto' teachers, ran the risk of being expensive and alienating teachers by limiting their involvement in decision-making processes.

Aside from the importance of teachers being given the right training, tools, and resources to work with educational games, the practical reliability and stability of the games themselves was pointed out as a crucial factor for them to be seen as viable teaching tools.

Reliability was declared to be more important than the specifics of the game's design and themes. All the teachers in the group saw this as a matter of trusting that work would not go to waste, and that they needed to be able to be absolutely certain that time spent designing and preparing game activities and curricula would pay off. Feeling that they are working with a reliable system, which will always be there and work every day as class starts, was said to be a crucial factor for most teachers, if they were ever to even start considering any type of instructional technology as a relevant educational tool.

10.2.2 PARTICIPATION OBSERVATIONS

The participation part of the study revealed some general challenges regarding the integration and use of educational games in formal settings. Primarily, the study revealed that researcher interventions were a significant necessity with respect to hardware preparation, as well as game acquisition, installation, and maintenance throughout these types of studies. Furthermore, the study revealed how the pursuit of learning objectives, a game's limitations as an educational tool, and the practicalities of formal education processes and organisations (e.g. resource limitations, scheduling constraints, curriculum goals) affect game-based learning projects.

As stated previously, this study should be considered an 'extreme' case rather than a critical one. The study was conducted in a formal environment with a beneficial student-teacher ratio, relatively flexible learning goals, and a somewhat malleable curriculum that could be adapted to suit the type of learning afforded by the game. Thus, circumstances surrounding the study were highly accommodating for educational game integration and the execution of game-based learning activities. The outcomes of this study were, however, very influential in the design of the continued studies, and are thus included for the purpose of providing a thorough account of the research process.

INTEGRATING AN EDUCATIONAL GAME INTO A FORMAL EDUCATION ORGANISATION

At the outset of the project, time and resources needed to be spent to establish an environment and a technological infrastructure that were receptive to game-based learning activities. As the teachers I collaborated with worked with small numbers of students, the activities could be held in a small computer lab (as opposed to a large 20-30 student classroom) that already had a couple of desktop computers and a teacher's laptop that was used occasionally when needed. However, more hardware had to be brought in to accommodate for all the students simultaneously, which required me to contribute two laptops to the classroom. Furthermore, the school itself did not purchase the game licenses used during the study, which led me to acquire enough licenses for game-based learning sessions with up to five computers simultaneously, as well as game licenses for the teachers, in case they wanted to try the game at home.

The process of preparing the classroom was more circuitous than expected. Even though only five computers were used, and with my previous experiences working with *Minecraft* in municipal schools (e.g., Berg Marklund, 2013; Berg Marklund, Backlund & Johannesson, 2013), the setup process suffered from several obstacles, some of which were expected and others that were not. Acquiring and installing game licenses through the school network was a laborious process that required us to circumvent the municipal school network's automatic blocking of specific types of network communication (some of which happened to be associated with *Minecraft* and other game services). Granting the new laptops access to the school network and arranging their authorisation of use on the municipal network required some specific assistance from the school's IT department. Beyond those issues, which are more specific to the structures and safety regulations of formal education, there were some general technical problems with setting up a reliable multiplayer server and backup-saving system for the play sessions. It should be noted that I was, for the most part, in charge of this implementation process. Furthermore, the process was expedited by one of the teachers (Teacher A) in the project who was, as previously mentioned, directly involved in the school's IT department and had access to information and functions that were useful in setting up the environment. Again, it was these kinds of factors that made me consider this an 'extreme' case, as easy access to such facilitating situational components is not typical for most teachers (cf. Egenfeldt-Nielsen, 2008; Ketamo et al., 2013; Ritzhaupt, Higgins & Allred, 2010; Ruggiero, 2013).

The process of integration not only involved establishing a stable technological infrastructure that was functionally receptive to educational games. The work also involved reviewing the educational organisation's available resources and working processes, and to introduce educators, students, and other stakeholders to the game-based curriculum. Thus, a large initial part of the project also required establishing a unified dialogue around educational games that made it possible for teachers to contribute in the design and execution of game-based activities. In the interviews conducted before this study, educators frequently pointed out that it was important for teachers to learn how to work with games as educational tools, in order to make good use of the games and truly integrate them into the teachers' working processes. While one of the involved teachers (Teacher A) and the teachers' assistant were somewhat familiar with games, and even *Minecraft* in particular, the principal (Principal B) and the other teachers (Teachers B, C, and D) had little-to-no such previous experience.

Constructing a system that included the other educators in the game-based curriculum and activities was important, but it was something I personally felt that I did not quite manage to achieve. While the educators' involvement in the design and execution of game-based activities, and in the discussions surrounding them, improved slightly over time, the project was essentially 'spearheaded' by me and the more game-savvy teacher. The other educators' involvement was mostly limited to discussing different types of learning objectives that they hoped to pursue in the project, which I then translated into how the planned or the conducted game-based activities could serve in achieving those objectives. Thus, the conversations with most educators were a call and response process, where they discussed whether, for instance, English vocabulary exercises can be implemented in the game-based activities, and where I and the more game-savvy teacher would posit ways in which that could be achieved. After seeing some positive results from the game-based activities, the other educators became increasingly more interested in understanding the working processes behind the game-based activities and how different elements of the game were conducive to different types of learning objectives. However, that only happened towards the end of the project. If the project had continued for a longer period, a more even and 'horizontal' dialogue may have been achieved.

These observations made it apparent that the process of integrating *Minecraft* into the studied setting involved more than the more obvious tasks of constructing a robust technical infrastructure for educational game use. It also involved the tasks of establishing an organisational working structure around the game-based learning curriculum and the cultivation of an organisational culture that facilitated open dialogues around educational games and game-based activities (as shown in Figure 10.1). Thus, the process of setting up the game-based learning environment required the preparation of three different 'resources' within the formal educational setting: establishing the technical infrastructure; reviewing and adapting organisational work structures and praxis; and cultivating the 'human factors' of the organisation and the game-based curriculum.

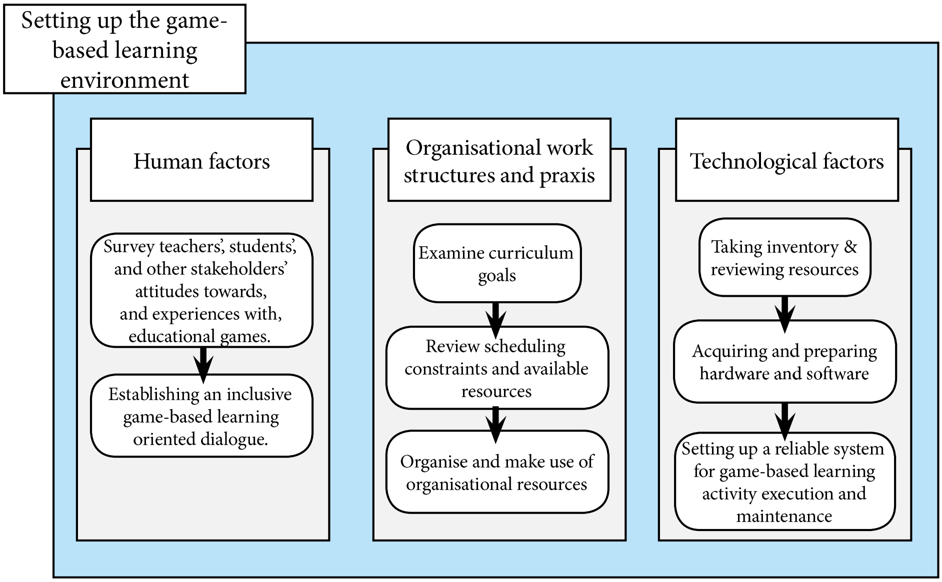

Figure 10.1: An overview of the situational factors encountered during the initial integration of the educational game into the formal educational setting. Factors relating to personnel, organisational resources and praxis, as well as technological infrastructure needed to be inventoried and organised in order to make the educational game an integrated part of the curriculum.

When these supporting resources had been reviewed and prepared, the task of designing and developing game-based exercises that would adhere to identified student needs and learning objectives could be initiated.

DESIGNING, CREATING, AND CONDUCTING GAME-BASED LEARNING ACTIVITIES

The design and creation of a game-based curriculum and its activities start with an examination of what type of game (and what type of specific game mechanics) corresponds well to the pursued learning objectives. As stated above, the discussions regarding how learning objectives could be achieved through game-based activities were primarily led by me and the more game-savvy Teacher A. Thus, the initial process of exercise design was not as thoroughly collaborative as I may have hoped, and the educators were more akin to 'clients' than close collaborators in the first couple of months of the project. Even so, early discussions clarified that the learning objectives we would pursue during the project were: improved Swedish reading comprehension and writing, English reading comprehension and writing, and collaborative practice of conversational English. During the team meetings, the educators described the details of these learning objectives and how the different students needed to work towards them. It quickly became apparent that the needs of individual students differed greatly, and that the learning objectives could be achieved by having students interact with language in various ways (e.g. through writing, reading, or conversations). This meant that we needed a game that allowed for collaborative as well as solitary exercises while it encouraged students to increase their vocabulary and reading comprehension. The students also differed quite significantly in their current language comprehension, their proficiency as game players, and in the types of challenges to which they responded well. Thus, the game needed to be inclusive to a wide range of players/students. With all this in mind, and naturally also aided by the game's popularity, recognisability, and my previous experiences of working with it, *Minecraft* was chosen as the tool to be used during the game-based curriculum. Minecraft would provide me and the teachers with the flexibility necessary to create challenges that catered to the students' varied preferences and skillsets, and ample opportunities for solitary game-based exercises as well as collaborative ones.

In the initial stages of the study, I would actively participate in the game-based activities by playing alongside the students as well as by helping them out and devising activities for us to do together. This was not only done to ensure that the students familiarised themselves with the basics of the game, but also to reveal what types of game performance could be expected from them and what types of gaming challenges they seemed to enjoy. After I had played the game with the students long enough to know what types of challenges they could handle and would respond well to, I started designing adventures and challenges for them to perform on their own with some supervision. These adventures usually resembled role-playing game or adventure game quests, and treasures or secrets would be hidden in the game-world which the students could find by solving riddles and following directions (written in the language they were studying). This process thus both allowed the students to become familiar with the *Minecraft* mechanics that would be used in the game-based activities and allowed me to better understand their grasp of the subject matters they were studying.

After these initial familiarisation exercises had been conducted, I retreated to a 'behind the scenes' role in which I mainly prepared game-based activities for the teachers and students to perform together without my direct involvement. It was during these exercises that the collaboration with the teachers became more significant, since they provided more input into the design of game-based activities and I briefed them on how to work with the challenges I had created for them and their students. The teachers' increased involvement in the task execution also gave them an opportunity to experience the ways in which the game-based activities contributed to learning objectives. Having meetings where the working group could debrief and assess the conducted game-based activities also became a more valued part of the working process at this point. Thus, after a few months of working with the teachers and the students in these different ways, a more inclusive and collaborative system around the game-based curriculum had slowly been established.

When the collaborative working processes had started to solidify, the cyclical process of preparing and conducting game-based activities settled into six discernible steps (shown in Figure 10.2). Initially, learning objectives had to be reviewed in relation to the students' current progression through the curriculum. After identifying new learning objectives to focus on, or old learning objectives that the students would benefit from repeating, new game challenges could start to be designed. The design process consisted of an initial ideation process, where the learning objectives were 'translated' into new game challenges, and the presentation of a rough draft of the new challenge designs to the working group for reviewing. The process of designing challenges, presenting a draft, and reviewing it as a group would be repeated until the challenge met everyone's requirements. Thereafter, the game challenges were created and implemented into the game, distributed to the teachers and the students, and subsequently put to use during game-based sessions. After debriefing the game-based sessions with each other and assessing the students' progress and reception of the game-based challenges, learning objectives were once again reviewed and thus the cycle started anew.

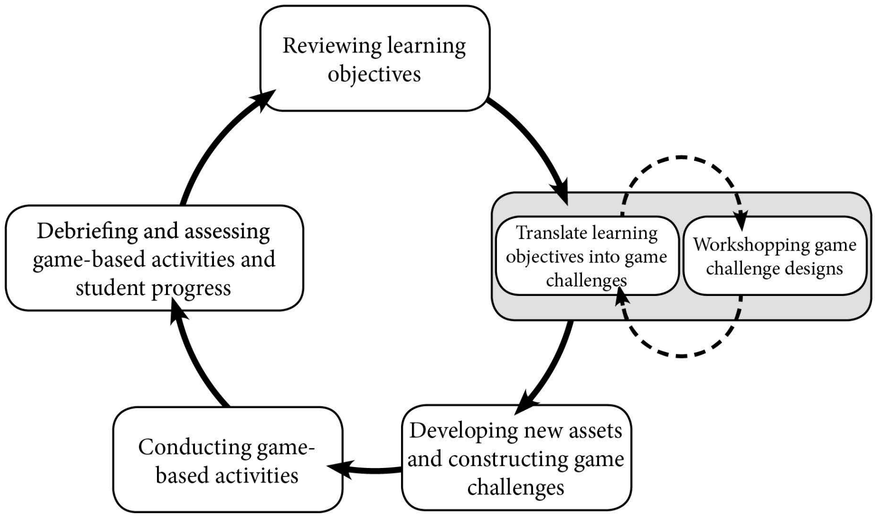

Figure 10.2: The cycle of game-based activity preparation, execution, and assessment.

The amount of preparation time needed for different types of game-based activities varied greatly. Exercises in which I played alongside the students and teachers usually required less preparation, as I could contextualise and explain the challenges to the students directly. Conversely, preparing tasks that were to be performed without my direct involvement, or where I took a more passive role, was significantly more time-consuming. These exercises had to be able to function reliably without my direct involvement and thus needed to be accessible and dependable so that teachers could start up and conduct the game-based activities easily.

The task of designing and preparing game-based learning activities in *Minecraft* that accommodated identified learning objectives and individual student needs was unexpectedly demanding and time-consuming. Preparing assets and creating game challenges for a one hour long, game-based classroom session could take anywhere between four to twenty-four working hours. The large amount of preparation time needed may likely be the result of the "growing pains" associated with launching a school's first game-based learning curriculum. Once assets and challenges have been prepared, they can be catalogued and re-used, which might reduce the preparation times significantly. However, the time needed to prepare relatively simple, game-based challenges needs to be taken seriously, as it has severe implications for educational games' feasibility as educational tools. If someone with a lot of experience working with educational games, and *Minecraft* in particular, needs several working days to prepare for one game-based classroom activity, the average school teacher may find the task of using educational games a near impossible hurdle to tackle.

OUTCOMES OF THE GAME-BASED LEARNING CURRICULUM

The project had several positive outcomes and a few negative ones. The educators I worked with reported that the students' attendance had increased and that the game-based activities had made a positive impact on their academic achievement and willingness to engage with academic subject matters. One student in particular had previously been staunchly averse to reading and writing, but had willingly started to engage with reading and writing tasks a couple of months into the game-based curriculum. The teacher working with the student (Teacher D) reported that the student had said that "reading is actually pretty fun*", which she considered a significant leap forward from his previous refusal to engage with written language. The other teachers also mainly had positive experiences from the project and had, as previously mentioned, become more and more involved and interested in exploring new ways of employing educational games in various subject matters. Their main positive remarks from the project were that games had proven to be a good way to increase students' engagement with various subject matters by democratising the classroom (in that students could work in familiar environments together as the teachers' equals, or even their guides) and presenting the subject matters in a more fun and engaging way. However, after my departure from the working group and the students, there was no discernible increase in the utilisation of educational games or game-based learning activities. In some brief, unplanned discussions with Teacher A and Principal B several months after the study, they said that they had not really returned to *Minecraft* or other games as teaching tools.

From my own experiences working with the students, a major recurring obstacle was that the game-based activities often veered off-track, and that it was difficult to maintain focus on the educational goals of the exercises. The 'framing' of the activities as being centred on learning and a certain subject matter turned out to be very fragile. It took very little for students to lose any momentum we had built up towards engaging with language and collaboration and turn their focus instead towards mastering and manipulating game rules and game mechanics. Here, *Minecraft*'s lack of direction and emergent gameplay qualities could be very distracting, making it difficult to direct exercises in ways that were conducive to established learning objectives. As previously mentioned, explicit learning outcomes were not a particularly high priority during this project. However, in situations where learning objectives are the main focus of using an educational game, this may become a more dire issue.

Again, I want to reiterate that it was a laborious project to carry out, in a practical sense, and that the educators' ambitions for increased academic achievement were relatively low. The reported increase in subject matter engagement of a handful of students working under very 'relaxed' circumstances should not be interpreted as a declaration that educational games are highly powerful teaching tools. It is equally likely, as was stated by Principal B in one of the early group meetings, that the students' increased excitement for the classroom activities was a reaction to an exciting new "flavour of the week", rather than to a quality inherent in the employed educational game.

WORKING WITH GAME-BASED LEARNING IN EDUCATIONAL SETTINGS

Altogether, the study uncovered some of the fundamental practical considerations, challenges, and possibilities that arise when games are brought into formal educational settings. The project allowed for a cursory mapping of the tasks required to set up the game-based learning environment and curriculum, as well as the ones involved in designing, preparing, and conducting game-based activities. Essentially, establishing and carrying out a game-based curriculum is a two-part process: one part in which the educational organisation and environment is surveyed and prepared to receive and work with an educational game; and a second cyclical process where learning objectives and students' progress are continuously reviewed, and game-based activities are designed and prepared to accommodate them. These two processes are summarised in Figure 10.3.

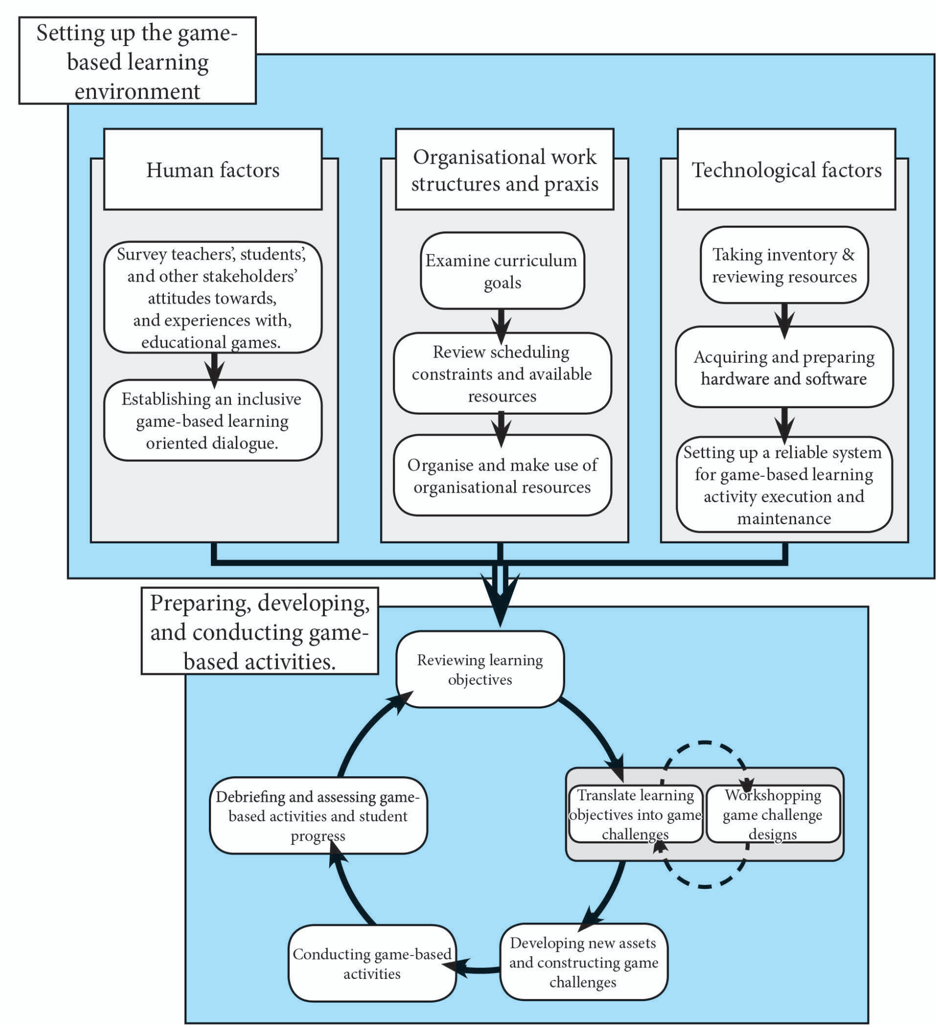

Figure 10.3: Combined model for the integration of an educational game in a formal setting, and the cyclical working processes involved in executing continuous exercises throughout a game-based curriculum.

Not included in this working process is the effort involved in closing down a game-based learning project and storing away the developed resources for easy access in later game-based curricula. The process also omits the important task of ensuring that the increased familiarity with, and understanding of, the functionality of the used educational game is disseminated amongst other members in the organisation; which can be important for ensuring and improving future educational game use. My hopes for this project were not only to produce research, but to collaborate with teachers in establishing an environment which they could keep using without my direct involvement. As previously mentioned, the project suffered from a hierarchy that separated the more tech-savvy teacher and me from the other collaborating educators. This led to a collaboration where the other team members effectively functioned as 'clients' who put forward requirements and ideas that the more technology and game experienced participants responded to and 'translated' into game challenges.

CHAPTER 11
LITERATURE REVIEW INTERLUDE: REVIEWING EDUCATIONAL GAMES RESEARCH

During the phase two case studies, I experienced some distinct differences between what working with educational games in formal educational settings is like and how researchers often discuss educational games in academic publications. Many of the working processes, situational factors, and challenges involved in conducting the game-based curriculum in the case study were largely unanticipated, and I had seen few scholarly studies examining them in my initial broader literature reviews. Given that some of the encountered challenges significantly dictated the direction and structure of the game-based curriculum, I found it surprising that I had not encountered them in the literature. In order to examine whether this incongruity was just a result of shortcomings in my own initial literature surveys, or whether it was a symptom of a general knowledge gap in the field of educational games research, a structured review of the literature was conducted.

The general overview of educational game research, provided in chapter 5, presents a broader overview of academic writing in the field and contains examples of research that examined educational games in their contexts of use. However, while the process of producing the overview entailed extensive reading of literature on various topics relating to educational games, it was not particularly systematic and could thus not account for how research efforts were distributed between the different topics. Research on the properties of formal educational settings seems to be sparser than research on engagement, pedagogical principles, and design guidelines. But, I wanted to conduct a closer examination of the proportional differences in how much different topics relating to educational games are researched. Previous games researchers have also made claims that educational game research is lacking empirical studies on how games function in their contexts of use (Backlund & Hendrix, 2013; Linehan et al., 2011; Squire, 2002; Young et al., 2012). As stated by Egenfeldt-Nielsen:

> "The discussion of the educational potential of computer games have raged for more than 30 years. This discussion has been present in the public debate but also with varying degrees of intensity in the research community… [but] has ignored the more practical and self-evident problems inherent in the use of games in educational settings" (Egenfeldt-Nielsen, 2008, p. 30)

However, these types of claims often seem to be based on observations made during broader literature overviews rather than on structured examinations, similarly to how I initially reached the same conclusion. This literature review "interlude" was thus, briefly put, conducted to examine whether my experience of literature in the field reflected the actual state of educational game research, or if it was just a limitation or bias in my approach to the literature. The review was conducted before I initiated the case studies in the third research phase. More elaboration and details of the review can be found in the published paper (see Berg Marklund, 2014).

11.1 METHOD AND EXAMINED VENUES

The literature review was conducted on publications in three academic forums. The examined forums were two broader game studies conferences and a strictly game-based learning focused journal: the Digital Games Research Association (DiGRA), Foundations of Digital Games (FDG), and the International Journal of Game-Based Learning (IJGBL) respectively.

The papers were first filtered through a series of search terms applied on paper titles and abstracts (learning, gamification, classroom, student, teacher, and school). Each paper was subsequently evaluated to decide whether it in fact examines educational games, or whether it made it through the filter by happenstance. The individual examination of each paper was a necessity, since the keyword searches would include papers on games for health and on how the act of creating games can be educational. Since this thesis is concerned with examining research on games that intend to teach through their content, research on what can be learned through the development of games or, for example, how manual dexterity can be trained through gameplay was not considered relevant. The filtration process resulted in a total of 104 papers[7]:

- 13 papers from FDG conference proceedings (spanning 2009-2013)
- 41 papers from DiGRA conference proceedings (spanning 2003-2013)
- 50 papers spanning all IJGBL volumes (spanning 2011-2013)

The papers were grouped into eight different categories according to what they aimed to contribute to the educational games and game-based learning discussion (see Table 11.1). The categories were primarily inspired by the ADDIE model (see Figure 7.1) from the field of instructional system design (Gustafson & Branch, 2002).

Table 11.1: The eight categories used during the literature review and their mapping to the ADDIE model.

Educational potential 1. Games and learning principles	**A**
Game quality and creation 2. Design tools and techniques 3. Development tools and techniques	**D** **D**
Users, application, and environments 4. Attitudes towards GBL 5. Using games in formal contexts 6. Properties of formal contexts	**I**
Evaluation and assessment 7. Research methodologies 8. Learning effects and outcomes	**E**

[7] The list of papers can be found in Appendix A

As previously mentioned, the ADDIE model describes the process of creating instructional systems by dividing it into phases (Moore, Bates & Grundling, 2002); analysing and understanding the overall purpose of the solution; designing the system components; developing the system; implementing it and using it in its intended setting; and finally assessing and evaluating its impact during and after use. For the purposes of this literature review, the phases were "transposed" to better describe the lifespan of an educational game and subsequently divided into sub-categories to provide a more granular description of the reviewed papers.

It is important to note that the literature review is not an exhaustive investigation or definitive quantitative analysis of all educational game research. The review is based on a segment of game studies and is primarily intended to highlight how material published in game conferences and journals tends to examine educational games. The method of categorisation was, as evident by the use of the ADDIE model, influenced by research in instructional system design. Comparatively, research in that field tends to be more practically oriented and, since the review focused on examining whether educational game studies lack a pragmatic approach, this framework seemed to be suitable for the study.

The selection of publication venues is admittedly quite limited; there are certainly more journals and conferences publishing material on the subject of educational games than the ones chosen. DiGRA and FDG were chosen because of their inclusion of a wide variety of games-related research. Due to their size, recognisability, and the breadth of research they publish, their publication archives were used as "sedimentary records" of the broader field of game studies. While more niched venues might provide more detailed deliberations on nuances in specific sub-genres of games research, DiGRA and FDG can provide comprehensive cross-sections of how the scholarly climate has shifted and changed throughout the last decade. IJGBL was chosen to compensate for the generality of the conferences and to represent communities specifically oriented towards educational games. While there are several other publications that could be suitable additions to the review, the three venues chosen have a beneficial straight-forwardness to them. Publications like the serious games research staple Simulation & Gaming (S&G) or the European Conference of Game-Based Learning, for example, require more sophisticated tools of filtration, as their treatment of a 'game' as a term and object of study is ambiguous. For example, S&G papers are not very particular about distinguishing between systems, environments, simulations, and games[8] and to avoid ambiguity, regarding what 'educational games' refers to in this review, the publication was excluded entirely. To conduct a review of that magnitude while maintaining cohesiveness, filtration methods and categorisations would need to be developed and conducted by a committee that covers a wide range of expertise in the area of games and serious games, rather than a sole author.

[8] From S&G's guide for authors, retrieved 2015-09-01 from www.unice.fr/sg: "Simulation/gaming is to be taken in its broadest meaning, to encompass such areas as simulation, computerized simulation, internet simulation, gaming, simulation/gaming, serious games, educational games, training games, e-games, internet games, video games, policy exercises, day-in-the-life simulations, planning exercises, debriefing, analytic discussion, post-experience analysis, modeling, virtual reality, game theory, role-play, role-playing, play, active learning, experiential learning, learning from experience, toys, augmented reality, playthings, structured exercises, education games, alternative purpose games, edutainment, digital game-based learning, immersive learning, brain games, social impact games, games for change, games for good, synthetic learning environments, synthetic task environments."

11.2 EXAMINATION OF EDUCATIONAL GAME RESEARCH

After categorising all 104 papers (collected from the Foundations of Digital Games, Digital Games Research Association, and International Journal of Game-Based Learning libraries), an indication of the aspects of educational games that researchers tend to focus on emerged rather clearly (see Figure 11.2). The most common subject of examination was ways to improve the quality of gameplay in educational games (44 papers), often through devising guidelines for how to better balance what is usually referred to as 'engagement' factors and 'learning' objectives. Investigating whether games and gameplay correspond well to learning principles was also a common research topic in 25 papers.

In general, studies focused on establishing reasons why games should or should not be used for educational purposes, by describing games' links to learning principles, and how educational games should be designed to both engage students and represent subject matters and learning objectives. In line with the statements made previously by researchers, there were noticeably fewer studies investigating how games are used and how they fit into formal educational environments.

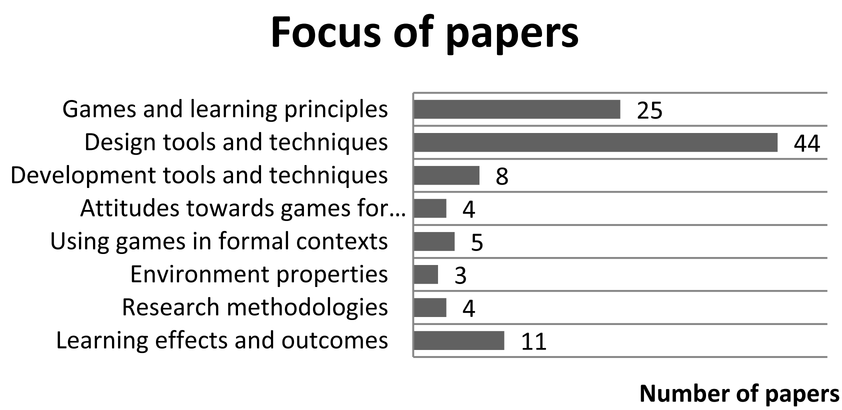

Figure 11.2: An overview of research foci in studies examining educational games.

In order to contextualise the findings of the literature review, the different categories will be broken down and discussed in some more detail. While the purpose of this part of the thesis research is to discuss where research on educational games is lacking, describing what studies tend to focus on adds some important context. To this aim, brief descriptions of the common approaches used in the different types of studies are provided, along with some specific examples from the investigated literature as well as relevant sources from outside the scope of the review.

11.2.1 GAMES AND LEARNING PRINCIPLES

One of the more common themes in educational game research is explaining the educational potential of games and gameplay (Blumberg & Ismailer, 2009; Gee, 2009). This is often done by coupling established pedagogical principles to common game design principles and parts of games' "natural" anatomy, for example, in Becker (2005) and Medina (2005). As described in chapters 4 and 5, games' potential virtues as educational tools were described in the early days of educational game research (Malone, 1980b, 1981).

But, since both games and pedagogical principles are continuously evolving, new ways in which games manifest pedagogical principles are frequently discovered and elaborated upon. It should be noted that not all studies reach conclusions that support the notion that digital games and gameplay are naturally conducive to deep or effective learning. For example, Wechselberger (2013) presents the issue caused when students frame learning activities as game activities, which can prevent in-depth reflection on the experienced content, and Linderoth (2012) discusses how games' ways of providing and conveying affordances to players can inhibit valuable learning processes.

11.2.2 DESIGN AND DEVELOPMENT TOOLS AND TECHNIQUES

The design and development processes involved in the creation of educational games are frequently subject to investigation. There are many differing perspectives on how an educational game should be designed and developed, in order to make good on their perceived educational potential (Engström et al., 2011; Franzwa, Tang & Johnson, 2013; Whitton, 2011). Some developers and researchers factor engagement and the integrity of "traditionally" sound game designs higher than educational content, whereas some take the opposite stance and value correct subject matter representation higher (Egenfeldt-Nielsen, 2011; McClarty et al., 2012). Some stand between these two camps and champion a direction where concessions are made in how we appraise gameplay and educational processes (Bogost, 2008). The behaviouristic paradigms that dominated the educational game landscape in the past have been on a continuing decline since the edutainment game market collapsed in the late 1990s (Ito, 2009). New pedagogical principles are now influencing educational game research and development, and the lenses through which we examine them are becoming more nuanced as a result (Egenfeldt-Nielsen, 2006; Ratan & Ritterfeld, 2009).

Out of all of the reviewed papers that investigated ways to improve the design of educational games, only five put games to use in a formal setting, and only one proposed design improvements aimed at facilitating formal use (Rikke, 2007). The other four evaluated designs primarily on the games' ability to engage or educate their players during play sessions. Studies on development processes, while rarer than design research, usually had the same general approach: few of the studied cases were based in formal settings and the focus was placed on examining how development can be conducted to improve the quality of gameplay while including educational content.

11.2.3 LEARNING EFFECTS AND OUTCOMES

When evaluating the educational effectiveness of educational games, researchers tend to aim at finding a balance between engagement and learning in their studies (Rai & Beck, 2012a). They often evaluate what has been learned and how engaging the learning process was in the eyes of the student. A study on the effects of console gaming in schools, conducted by Groff, Howells and Cranmer (2012), is an example of this approach, as it directly contrasted console play with other school exercises. At the end of a project, in which students and teachers had used console games for various classroom activities, participants' experiences and perception of game-based learning were examined through interviews. Students and teachers reported an overwhelming positivity regarding games' ability to be engaging and motivating, especially in comparison to other ways of learning and teaching. As described in chapter 5, many educational game studies aim at examining the educational outcomes of using games for teaching in comparison to what is often referred to as 'traditional teaching methods'. These studies make statements regarding both whether the players learned anything and how much fun or engaging the learning activity had been (McClarty et al., 2012).

11.2.4 LESS EXPLORED AREAS

The conducted literature review suggests that while there are lively discussions regarding educational games' educational potential and design, deliberations on how they are practically utilised and the properties of their context of use are quite sparse. This observation has, as previously mentioned, been made in previous research as well (Egenfeldt-Nielsen, 2010; Kirkley, Tomblin & Kirkley, 2005; Klopfer, Osterweil & Salen, 2009) but it is seldom based on structured reviews. While different design approaches have been invented and put to use to provide new ways of balancing engagement with learning, there has not been much progress with regard to finding sound methods for how educational games can be developed to ensure that the end product is actually useable. As described earlier, discussing the design of games is useful for examining their inner workings and how different game elements can fit together to create an experience.

Out of the 104 reviewed papers, eight can be considered to have been conducted with the expressed intent to investigate the properties of end-user contexts or the application and use of educational games. Four of these papers relied on surveys and interviews to obtain teachers' perspectives on how games fit into formal educational settings from a practical standpoint (Becker & Jacobsen, 2005; Kirriemuir & McFarlane, 2003; Razak, Connolly & Hainey, 2012; Tan, Neill & Johnston-Wilder, 2012), three papers described case studies where games were developed and implemented into their intended contexts of use (Petley, Parker & Attewell, 2011; Saridaki & Mourlas, 2013; Wagner & Wernbacher, 2013), and one paper took an ethnographic approach to understand how the practicalities of the use-context affects learning (Chia-Yuan, 2007). The inclusion of the latter in this category is, perhaps, debatable, as it primarily focused on examining how internet café contexts functioned as environments of situated learning. Its focus on context-based learning, however, made it more suitable in this category than any of the other ones, even though the studied context was not particularly formal. All four papers based on surveys and interviews conclude that educational institutions are largely unprepared to receive educational tools as technologically advanced as digital games. The case studies present a somewhat broader picture by being able to describe aspects of development and implementation in more detail, but also conclude that the realities of formal educational environments present obstacles that cannot be solved solely through clever design choices.

A development focused case study conducted by Wagner and Wernbacher (2013) concludes with some remarks on how previous research has been insufficient in mapping out the impact the practicalities of formal settings have on educational game development:

> "A larger research question arises from the fact that our research suggests that the formal educational use of games requires a significant amount of learning process management through a teacher or trainer. This contradicts opinions that games are excellent tools for self-directed learning and would indicated (sic) that it is difficult if not impossible to achieve economies of scale in educational game development." (Wagner & Wernbacher, 2013, p. 350)

Wagner and Wernbacher's research suggests that the current realities of formal educational settings are so incongruent with processes of game development that the marketing and distribution of an educational game on a scale that produces revenue to sustain business is difficult. Furthermore, their study shows that educational games require a supporting system of contextualising activities around them, in order to produce positive results in formal educational settings.

Looking at the literature produced in the chosen venues, much work has gone into detailing and mapping out the internal structure of educational games as 'game products', but comparatively little work has been done to understand the context in which they are to be used. Thus, the findings of this, admittedly somewhat limited, literature review ratifies these types of claims made by previous researchers (cf. Egenfeldt-Nielsen, 2011; Squire, 2003; Young et al., 2012).

CHAPTER 12
PHASE III: DESCRIBING THE INTEGRATION AND USE OF EDUCATIONAL GAMES

The purpose of the final phase of the research process was to describe and detail the implementation and use of educational games in formal education. The first two case study phases, and the licentiate thesis produced from their outcomes (Berg Marklund, 2013), outlined some of the bigger contradictions between game development, game design, as well as working processes and organisational structures in education. In order to examine the viability of these outcomes in more 'representative' educational settings and find ways to potentially alleviate some of the found issues, the final research endeavour entailed a more in-depth participatory study with educators where I was involved in implementing and using games in two different types of K-12 classrooms. The primary purpose of these final case studies was to examine:

- What types of interventions are necessary to create an environment and local infrastructure to make educational gaming sessions possible?
- What types of responsibilities do teachers need to assume during a game-based curriculum?
- How do the realities of formal education influence the types of game challenges that can be designed for classroom gaming sessions?

One realisation that emerged during phase two's case study was that it could be valuable to document my own experiences collaborating with students, teachers, and administrative staff in more detail. Indeed, the work conducted in phase two and the literature review indicated that the researchers' presence during the implementation of educational games in formal educational settings impacts the researched organisational context to the extent that it is dubious whether any valid conclusions can be made. The use of games in the educational settings was so highly dependent on my own (or other researchers') presence and the interventions I made, that most conclusions would have to be confined to describing how games function in educational environments, *given the presence of a subject-matter expert and the extra resources brought in by said expert*.

The studies in phase three were thus used to map out, in detail, what types of interventions are needed to make educational games function in "average" classroom environments and to give an honest account of how these interventions were made. By participating and observing the method of implementing and using educational games in middle, and secondary school classrooms, the study presents an in-depth and close-up look at what types of efforts educational games require from educational institutions in order to work. An important distinction to make here is that the study is not meant to declare whether or not the extra work can be assigned to teachers and how teachers can approach them, but rather to examine what efforts are necessary. The research conducted in the previous phases of this thesis work points to a significant lack of research in the area of the practical implementation and use of educational games (which has also been identified as one of the crucial reasons why educational games often fail to have positive impacts in educational settings), which this phase aimed to ameliorate.

Another important purpose of these final case studies was to also examine what types of roles teachers take on during a game-based curriculum. By giving teachers more time and space to conduct game-based activities on their own, and documenting my own work as a teachers' assistant, the working processes necessitated by educational games could be examined more closely. Hardware and software integration and maintenance, classroom activity supervision, as well as student guidance and tutoring were all followed by more robust and nuanced documentation. Thus, the concluding phase of this thesis work resulted in both more comprehensive and in-depth descriptions of teachers' experiences when working with educational games.

12.1 CASE DESCRIPTION, AND METHODS OF DOCUMENTATION AND DATA ANALYSIS

For the final case studies, an initial number of four teachers working with three K12 classes were included: one middle-school class (two teachers with students of ages 11-12), and two secondary-school classes (two teachers with students aged 14-15). However, due to various circumstances, one of the secondary-school teachers was disconnected from the research project shortly after the initial meetings, interviews, and planning sessions had been conducted. The study also included interviews and meetings with a principal at the school. These meetings focused on discussing and setting up the projects, so they were of less importance to the research questions pursued during this research phase.

One realisation that emerged during the previous research phases was that multiple methods of data gathering needed to be used in the attempt to create a comprehensive overview of the working processes that make up the large system of actors, events, and objects that comprise game-based learning initiatives. During these case studies, the data gathering process involved three separate parts:

- Written protocols were kept for the preparations and investments I made when setting up the classrooms for gaming activities.
- Interviews were held with the involved principal and teachers before, during, and after the project and documented through real-time note-keeping and transcripts of audio recordings.
- Game-based classroom activities were documented through participant observation protocols and by transcribing audio recordings made during the game-based exercises.

This combination of data gathering methods aimed to collate enough data points to produce a comprehensive overview of the examined setting, its processes, and my own influence in creating the studied scenario. As shown in the analysis of the more 'focused' literature review conducted before this study (see chapter 11), ambiguous research circumstances (and researchers' involvement in preparing actors, environments, and resources for game-based learning) are a recurring problem in educational game research. Using multiple methods of data collection and documentation is my way of avoiding such ambiguities, as it facilitates the production of 'thick descriptions' of the case study. The details of how each individual research method was carried out are presented in the sub-chapters below.

Table 12.1: Participants in the third phase of case studies.

Role	Profile(s)	Purpose	Method
Principals: **Principal C**	Principals of different departments in a school with students aged 10-15	Gather opinions and discuss the general viability of educational games from educators' perspectives – e.g. administrative, technical, or ethical concerns of using educational games	Semi-structured Interviews
Teachers: **Teacher E** **Teacher F** **Teacher G** **Teacher H**	Teacher E & F, male teachers of high-school students. Teacher G & H, female teachers of middle-school students.	Discuss the pedagogical reasons for and against using educational games, and collaborating during game-based curricula to examine the processes of integrating and using educational games in formal settings.	Semi-structured Interviews Structured interviews Workshops and meetings Participant observation during exercises Recorded game-based exercises

The research period spanned a total of 10 months, with the first five months spent preparing the game-based curriculum and discussing the project with principals and teachers I collaborated with. The actual implementations and uses of the educational games started during November 2014 and lasted until the end of March 2015. The research also included post-production activities following the conclusion of the implementation and use of the educational game, as well as some follow-up interviews when the data had been sufficiently collated to inform interview questions. The purpose of the follow-up interviews was to both validate observations made during the implementation and use process and to collect teachers' and organisational administrators' reflections on using educational games in their classrooms.

The two projects followed a general progression where I served a more hand-holding role in early classroom activities but assumed a more passive observatory role as teachers became increasingly more familiar and confident with the used game. In the final couple of exercises during the game-based learning curricula, I was completely absent from the classroom and instead analysed the activities from recordings (with a microphone attached to the teacher and recorders placed in the classroom). The processes of interviewing, meeting, implementing, and using games in the different classroom settings are detailed below in Table 12.2.

Table 12.2: An overview of the research activities that were held with the two different classes and their teachers from 2014 to 2015. The tables are divided into two different coloured hues: orange symbolises activities that occurred largely independently of classroom exercises, whereas purple symbolises activities that happened in or were directly related to classroom exercises. The classroom exercises are divided into exercise preparation, introduction, execution, and game content preparation (i.e. creating/preparing game content for the planned exercise). The activities are marked with an R and/or a T, depending on whether it was primarily executed by the researcher or teacher respectively, or both.

7th Grade	17/6	15/8	21/10	12/12	18/12	16/1	23/1	30/1	6/2	20/2	27/2	11/3	20/3	27/3	28/8
Teacher meetings	•		•								•				
Game integration				•	•	•									
Exercise preparation		RT			RT	RT	RT	RT	RT	RT	RT				
Game content preparation					R	R	R	R	R	R	R				
Exercise introduction					R	R	RT	RT	RT	RT	T	T	T		
Exercise execution						R	RT	RT	RT	RT	RT	T	T		
In-progress interviews						•	•	•	•	•	•				
Post-curr. interviews														•	•

5th Grade	11/12	7/1	16/1	20/1	27/1	3/2	17/2	24/2	27/2	2/3	3/3	12/3	24/3	24/4	16/6
Teacher meetings	•	•	•						•					•	
Game integration				•											
Exercise preparation		RT	RT												
Game content preparation				R											
Exercise introduction				R	R	RT	RT	T	T	T	T	T			
Exercise execution				R	RT	RT	RT	RT	RT	T	T	T			
In-progress interviews				•	•	•	•	•	•						
Post-curr. Interviews													•		•

Table 12.2 shows the overarching research process, as well as the game-based curriculum as it was designed together with the teachers. In order for teachers to become acquainted with how the game could function in the classroom environments, I took on a more leading role in the initial game-based exercises. As the curriculum progressed, I reduced the interventions during the exercises until I was only present as an observer and safety net for the teachers, and ultimately the teachers conducted entire exercises on their own.

The physical classroom setups of the conducted gaming activities differed somewhat between the two studied classes as a result of hardware and physical space limitations (see Figure 12.1). The students in the 7th grade class were all part of a national program that supplied them with one laptop per individual, whereas the other 5th grade class had a collection of communal computers to share amongst each other. The classroom sessions were thus structured differently, as the older students had enough hardware to play games as a whole class (all 22 students could play simultaneously), and the younger students played in smaller groups (24 students divided into two groups of 12 that shared six computers). However, even though the secondary-school class had enough computers to play individually, the teacher often opted to have them work in groups of two, sharing one of their laptops. The reasoning behind this choice is explained further in the results presentation and analysis.

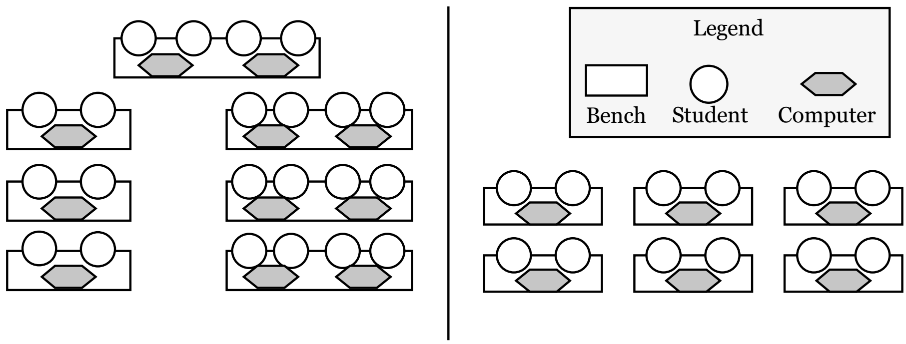

Figure 12.1: Though the 7th grade students (left) had individual laptops, they were divided into groups of two and shared one laptop. The 5th grade students (right) worked in groups of two on communal laptops.

The two classes also worked with different subject matters: the 7th grade class worked with mathematics and geometry, and the 5th grade class worked with medieval history. The 7th grade students worked in smaller groups and collaborated on a series of different geometry exercises. The 5th grade students worked with history and had a longer continuous collaborative project where the class was divided into two groups of 12 to build medieval structures and societies.

12.1.1 INTERVIEWS

Similar to the interviews conducted with teachers and principals in phase two, the interviews during these case studies went through a gradual transition and the protocols used during interviews changed as the implementation and use of games in the classrooms progressed.

INITIAL INTERVIEWS

At the start of the research project, the respondents of the case study were interviewed twice. The two initial interviews were structured to examine the included teachers' and principals' attitudes, opinions, and previous experiences of using games and technology in classrooms. To that aim, the interviews simultaneously functioned as validation of previous conclusions and as fundaments for the upcoming collaborations with the interviewees. The interview protocols used during the very early interviews were at the outset open ended to avoid directing educators to merely reply or reinforce my own preconceptions based on the previous studies. If the educators brought up previously identified concerns or possibilities spontaneously during the open-ended interviews, the previous conclusions could at least be seen as somewhat anchored in reality and not specifically confined to just those cases studied previously. This being said, the initial interviews served as important generators of novel data as well.

The first interview with the principal, as well as the first ones with the teachers, lasted between 20-40 minutes. The interviews were unstructured and conversational, and were not recorded or transcribed in detail. The reason for not recording the first interviews was to ensure a safe environment where we could discuss the upcoming teacher and researcher collaborations. Using recording equipment during the initial contact with the respondents could enforce an immediate sensation that the researcher was holding authority over the proceedings and the other participants at the meeting (Robson, 2002). Since the aim of this study was to collaborate with teachers and to become entrenched, as much as possible, in the context of educational game use, I thus opted not to start collaborations with recording devices. The meetings were, however, documented with notes taken during the discussions, and longer post-meeting summaries were written shortly after the meetings concluded in order collate all the main talking points and my own interpretation of the discussions.

The primary concerns, visions, and discussions that arose during the first unrecorded meetings were brought up again in the second meetings with the respondents for purposes of validation. Viewpoints and descriptions expressed by the respondents were repeated as talking points and discussed again, in order to examine them further and to ensure that I had interpreted them correctly during the first meeting. The second round of interviews was more structured and followed an interview protocol, the structure of which was informed by the previous case studies and the first meeting with the respondent (the used interview protocol can be found in Appendix B). These interviews also lasted between 20-40 minutes and were, as opposed to the first interviews, recorded and transcribed.

IN-PROGRESS INTERVIEWS

The interviews conducted with teachers during the implementation and use of games in their classrooms followed an entirely different protocol than the one for the initial interviews. These interviews were held with a constant core protocol with addendum questions that were based on specific observations made during the classroom sessions or in the preparations for these sessions. In-progress interviews were held directly after classroom sessions. The interviews were short, spanning between five to ten minutes in length, and served to capture the teachers' experiences and perceptions of how the projects were progressing and how specific classroom activities played out. The interviews also gave the teachers an opportunity to discuss aspects of the project they felt were positive, the ones that concerned them, and potential new goals and directions they wanted the project to move towards.

POST-CURRICULUM INTERVIEWS

Teachers were interviewed for post-curriculum summaries of the game-based projects as a whole. The interviews were semi-structured and followed interview protocols based on the observations made during the implementation process and classroom sessions, which had been collated before the interviews were conducted (interview protocols can be found in Appendix B). The protocols served as the main "trunk" of the interviews in that the interviews touched upon all of its questions, but the answers were allowed to branch out into longer conversations, depending on how they resonated with the respondents.

Similar to the initial interviews, the post-curriculum interviews served to generate new data as well as to validate my own observations and interpretations of how the game-based exercises and surrounding processes had progressed. To this aim, the interviews again started with open-ended questions where the respondents could talk about their experiences of working with educational games the past few months. Once the open-ended segment of the interview ended, a protocol created from my own observations and experiences of working with the teachers and their students was put to use. The interviews thus entailed discussions regarding how teachers had experienced the process of integrating the educational game into their classrooms (e.g. how they perceived the reliability of the technology and the properties of the educational game as a teaching tool), the execution and results of the game-based exercises (e.g. how the classroom atmosphere changed, or how their own roles during classroom activities were affected), and reflections on the curriculum structures and outcomes.

12.1.2 PARTICIPANT OBSERVATION AND RECORDINGS OF GAME-BASED EXERCISES

The participant observation methods played an important part in this study and served as the primary generation of new data. The interviews, while sometimes generating new data, primarily served as a tool for validation and explanation of data gathered during the participatory parts of the research. The participative part of this research served to examine the process of integrating the educational game into the two different classroom environments, the surrounding activities needed to prepare for classroom activities, as well as the process of conducting the classroom activities by observing their execution.

TIME AND RESOURCE INVESTMENTS

The time and resources I invested when preparing the educational environment for game-based classroom activities were an important factor to monitor, as it was a central part of the enquiry in this phase. Examining the investments necessary to carry out classroom gaming in formal educational settings, and later evaluating these investments together with educators, can reveal some crucial shortcomings that must be overcome in order for educational gaming to be an impactful endeavour.

To this end, the time spent preparing for classroom sessions, and the investments made acquiring game licenses or upgrading hardware, was documented in minutes and Euros. The function of this documentation is to show some of the behind-the-scenes work that I put into the case study as a researcher, as well as the efforts and investments required to make game sessions in classrooms possible. As stated previously, research seldom brings these practical details to the fore, and I thus consider it necessary to provide an honest account of how the technological infrastructure that enabled the conducted game-based curricula was established.

PREPARATION AND DESIGN OF CLASSROOM ACTIVITIES

Beyond preparing the hardware and software and establishing an environment where educational games could reliably be played, an important recurring element of the case studies was the preparation and design of game-based classroom activities. Since the classes included in the study differed from each other in various ways (e.g. subject being taught, scheduling constraints, ages of the students, number of available computers, and learning objectives), the game-based curriculum needed to be specially customised for each of them. Surveying the learning objectives, available resources, facilitating conditions, and scheduling constraints – and subsequently designing a curriculum and activities that would accommodate for them – were found to be crucial tasks when working with game-based learning during the studies in phase two. In addition, documenting these procedures was thus made a high priority during this research phase.

These processes were documented through a combination of interviews and my own journal entries. The design of the game-based activities was created in collaboration with teachers through regular meetings, both before the classroom activities started and between individual classroom sessions as adjustments were deemed necessary. I collaborated with teachers to assess the students' progress through the game activities (through the in-progress interviews) and we discussed how continued activities would be conducted. Changes in directions and the design of various classroom activities were included in the kept documentation throughout the project.

OBSERVING AND RECORDING CLASSROOM ACTIVITIES

In order to document classroom gaming sessions in an unobtrusive way, an observation protocol that followed a predetermined structure was written during each session. The protocol structure served to group observed events, behaviours, and actions into seven distinct categories:

1. Pre-exercise preparations
2. Preparatory instructions
3. Teacher interventions
4. Researcher interventions
5. Student discussions
6. Technical difficulties
7. Summary and post-exercise discussions with teachers

Throughout the game-based classroom activities, I would write notable observations down in these seven categories (examples of completed observation protocols can be found in Appendix C). When the activities began, I kept notes of how I and the teacher prepared the students by, for instance, introducing new subject matter details or assignments for the day's lesson. I also took note of the students' reception and interpretation of those preparations. During the execution of the classroom activities, I kept notes of interventions made by me or the teacher (e.g. discussing the subject matter with students, helping a student understand the assignment better, mediating student discussions and tutoring students in how to play the game, or encouraging students to remain focused on the learning objectives). Depending on who made the interventions, the observation would be noted in either the 'teacher' or the 'researcher' intervention categories. Whenever an observation was made, I also included a note of *when* the situation or exchange occurred, so that I would be able to locate it in the audio recordings of the exercises. The other categories were used in a similar fashion. If I saw students discussing the assignment or the educational game in notable ways, or if there were any technical difficulties, I briefly described the nature of the discussions or the technical issues and noted approximately when they occurred, so that I could find them in the audio recordings for closer examination. This meant that the observation protocol served two purposes during the research process, as it was used both as a data source and as a means to facilitate the process of mining the audio recordings for more detailed data.

AUDIO RECORDINGS

The audio recordings themselves were made with voice recorders that were placed in various positions in the classroom during the game-based exercises. Just as with the initial interviews, I chose to not record the first game-based exercises to avoid the risk of making students uncomfortable at the outset of the project. As the curriculum progressed, three voice recorders were brought in and placed in 'triangulating' positions across the classrooms; one on the left side, one on the right, and one at the front and centre of the classroom. During the exercises held at a late stage of the curriculum, where I was entirely absent from the classroom, the front and centre recorder was instead attached to the teachers, in order to make their activity and discussions with students during the exercise easier to follow. Teachers were also given a short tutorial as well as a 'check-list' protocol of how to start the recorders at the beginning of the classroom session in my absence.

12.1.3 DATA PROCESSING AND ANALYSIS

The most extensive data processing task undertaken during this thesis work was transcribing and subsequently coding and analysing the audio recordings of interviews and the game-based exercises. Recording and transcribing the teacher interviews was fairly straight-forward, but the game-based classroom activities were more complex and laborious. Audio was captured by the use of recording devices that were placed at different locations in the classrooms. The number of devices sometimes varied, due to technical difficulties (this primarily happened during early sessions), and it was not unusual for one recorder to either not function properly during the game-based exercise, or that the audio recorded was of too low quality to be usable. However, when everything worked as intended, three devices were used. After a classroom exercise had been conducted, the audio was uploaded to a computer and the different audio sources were synched to audio software that enabled easy manipulation of multiple audio tracks, which made it easy to mute or focus on different sources when necessary. After the audio had been prepared, the transcribing process began. When the transcripts of all the exercises were completed, they were collated and subject to thematic analysis, according to guidelines provided by Braun and Clarke (2006), which is described in more detail in the following section.

Transcribing audio from three different recordings made in a, sometimes quite noisy, classroom environment was a time-consuming task. High noise levels made careful listening and re-listening necessary, when attempting to discern specific discussions (especially ones held at a distance from the recording devices), and the multiple tracks meant that it was usually necessary to carefully listen to one minute of audio three times. Due to these challenges, ten minutes of recorded classroom activity often took approximately 120 to 150 minutes to process. Since roughly 15 hours of classroom audio was recorded (or ~45 hours when accounting for the multiple tracks), transcribing every game-based exercise in its entirety was an unrealistic undertaking. However, a protocol was devised at the outset of the project to make the data processing more manageable, without sacrificing its usefulness. According to the protocol, transriptions were to begin with the first 10 minutes of exercises, and would be followed with subsequent transcriptions that were based on the ‘points of interests’ identified in the participant observation protocol (shown in Appendix C). For the exercises where I was not present, the first 10 minutes were transcribed along with points of interests that I identified by listening to the exercises in their entirety.

The reason for simplifying the transcription process in this specific way was that the first 10 minutes usually contained a wide variety of activity throughout the classroom. Teachers and researchers made many different types of interventions, technical difficulties emerged and needed to be resolved, and students discussed and planned the ways in which they would execute the assignments for the day. The first minutes also captured the general atmosphere of the classroom and the tone of conversations in the collaborations between the students, which was helpful for contextualising discussions during the points of interest found later during the exercises.

The audio was transcribed into separate ‘tracks’, in order to make the separate simultaneous discussions going on in different places of the classroom easier to follow (see Table 12.3, or Appendix D for examples of transcribed exercises). The transcripts were written in the language spoken by the students, but the parts of the transcript excerpts that are highlighted in this thesis have been translated into English. For the most part, the coupling between the observation protocols and the audio recordings, as well as my own familiarity with the students, made it relatively easy to match student names to the voices heard in the audio recordings. However, when a specific voice could not be clearly identified, it was marked down simply as ‘(M) Student’ or ‘(F) Student’, depending on whether the voice was male or female; at times when several students made a statement in unison, the moniker 'Student(s)' was used. When voices were clearly distinguishable, however, statements were coupled with the pseudonyms given to the students.

Table 12.3: An excerpt of 60 seconds of transcribed game-based classroom activity. The students' discussions are transcribed in the language spoken. Various sounds and non-verbal expressions were written in English (mainly due to my own academic writing preferences).

Time	Left side recorder	Front centre recorder	Right side recorder	Comment(s)
04:30	Dylan: Vad skulle *unintelligible*... *Silence, mouse clicks* Dylan: Vad har han tänkt? Ernest: *quiet reply – unintelligible* Dylan: Men nu är det inte mycket kvar. *Pause* Ernest: Så sen får inte jag köra min idé... För då hade man inte kor inne. Dan: Det är en ko på övervåningen.	Teacher: Vad är det som är tråkigt Louise? *Walks across classroom* Louise: Eh. Eeeh. Lite... *Unintelligible* Louise: Asså det är liksom *Unintelligible* man ska piffa upp den lite. Teacher: Okej, hur tänkte du då? Louise: Typ bokhyllor, men dom måste – dom är liksom så himla stora. Teacher: Ah. Men tror du att det var, om man tänker på hur det var på den här tiden i klostret.	Adam: Tar man ut hinkar med vatten? *Giggles* George: Och sätter ut mer vatten? *giggles* Marcus: Nej jag tanker inte sätta ut mer vatten... *Laughs* Adam: *unintelligible* *Mouse clicks* George: Jag trodde det skulle funka. *Mouse clicks* Marcus: Det funkar. Miley: *shouting from accross the room* Funkar det Marcus? George: Du sätter ju tillbaka vattnet. *giggles* Miley: Du täcker för det.	Louise and Julie are (still) having a hard time coming to terms with the lack of precise fidelity of game objects. The game objects are a bit too 'modern'.
05:00	Dylan: Jo när jag får Minecraft sen så ska jag försöka bygga hela våningen. *quiet, unintelligible whispering between Dylan and Ernest* Dylan: Vi behöver göra nått fusk eller nått. Jag vill ju göra pappas bidrag. (tough to make out the end) Ernest: Moahahahaha.	Louise: Alltså det var nog ganska tråkigt. Teacher: Men ni har ju rätt i att - böcker fanns det ju. Louise: Aaa. Teacher: Annars är det inte så mycket man kan... de åkte ju inte direkt till [Local home decore store] och köpte dukar och krukor liksom. Julie: Nej. Louise: Nej. Teacher: Så jag förstår hur ni tänker, att det ser lite tråkigt ut... Men det kanske måste vara så? Louise: Aaa.	Adam: *Laughs* Du tar ju inte ens upp vattnet. Klicka en gång. Miley: *shouting* Eller är det i det här... Marcus: YOLO! Miley: Vad gör du? *Mouse clicks* Marcus: Nej... George: Du tar ju inte upp *laughs* Marcus: Okej det här går inte bra... George: *Laughs* Marcus: Det får va så.	Miley provides a nice contrast here to Louise and Julie – she is more wrapped up in playing around with game mechanics.

When all the game-based exercises had been concluded, and the transcripts completed, the amassed set of transcripts was subject to thematic analysis. Briefly summarised, thematic analysis is a method that can be used to codify, analyse, and describe predominant and interesting patterns that emerge across data sets (Braun & Clarke, 2006). In thematic analysis, a 'theme' captures something important about analysed data in relation to the posed research question; in my case, themes would thus relate to various ways in which the used educational game affected students' and teachers' work and collaboration processes during formal educational activities. A theme could, for example, be 'exercise disappointment', which captures how students could sometimes be disappointed in the educational game, either because the design of the game-based exercises made the game less fun, or due to 'game disappointment' which was caused if the game's content or the used hardware failed to match students' expectations. Following the guidelines provided by Braun and Clarke (2006), themes such as these were the result of a six-step process of transcript analysis (shown in Table 12.4).

Table 12.4: The six steps of thematic analysis, as described by Braun and Clarke (2006), along with a description of how the process was applied during this research.

Phase	Description of the process	Application during this research
1. Familiarising yourself with your data:	Transcribing data, reading and re-reading the data, noting down initial ideas and interpretations of the data.	By both transcribing and participating in the interviews and game-based exercises from which the data was produced, I became very familiar with the data and produced ideas and interpretations throughout the research process.
2. Generating initial codes:	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.	By processing the data, re-listening to recordings, and reading through transcripts, some initial codes of how students behaved and talked during game-based exercises, and how teachers worked during them, were established.
3. Searching for themes:	Collating codes into potential themes, gathering all data relevant to each potential theme.	With the codes established, some unifying themes between them could be identified. For example, codes capturing different types of engagement and frustrations students displayed, and the various roles teachers took on during exercises could be collated into a set of themes.
4: Reviewing themes:	Checking if the themes work in relation to the coded extracts and the entire data set, generating a thematic 'map' of the analysis.	The themes were honed as I re-visited the data set with the themes as a 'lens'. Some themes could not account for certain data excerpts, in which case the old themes were modified or new ones were established to accommodate them.
5. Defining and naming themes:	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells; generating clear definitions and names for each theme.	By looking at the 'story' told by the themes, and especially by how the themes were distributed throughout the data-set, the themes' roles in telling the 'story' of the educational game use processes could be defined.
6. Producing the report:	The final opportunity for analysis. Selection of vivid compelling extract examples, final analysis of selected extracts, relating back to the analysis to the research question and literature, producing a scholarly report of the analysis.	Choosing excerpts to include in this thesis came down to reflecting on what aspect of the educational game use I wanted to describe, and then turning to the data set to select transcript excerpts that encapsulated the nature of said aspect well.

To exemplify the process, I will describe the generation of the 'game disappointment' and 'exercise disappointment' themes below. As seen in the six-step guide, the themes were established after I had made an initial generation of codes. Codes are smaller data items that are found across a data set and that appear interesting to the analyst (Braun & Clarke, 2006); in the case of the 'disappointment' themes, relevant codes in the data could be that students compared the educational game with games they play at home (e.g. comparing the game content to that of other games), students being disengaged with the exercise (e.g. students sighing a lot or being quiet), or simply that students vocalised disappointment with the game-based exercise (e.g. "this sucks" or asking to do something else). When expressions that matched these codes started recurring and becoming prevalent enough in the data set to be considered a significant part of the game-based exercises, they would be grouped according to over-arching themes they were related to (e.g. 'engagement', 'expectations', or 'negative talk') that would subsequently be reviewed and refined into more concise themes (such as 'exercise disappointment' or 'game disappointment'). These themes would subsequently be examined together to examine how they, in Braun and Clarke's words, "fit together, and the overall story they tell about the data" (2006, p. 21). The two disappointment themes 'told the story' of students sometimes being frustrated or disengaged with the exercise and the game, and the codes making up the themes explained how and why these frustrations occurred and were expressed.

At the end of the thematic analysis process, a set of these types of themes had been generated. These could then be used to re-visit the transcripts to choose transcript excerpts that could be used to exemplify different ways in which students and teachers used, played, and reacted to educational games during game-based classroom activities. The same process was applied to the transcribed interviews with educators, but then with different codes and themes. For example, teachers could make statements that, when coded and aggregated across interviews, could lead to themes relating to concerns about the educational game's accessibility, technology reliability, or excitement about trying something new. The transcript excerpts from the game-based exercises and the interviews with educators found in the results presentation below were chosen through the use of themes generated by the described method of thematic analysis.

12.2 THIRD PHASE CASE STUDY RESULTS

The third phase of case studies was, as previously mentioned, the most in-depth examination of how game-based learning processes can be established and maintained in formal educational settings. In total, the project spanned a period of ten months: five months of preparatory interviews and meetings with teachers, followed by the implementation and execution of a five-month long game-based learning curriculum. The study included two classes of students at a municipal school in Sweden: one 5th grade class with 24 students, and one 7th grade class with 22 students. For these studies, the project was initiated by discussions with a principal who directed me towards teachers that he knew were interested in using games in their teaching. After initial meetings with the principal, I was first introduced to two 7th grade teachers (Teachers E and F) with whom I started discussing different ways of implementing game-based activities into their math classes. A few months later, the 5th grade class was added to the project, as I was contacted by two more teachers (Teachers G and H) who were interested in using *Minecraft* to teach history.

I would also like to reiterate the thoroughly collaborative nature of these game-based learning projects. During the research, I did not passively observe the projects as they unfolded, and I played an important part in their execution at several junctures. However, for this thesis, I argue that the interventions made by me are ones that the teachers would also need to make, in order to integrate games into their classroom environment. All interventions were discussed with teachers before they were made, and the interventions served project goals that were established in close collaboration with the teachers. The tasks involved in integrating the educational game into the formal educational settings are likely to be necessary in any game-based learning project, and thus the tasks performed by me are analysed from a teacher's perspective.

By collaborating closely with these teachers and by observing and participating in game-based classroom activities in a more 'representative' context than in the study conducted in phase two, while also employing more structured and rigorous methods of documentation, these case studies provided more in-depth insights into the processes involved in conducting game-based learning projects in formal educational settings. Here, the data gathered from regular interviews with teachers, logs of the tasks performed in establishing the technological infrastructure for the game-based curriculum, and observation protocols and recordings from classroom exercises are presented. The outcomes of this study shares many similarities with the previous case study in phase two, but some of the concepts revealed previously are here described in more detail as a result of the more in-depth research process.

12.2.1 INITIAL INTERVIEWS WITH THE PRINCIPAL AND THE TEACHERS

The interviews and meetings that initiated the project played an important part in setting the scene for how the game-based curriculum would be implemented and designed. The initial interviews with the principal produced similar responses as the previous interviews held with Principals A and B. His primary concern was that the educational tool would exclude the teachers from the teaching process. One of Principal C's main concerns regarding new educational tools was that they:

> "[…] would be a… it would be if the tool is too dominant. That the teachers aren't teachers any more, but instead just become the conveyors of a textbook, for example… that the textbook author completely takes over the teaching in the classroom. Of course, textbooks are useful in certain contexts, but they should not be allowed to take over the planning and working processes of the classroom."

This concern is akin to previous concerns raised by principals in regards to the 'opacity' of games as educational tools: the principal was adamant about not implementing intractable educational tools with fundamental functionality, content, and ways of administering subject matter information that were inaccessible for teachers to control and redesign. Beyond these concerns, the principal also stated that the amount of resources required for purchasing and conducting maintenance on the game software and hardware for game-based activities would be the primary practical obstacle that may prevent them from using games: "the only limiting factor is the economy. In the end, the price-tag is what might put an end to employing a certain educational tool."

Other than these general concerns, the principal had a very hands-off approach when it came to the practical execution of the GBL-projects. Again, his chief concerns regarding the practicalities of the teaching tools were the amount of effort and resources required to purchase and maintain them. He trusted in the teachers' abilities to transform almost anything into a useful educational activity, and the only direction or request he posed was that the material itself needed to enhance or modify the teachers' craft without controlling it. Thus, the educational games were not judged on particular traits of the games medium, but were rather considered as an extension of the teachers' pedagogical vocabulary, just as any other educational tool.

After initial interviews with the principal, he connected me with a couple of teachers that he knew were interested in trying to conduct a game-based curriculum. The first meeting was held on the 17th of June in 2014 when Teachers E and F and I gathered as a group to discuss how our collaborations could be structured, and what types of subjects and classes the game-based curriculum would be suitable for. As with previous projects, the teachers had little prior experience with educational games. Therefore, discussions mainly focused on the teachers presenting learning objectives they would like to pursue (mathematics and geometry), and I presented some ideas and concepts regarding how they could be implemented into game challenges. I wrote up a short guideline with suggestions of different games that could be used for the chosen learning objectives, and gave the teachers some time to read through it and familiarise themselves with the different games. In the end, as is so often the case, we chose *Minecraft* as the most suitable game for the learning objectives we were pursuing.

After five months of back-and-fourth with the teachers and the principal through email conversations and meetings, the practical preparations for the game-based curriculum started in November 2014. Around this time, however, Teacher F could not continue with the project. A few months prior to this, however, I was approached by two other teachers (Teachers G and H) that wanted to use *Minecraft* in their 5th grade history curriculum. To compensate for the loss of Teacher F's class as a case, I started focusing my efforts on collaborating with these new teachers, and employed the same process of interviews and meetings to start planning a game-based curriculum with them. Thus, the case studies ended up including a 7th grade class as well as a 5th grade class, as described earlier.

Similar to the interviews held with the principal, the interviews held with the teachers throughout the project's initiations both ratified outcomes from previous studies and revealed some new perspectives on educational game use. Here, the different talking points are categorised according to some of the overarching interview questions that were asked.

Question: What has raised your interest in starting to work with educational games?

Follow-up: If there was prior interest, what prevented you from working with educational games before my involvement?

For this study, I wanted to examine whether the impetus for working with educational games had been generated by my involvement or whether the teachers had explored the subject on their own previously. The teachers had quite similar responses to why games seemed interesting to work with and what obstacles they experienced in starting to experiment with educational games as teaching tools on their own. All teachers had explored and thought about games earlier, but cited the high barrier to entry – consisting of both practical as well as more intangible challenges - as the main reason why they had not started working with them on their own.

Teacher F stated that he had been thinking about using games from seeing his own children play games at home and reading about games in teaching magazines. He said that he had often seen games as "potentially useful, but they would take too much work to even begin using". Similarly, Teacher E said that he had been seeing more and more articles about games in teaching magazines, and specifically *Minecraft*, and how they could be used in classroom activities, and always thought it sounded interesting and had long wanted to try it out: "Yes, [my interest] has been there. It's been… well you always read in, in the literature… or in teachers' magazines about how you can use [games]. And it was an article, I think in the latest 'Skolvärlden', or 'Lärarnas Tidning', about how you use Minecraft. […] when you read these different articles, you start becoming interested in 'oh, is this something we could make use of [in our school], and how would that work?'."

The 5th grade teachers had similar previous knowledge of educational games from articles and from seeing their children play at home, but their motivation to start using them was more heavily influenced by previous discussions and experiences they had with their own students. Teacher H stated that "it feels like the students bring up Minecraft in every other class discussion we have", and Teacher G said that "As soon as I said 'Medieval Ages' [during a lecture], the students were really quick to bring things into the classroom and show off the monks and castles and things they had made [in Minecraft]." They had also received an unsolicited one-page essay from a student who had conducted his own poll of his classmates to show that the class was interested in starting to use *Minecraft* in school activities. In the essay, the student also presented some of the educational benefits of using the game.

As there had been previous interest in working with educational games, we also discussed the reasons why they had not started experimenting with them prior to my involvement. Here, all teachers brought up a combination of limited working hours, resources, and their limited familiarity with games as the primary obstacles. These factors made the threshold for using games even in smaller scale projects feel too high to tackle without some significant forms of assistance from the institution or a third party.

The 5th grade teachers also said that the students' interest had led them to ask their school's IT department if they could acquire some *Minecraft* game licenses for classroom use, but that the teachers had been told that the licenses would be too expensive and too laborious to install and maintain. For the 7th grade teachers, their already extensive work load was a huge obstacle to starting to work with educational games. Since they were unfamiliar with the practicalities of educational games, the work needed to become experienced enough to be able to make gaming activities into a reliable educational tool seemed somewhat overwhelming. As previously stated, Teacher F had felt that he saw games as being "potentially useful", but also that "they would take too much work to even begin using" and that the threshold for getting into games and exploring their educational uses, even at a fairly rudimentary level, was too high: "On my own, I'd never be able to make this happen. That's just the way it is. So it feels like a great help to get assisted in this way."

Echoing the statements made in earlier interviews with educators, the issue of educational games' 'opacity' as teaching tools was also brought to the fore. The practical tasks of acquiring a game and implementing it into the classroom environment was seldom specifically brought up as the main concern keeping teachers from using them, but rather the effort required to build up enough expertise with games, in order to be able to use and adapt them to their own and their students' needs. In one of the interviews, Teacher E elaborated on this challenge:

Excerpt from interview with Teacher E

Teacher E: It is probably getting the time to do it, to get acquainted with… how I can… Well, on one hand I have to make it 'my own' kind of, that I understand how it works – and then the next step is to find ways of adapting it to my classroom. That is to say 'how can I make this work, and what is it I want to achieve by using it?'

Researcher: So you want to be able to be a part of the game process yourself?

Teacher E: Yes, exactly. I want to have control over it by understanding how things work – and I also have to see the purposes that the games can be used for, the goals.

Later in the interview, Teacher E added some more details regarding how much working time he was able to spend preparing for individual lectures:

Excerpt from interview with Teacher E

Teacher E: One lecture? Yes, I have quite a bit of room to redistribute my time in preparing for lectures, so if I want to focus on one in particular, then I might devote two hours on it, that's a possibility for me… But, that means that I might have to treat the other classes a bit 'step-motherly' ('step-motherly', i.e. treating them nonchalantly).

Researcher: Ah, ok. So, for planning, your familiarity with games could become a bit of an obstacle?

Teacher E: Oh yeah, like, my familiarity with games is absolutely zero, you know. So, for me it is a matter of learning the basics, just so that I can start planning anything at all.

Teachers G and H had similar reservations that kept them from experimenting with educational games on their own. Teacher G had some familiarity with games and *Minecraft* as her children played it at home, but Teacher H professed to have little to no familiarity with games in general. As previously mentioned, the impetus for working with educational games was highly informed by some of their students who had repeatedly voiced their wishes to use *Minecraft* in school. For the teachers, educational games and *Minecraft* seemed intimidatingly 'alien' to start using on their own, and as with the other teachers it is unlikely that they would start using educational games without my involvement.

The obstacles brought up by the teachers were also described by the principal in broader terms. The principal professed to have been part of a game-based project earlier, where *Minecraft* had been used in a special education setting (similar to my own previous case studies). While the project did have positive outcomes, he noted that "… it left no ripples on the pond", meaning that the project never progressed from being an exercise designed for an individual student's needs into a more codified, institutionalised practice that could be applied in other educational settings. Echoing the statements made by the teachers, the principal also noted that he had seen a growing interest in the pedagogical community of using educational games, but also acknowledged that educational games were difficult to start working with, due to the time that teachers had to spend developing their knowledge in other ways. Furthermore, the principal stated that the institutional support structures needed to give teachers a safe way to start working with educational games had not really been established yet:

Excerpt from interview with Principal C:

Researcher: What do you think have been the main obstacles for starting to work with educational games?

Principal C: … we need to understand [game-based learning] from an organisational perspective. In part, there is currently a lot of talk about digital tools in general, and that takes up a lot of time and energy right now – how we're going to integrate that. Then it's also the knowledge, that there are a lot of things you need to absorb. I don't think it has anything to do with 'resistance', but rather a lack of knowledge and a different set of priorities.

Researcher: So there is not really resistance, but other challenges standing in the way?

Principal C: I think that teaching is a difficult craft. And I want to think that it's mainly about not wanting to treat the classroom as an experiment laboratory, and that the teachers might be a bit uncertain themselves and not want to test their lack of knowledge on their students' expense. […] Many [teachers] see this as something interesting – but there aren't any colloquiums that support these processes, which makes it a bit scary to take the plunge [into educational games use] on one's own.

In summary, the teachers and the principal were uniformly positive towards educational games, and had prior interest in working with them before my arrival. Teachers G and H were somewhat divergent in that their impetus had been strongly influenced by hearing their students talk a lot about *Minecraft* in particular, and they did not directly cite articles or other discussions as being big contributors to their interest. The teachers also all stated that the biggest barrier to starting to explore their interests was the practicalities involved in working with educational games, coupled with their own limitations when it came to gaming and technology literacy.

Question: What are you main ambitions with this project, what do you want to achieve and get out of it?

After discussions regarding the backgrounds of why they were interested in educational games, as well as the more prevalent obstacles preventing them from pursuing those interests, I would transition into questions regarding what they hoped to get out of their educational game use together with their students and what they wanted to achieve with this particular project. Here, the teachers emphasised slightly different things.

Teacher F was hoping that using educational games would increase students' enjoyment of classroom exercises: "Well, it is the joyfulness you want to get to – it's that way you hope your teaching can be built and work, that the students will just want more and more… and we are not really there right now *laughs*". The teacher also added that this enjoyment was not an end-goal unto itself, but rather a means of showing the students that he was willing to work with them on their terms. By adding an additional "tool in his repertoire", he felt that he would have yet another way to help students attain learning goals, and that it would show students that there are many ways in which one can pursue and accrue knowledge: "I want to see that it is a tool that helps students to reach a higher understanding [of subject matters]. […] And maybe that I will be able to create a positive 'happening' around learning, that the students can see that there are many ways to achieve learning- and that I, as a teacher, keep finding new ways of helping them learn."

As we were intending to work in the area of geometry and mathematics, the discussion centred on how *Minecraft* could be useful as a teaching tool in those particular subjects. Here, Teacher F felt that he immediately saw a connection between the game and exercises he usually had with his students:

> "The immediate area of application feels like geometry and spatial geometry. The only… The only things we do are physics stuff when we do labs with water and stuff like that. But here there might be an opportunity to walk around in a three dimensional environment, to actually

> see what area and volumetric scales look like, that it is cubic, like it is in Minecraft for example.”

He then added that volume and three-dimensional objects were something students tended to struggle with. In accordance with recent changes in the Swedish mathematics curriculum, spatial geometry was now starting to be taught to students one year earlier than in previous years (in the 8^{th} grade instead of the 9^{th} grade), and the teacher had noted that some students struggled with grasping three-dimensional geometry calculations. Thus, *Minecraft* could be a useful tool for conveying spatial geometry, as it had some qualities that might circumvent some of the issues they had encountered with other teaching materials. Again, he saw educational games as another potential tool with which to convey an aspect of a subject matter, and wanted to find ways to incorporate it in his previous practices and use in parallel to other types of exercises.

Teacher E had similar ambitions for the project, and also saw it as a way for him to potentially add another teaching tool to his current working processes that may help him achieve better results as a teacher: ”... increased classroom results, that is one part of [what I want to achieve]. Then, of course, that is also combined with my own thing, it is a form of competence development for me too, to be able to get into a game and see how you could use it.” The teacher also clarified that using games was not something he did in an effort to tackle any current issues he had with his teaching or with student results, and said that: ”It’s more that... it feels like games could be... It feels like games could be an appropriate tool, and that I as a teacher feel – like ’well I’m sure I could use this, use games in a good way’.” Again, similar to the other teachers, heavy emphasis was put on considering educational games as an additional tool that could be useful for certain types of exercises where current mediums used (e.g. pen and paper, text books, or lab exercises) felt too constrained.

Teachers G and H also put emphasis on softer skills and did not focus as much on subject matter knowledge outcomes of the educational game activities. Primarily, they saw that collaborative work in *Minecraft* could be a good way for the students to experience more ‘democratic’ working processes, and to learn how to establish goals together, delegate tasks between one another, and compromise when necessary. In later questions, one of their primary concerns with using educational games was that some of the “bigger”, more game-proficient personalities could potentially dominate the tasks. While this was a concern, and something we would have to monitor closely during the project, the teachers also hoped that the game-based curriculum could turn out to be a good exercise in compromise and collaboration for them:

> **Excerpt from interview with Teacher G and H**
> Teacher H: This might be a way to learn how to work collaboratively, because you cannot really build something all by yourself in the real world, so this is a way to teach the students how to work together. To figure out who does what, and how they can work towards achieving what they want in the group.
> Researchers: To compromise and collaborate in a creative endeavour?
> Teacher H: Exactly

Principal C posed an interesting advantage he saw in games as educational tools, in that they gave little to the teacher “for free”. For him, an educational game, when it is incorporated with forethought by a teacher, has an advantage since it is unlikely to be specifically tailored to Swedish curricula demands and processes. This related back to his concerns with educational tools that take over the classroom, and games’ current non-conformance to classroom and curriculum processes could actually prevent this from becoming an issue: ”Games are such... standalone activities in a way. They make it necessary for the teacher to string game activities together in order to build their own teaching processes. A textbook can be followed for three years, and that might not be possible with a game."

Question: Do you feel any concerns or uncertainties when it comes to the game-based curriculum and with educational games as educational tools?

The first concerns that teachers had when it came to using games in the classroom were that the hardware would be unreliable and laborious to work with. The teachers themselves professed to having poor literacy in terms of technologicy use, and also very little time to dedicate to the necessary hardware and software preparations needed for the projects. This meant, as previously mentioned, that making sure the hardware and software worked essentially became my duty during the early phases of the project. Most of these concerns were, however, covered in the discussions surrounding the previous questions in the interview, but when exploring their concerns further, some other trepidations surfaced. Teachers were worried about the inclusivity of games as a teaching tool, and that a small group of more game-adept students would come to dominate the game-based sessions to the exclusion of less experienced players. Furthermore, the appropriateness of the tool and how students would perceive it was also cause of some concern.

In regards to the inclusivity of games as teaching tools, Teacher F said he was "... worried that the students who are not familiar with the milieu will have a hard time participating in the tasks. I suspect that the boys in the class are used to Minecraft, so I'm worried that they will nudge the others out of the exercises." He continued to say "I have made some mediocre attempts myself at my son's computer in order to try and *laughs*, and it's... yeah, it's this whole thing, when I was a kid you played with a controller or something with a little button, and now they work with keyboards and mice and these 3D-environments". These concerns and observations were echoed by Teachers G and H who also predicted that some of the students in the class, who were adept Minecraft players and had more dominant personalities, might end up taking control over the game-based sessions.

Teachers G and H often talked about the dynamics of their class as something that needed to be considered during the game-based exercises. It should be noted that the class dynamics or individual students were not always brought up in a negative light, but rather as aspects to keep an eye on and to consider when creating exercises and establishing the students' working groups. The class had some more dominating personalities, which they called 'Me'-personalities, that were usually very adamant about exercises being done on their terms. The class also had students with needs that had to be taken into consideration as well:

Excerpt from interview with Teachers G and H

Teacher H: It's exciting, I think, when it comes to the bigger 'Me'-personalities. It's going to be really exciting.

Teacher G: Mhmm. Because the biggest 'Me's are already really good at Minecraft to begin with.

Researcher: Ah, okay. Mhmm, that is going to be interesting. Do you have a lot of those types of personalities? Are there lots, or two or three of them?

Teacher H: Big 'Me'-personalities... I feel as though we have two extreme ones.

Teacher G: Yeah

[...]

Teacher G: And then we also have very many different needs in the class... one with autism, and then some others...

Teacher H: Dyslexics, a few.

Teacher G: Yeah, and other types of difficulties.

Teacher H: Yeah, one with performance anxieties

[...]

Expanding further on these differentiating pre-conditions, Teachers G and H were also worried about the educational game causing some inequality in their student cohort, since students who had the necessary hardware and software at home would have more opportunities to work and prepare for game-based exercises. All students could not be expected to have those resources available at home, and thus they felt that they could not in good conscience construct a game-based curriculum that relied on any work outside of the classroom exercises. Thus, the teachers preferred it if the students could only play the game and work on the game-based exercises together when they were at school, and did not want to give students game licenses for home use, as it could be problematic. Handing out game licenses would become a school endorsement and encouragement for expensive hardware and software investments, which could potentially lead to problematic economic and social situations, both in the classroom and at home.

Teacher E did not echo these particular concerns, but was more worried that game-based exercises would not be taken seriously:

> "Yes, [my concern] is that the students won't... take it seriously. That they will think that 'now it's time for gaming', 'this is just play', or 'this isn't that important', and for that reason it might be important that [we] clearly state, before each class session, 'these are the goals we are working towards during this lesson'."

The teacher's worries echoed observations made in the previous case studies in phase two, where the difficulties of maintaining the educational 'frame' around game-based activities were encountered.

> **Question: What would you prefer my role to be during this project, what types of tasks and activities do you think you will need my assistance with?**

To see what type of assistance the teachers themselves felt they would need to create and conduct their game-based curricula, we also discussed and clarified my own role in the project:

> **Excerpt from interview with Teacher F**
>
> Researcher: So what do you think you will need help with from me? Would it be practical matters relating to tech-support, would it be tutoring you and the students in the game, or more along the lines of helping out with designing game-based exercises?
>
> Teacher F: All of it, help with every aspect of it would be much appreciated *laughs*. Of course, hopefully [we teachers] will be able to do some stuff too. But, [we need help] to discuss what would be reasonable, what we could feasibly do within our timeframe, and what kinds of exercises we could set up.

Similarly, Teacher E also felt that he needed me to spearhead the practical tasks of integrating the game into the classroom, as well as getting him and his students up to speed with it: "Yes, [I need help] installing the game – and to make sure that we get a hold of everything so that things practically work. And then also some supervision when it comes to 'getting us into the game', to understand the game concept and stuff like that" Teacher G echoed this sentiment as well, and wanted me to introduce their students to the game, in order to make sure that everyone would be able to participate in the exercises: "We have to consider that... That some of them barely know what Minecraft is. Can you show some of it, like on a projector or something along those lines? Just to introduce the game in general"

Similar to the phase two case study, the process of integrating the game into the classrooms and getting the teachers and students acquainted with the game enough to start working with it on their own became my responsibility. As opposed to the previous project, however, more emphasis was placed on preparing the 'human factors' surrounding the educational game, and teachers wanted to make sure that both they and their students were given ample opportunity to improve their familiarity with the educational game.

12.2.2 DESIGNING GAME-BASED EXERCISES AND CURRICULA FOR FORMAL EDUCATIONAL SETTINGS

Similar to the previous case study, the initial stages of a game-based learning project was devoted to examining the different kinds of learning objectives the teachers wanted to pursue and how they could be achieved through the use of an educational game. These discussions also had to be framed within the broader organisational context in which the project took place. As opposed to the looser educational framework of the previous case study, the curricula requirements, scheduling constraints, and class setups were significantly more formalised. As a result, practicalities, such as scheduling, curriculum demands, and hardware availability, dictated the design of gaming sessions to a much greater extent than in previous studies. In the class of 7th graders, the abundance of laptops, short period times (45-60 minutes), and the stricter demands and educational goals established in the curriculum made the teacher gravitate towards shorter stand-alone game-based activities. In the 'stand-alone activity' curriculum, students collaborated in groups of two or played individually on assignments with fixed start and end points, which allowed for easier assessments of students' progress as the game-based curriculum advanced. Viewing each classroom session as a stand-alone exercise also had the benefit of allowing for changes in the design of the game assignments, according to the rate with which the students became more adept at playing the game and the taught subject matter. The conditions were quite different in the 5th grade class where the period times were longer (90 minutes) and the curriculum goals a little less strict. However, the class had significantly less hardware available, which made it necessary for us to divide the class into two working groups of 11-12 students each. As the longer period times opened up the possibility of longer continuous play sessions, and with the 'softer' nature of the historical curriculum (i.e. focusing more on representation than calculation), we aimed to construct a game-based curriculum focused on letting the students recreate iconic historical environments. Thus, a long-form collaborative classroom exercise was chosen for the 5th graders, where each group built one larger historically accurate environment and society, during the entire game-based curriculum.

The constraints imposed by different curriculum demands and scheduling also played a deciding role when it came to choosing the type of game to work with. For Teachers E and F, *Minecraft* was chosen partly due to its modular nature and accessibility; the game's focus on emergent 'sand-box' play makes it possible for teachers to model gaming challenges after their own educational goals and working conditions (i.e. the game is easily customisable); it runs adequately even on older computers; and it is a title most students are familiar with, thus lowering the entry barrier for many of them. These benefits outweighed the potential drawbacks of the game, such as its low physical, functional, and visual fidelity. For example, it is difficult to create spherical objects in the game (as its gameplay centres around the manipulation of large voxels), and objects sometimes have little visual resemblance to their real-world counterparts. However, while these types of drawbacks presented some challenges, they were not a major source of concern for the teachers at the outset of the projects.

The pre-existing organisational structures were, in other words, heavily influential when it came to establishing our working processes, the general structures of the game-based curricula, and even in the choice of the educational game we would work with. By organising the 7th graders' curriculum as a series of stand-alone activities, the teacher could exercise more control in how the game-based activities were designed and paced, as he could assess students' progress and reception of the educational game. Furthermore, the approach allowed him to iteratively become more comfortable with the educational game himself, and an unsuccessful session would not be too detrimental to the curriculum as a whole, as issues could quickly be ameliorated for subsequent sessions. The 5th graders' use of the game was, in a way, slightly more ambitious, since it focused on working towards one large creation, rather than a series of smaller ones. While the students' working processes were continuously assessed during the 5th graders' bigger project, the tasks could not be as easily 'isolated' and it was somewhat difficult to change students' working directions or assess whether all students were progressing at a similar pace. For this reason, there was also less scope to create more 'honed' introductions or repetitions of subject matter details throughout the project. Figure 12.2 shows the basic differences in project structures between the two working processes.

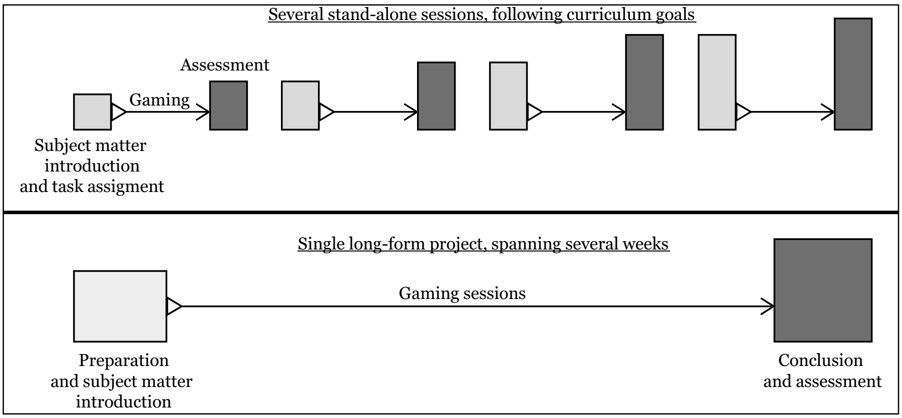

Figure 12.2: Overviews of the game-based learning projects. The long-form project spanned several weeks of gaming sessions, and more work was done before and after the project to contextualise game content in the subject matter. The stand-alone sessions were more beholden to curriculum demands, and were characterised by smaller assignments, progressively increasing challenges, and continuous assessments of students' subject matter knowledge (the increasing challenge/knowledge is symbolised by the increasing box sizes).

After our processes of collaboration with the teachers and the establishment of the over-arching curriculum design, the shape of the game-based classroom activities could be designed in more detail. Naturally, the designs of the individual game-based activities were tailored, to a great extent, to the chosen outlines of the entire curriculum. For the 7th graders, the game-based sessions were designed around the iterative introduction of new subject matter content based on the assessments of the students' progress. In practice, this lead to classroom sessions that had a three-part structure:

1. Introduction of new subject matter details (or repetition of previous content when necessary) and the game-based challenge of the day.
2. Students' tackling the challenges in the educational game.
3. A summary of the day's activity with students' showing off and discussing their work.

The actual game-based exercises were thus bookended with contextualisation provided by the teacher and classroom discussions of the subject matter. In this way, we hoped to establish a process where we could slowly increase the complexity of the game-based challenges. The introductions were conducted in prepared *Minecraft* worlds that contained different examples of the types of geometric shapes and calculations the students would be working with for the day (see Figure 12.3). The teacher and I projected the game on the classroom wall, and a fairly straight-forward introduction was held in which the teacher talked about the principles behind the prepared geometric shapes. Students were invited to help calculate dimensions and scales of the different objects, and the game environment could be navigated to show different angles and perspectives, or show, in real-time, how the geometric shapes could be built in *Minecraft*.

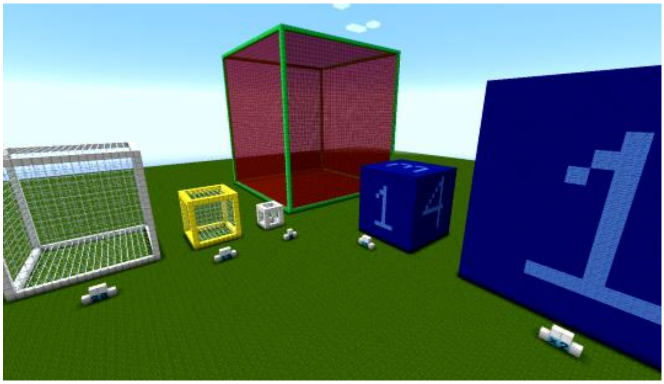

Figure 12.3: An example of a game-world that demonstrated volumetric scales. To the left, a "golden cube" was enlarged and minimised (in this example, 8:1 and 1:8 respectively), and to the right a 6-sided dice (that the students measured in the real world) was recreated and upscaled.

This setup of the game sessions served the purpose of slowly introducing aspects of the game to the students in tandem with subject matter content. By directly coupling the subject matter to in-game visuals, we hoped to show students how *Minecraft* looked and how the students themselves could implement geometric principles into the game during the game-based challenges. The iterative and stand-alone nature of the sessions also allowed me and the teacher to adapt our goals to the curriculum, according to our experiences of conducting the game-based activities. Thus, the ultimate end to the curriculum was not precisely defined at the outset, but rather emerged from our observations of what students responded well to and how quickly their knowledge of the subject matter content increased. Early exercises were very straight-forward, and the student groups worked to construct different types of geometric shapes and calculate their length, area, and/or volume. As the curriculum progressed, the tasks became increasingly more advanced and finally culminated in students producing scale replicas of real-world objects (e.g. buildings, furniture, countries, etc.).

The 5th grade class's exercises worked very differently in that new subject matter details were not explicitly introduced as part of the game-based lessons. For this game-based curriculum, the end goal was established at the outset, as we wanted the students to create iconic medieval environments and societies (shown in Figure 12.4). An important pre-requisite for this curriculum was thus that the students needed to be given ample time to familiarise themselves with the subject matter before the game-based activities started. The early plans of the students' creations would lay the foundation of the continued exercises; therefore, a lack of knowledge in the early activities could be detrimental for the long-term success of the over-arching exercise. Thus, rather than bookending individual sessions with introductions and debriefings, the curriculum itself was initiated with various 'regular' exercises to acquaint the students well with the subject matter. After this initial familiarisation process, the students' acquired knowledge was used as a foundation for planning the details of their historical recreations.

Figure 12.4: Two screenshots of the student groups' finished projects. The left screenshot is of a recreation of a medieval castle, with a smithy, stables, and living quarters. The right project is a recreation of a medieval monastery, with adjoining farms and stables. Both projects used imagery and descriptions from history textbooks, novels, and films as a foundation for the design of their creations.

As opposed to the 7th graders' series of stand-alone exercises, the 5th graders long-form project had a pre-established goal which the students slowly built towards during the entire game-based curriculum. The curriculum did not have any explicit methods of assessment regarding the students' progress, but the teacher and I instead supervised their collaborative work and guided it when necessary. Instead of piece-meal introductions of specific subject matter details, the students had to continuously use their subject matter knowledge to inform the designs of their creations and were encouraged to seek out more knowledge if they were uncertain about how to build something. Progressing through learning objectives thus became partly a collaborative exercise, but was also driven by individual student's own needs and interests. This curriculum and exercise design was intended to pursue the teachers' ambitions to both have the students recreate and explore history, but also to have them collaboratively create goals for themselves and their group, as well as to learn how to compromise and follow 'democratic' working processes.

To summarise, the curriculum designs were generated by discussions and reviews of the constraints and possibilities afforded to us through pre-established organisational frameworks. The mathematic gaming curriculum focused on increasing students' understanding of geometrical objects and calculations, by letting them manipulate and construct those objects first-hand, and the historical curriculum focused on letting students experience and reflect on the taught subject matter through re-creation and re-enactment. These broader curriculum outlines were then used to inform the designs of the individual game-based activities. Thus, the project was initiated in a similar fashion to the case study in phase two, but the longer period of planning and initiation enabled us to be more deliberate in our execution, which was important, given the more formalised demands placed on the teachers. The execution of the curriculum in this later research stage revealed certain benefits and shortcomings of both of these approaches to the game-based curriculum, which are soon described in more detail.

12.2.3 THE PROCESS OF INTEGRATING THE EDUCATIONAL GAME INTO THE ORGANISATION AND ITS WORKING PROCESSES

The practical tasks involved in integrating the game into the classrooms were, as was the case with the previous case study, quite demanding. As revealed during initial interviews and meetings, the primary concerns for all the teachers were: the uncertainty of hardware reliability and availability; the teachers' self-admitted poor gaming and technology literacy; and the limited number of working hours they could feasibly spend on preparing for classroom gaming sessions. This left me with the primary work load of establishing the educational game environment, and the two different types of classroom setups proved to present a widely different set of difficulties throughout the project.

Since the characteristics of the two studied classes differed in many ways, the actual processes of software installation and hardware preparation differed somewhat between them as well. Generally speaking, however, both educational environments necessitated the same series of integration steps that were experienced in the previous studies (as presented in Figure 10.3). An initial period of taking inventory of the available resources and organisational structures, as well as the students' needs and abilities, preceded the implementation of hardware and software and the creation of processes for conducting maintenance on the necessary resources.

Integration started with an inventory of the current state of the educational environment and the organisational processes and structures around it, an examination of the human factors that would be relevant to the project (e.g. parents' attitudes, students' needs, and teachers' requirements, concerns, and working processes), and a review of the technological infrastructure and available hardware. As previously mentioned, there were few obstacles, in terms of resistance or averseness to using educational games, and teachers reassured me that neither the students nor their parents would take issue with the project. Teachers had previous opportunities to inform parents about the project we were embarking upon, and we also composed a document for parents where I presented myself, what I was researching, and what type of data I would collect and how it would be treated. The human factors that needed some cultivation were primarily the teachers' own familiarity with the used game, their grasp of the technology required to use it, as well as making sure that students were given an opportunity to ask questions and familiarise themselves with the game. Taking a lesson from the previous case study, however, this time I attempted to establish a more robust system for conducting software and hardware maintenance and aimed to help teachers become more adept at using it. Once the teachers and I had a unified view of the conditions we were working under, and how we could construct a game-based curriculum around them, the process of preparing hardware and software began.

While few organisational support structures were available to us during this process, there were other facilitating circumstances that made the process of integration easier. Mainly, the teachers recognised that the presence of students who were very familiar with *Minecraft* would function as a useful resource during the process of implementation. The teachers' predictions that these students would be a valuable resource rang true during both my own work in establishing the educational gaming environment and in the game-based exercises conducted throughout the project. A few of these expert students, particularly in the 5th grade class, were able to provide valuable assistance to teachers and their classmates when they had technical issues or trouble understanding certain details of the game.

Table 12.5: A summary of the steps involved in the three different phases of integrating and using game technology in an educational environment. Some steps were not applicable to both classes (the dots mark whether a step was necessary in the corresponding case).

	Activities	7th grade classroom	5th grade classroom
Inventory	Take inventory of available hardware/resources	●	●
	Evaluate student profiles		●
	Examine curriculum goals	●	●
	Examine game software	●	●
	Establish educational goals for the game-based project	●	●
	Pull in organisational support structures	●	●
Implementation	Prepare the technology infrastructure		●
	Purchase game licenses	●	●
	Installation of software	●	●
	Prepare the classroom environments		●
	Prepare the game environments		●
Maintenance	Maintenance	●	●
	Setting up servers		●
	Preparing in-game subject matter content	●	
	Saving games and managing backups		●
	Tech-support during game sessions	●	●
	Closing down lessons		●
	Hardware maintenance		●
	Patching and software maintenance	●	●

The stand-alone exercise design chosen by the 7th grade teacher alleviated the need to prepare the hardware and game environments in which the students conducted their game-based exercises. As the students in that class also worked on their own computers, the classroom and hardware itself could not be specifically prepared before the game-based curriculum started. I was informed of the computers' hardware specifications so I could be assured that they could run the game adequately, but the actual preparation of the hardware was not possible. Instead, we had to devote the first couple of game-based classroom sessions solely to installing the game on the students' computers. This process was longer, more intricate, and more prone to errors than I had anticipated. Installing a game on 22 separate computers was difficult and the task was made even harder by *Minecraft* needing online account registrations. Even though I had prepared step-by-step instructions regarding how account registrations and game installation worked, and provided students with their own game licenses, the students needed assistance with acquiring, installing, and starting the game into early February. The initial plan was to have the game installed in late December so that the students had an opportunity to test the game during the winter break, if they felt inclined to do so. During the first attempt, however, many students encountered unsolvable issues with online registration (an error on the supplier's side that we had no control over), and several problems with software updates and compatibility. Solving these issues on the students' computers individually took some time, but since we had structured the tasks so that two students collaborated on one computer, we could circumvent the issue. According to my own personal log of my interventions, the process of integrating the game into the classroom took approximately 395 minutes, which were distributed accordingly:

Table 12.6: Tasks involved in setting up the 7th grade classroom.

Activity	Time spent	Date	Comments
Acquire software (for teacher)	50 minutes	11th of November	After initial interviews with the teachers were done, the game software was acquired and distributed to the teachers.
Acquire software (for students)	50 minutes	9th of December	After giving the teachers a chance to test the game, and discussing the curriculum design further, game software was acquired for the students.
Preparing for class introduction	180 minutes	11th of December	In preparation for the first classroom session, a step-by-step installation and game registration guide was written, and game codes were printed for distribution.
Classroom time – installing software	70 minutes	18th of December	The first session spent on installing the game software – lots of issues were encountered, many of which were unsolvable.
Second classroom session – installing software	45 minutes	16th of January	After giving students a few weeks to see if they could fix the installation issues, a second classroom session was spent on game installation.

When the game had finally been installed on all of the students' computers, no further significant maintenance or preparation activities needed to be done. That being said, new or recurring issues with the game kept affecting individual students throughout the game-based curriculum. Even during the very last game-based exercises, some students had uninstalled their games (either accidentally or deliberately) and one student's game encountered a software compatability issue and did not start. This is one of the reasons why the exercises were collaborative, and why two students did their assignments on one shared computer; if a group had issues with one of their computers, they still had a back-up laptop to work on, which reduced the "fragility" of the game-based exercises. Since the students in the 7th grade class had their own hardware and the curriculum was designed in a way so that the student groups worked on their own worlds during their assignments, no system for establishing servers or saving and keeping backups of game data was necessary. However, as the stand-alone sessions followed a steady progression of challenges, the classes required a different type of preparation: the creation of in-game examples of the assignments we were going to work with during game-based exercises. This preparation process followed the same lines as in the phase II case study, as described in Figure 10.2. The teacher and I reviewed learning objectives and assessed the students' progress in achieving them, and in initial sessions I prepared in-game examples of how new learning objectives and subject matter details could be conveyed in the game. The teacher and I then workshoped these designs and subsequently put them to use in the next game-based exercise. The process of creating the in-game examples (excluding the time needed for workshopping and assessment) took around 25-40 minutes for each classroom exercise.

The processes of integrating the educational game and preparing for particular game-based exercises were vastly different for the 5th grade class. Since this class shared a communal 'pool' of laptops, I had easy access to prepare them before the game-based exercises were conducted. Having direct access to laptops for preparations outside of scheduled school hours made it easier to solve issues as they emerged on any of the used computers. As the computers were maintained by the school, and perhaps because they were not the individual property of the students, I found that they had less troublesome software and 'bloatware' to obstruct the installation process. Thus, before the first game-based session began, the game software could be installed and tested and the network connection between the computers could be tested and tweaked as well. As it was easier to conduct maintenance on these computers, they also suffered less from recurring issues throughout the game-based curriculum than the 7th graders' computers. The process of acquiring and installing the software before the game-based curriculum started took approximately 250 minutes.

Table 12.7: Tasks involved in setting up the 5th grade classroom.

Activity	Time spent	Date	Comments
Acquire software (for teachers)	15 minutes	16th of December	Software for teachers was acquired, this time the process was expedited as I had a better understanding of the purchasing system.
Acquire software (for students)	30 minutes	19th of January	After giving the teachers some time to get acquainted with the game, software was acquired for the classroom computers.
Installing game software on classroom computers	140 minutes	20th of January	To prepare for the start of the game-based curriculum, I visited the school to install the game software on all classroom computers.
Preparing a server setup and backup system for use during exercises	20 minutes	26th of January	When the computers had been found to work amicably, and after the game had been introduced to students in a briefing session – the game server system was tested and laid out in more detail.
Preparing and testing the classroom / computer lab for the first exercise	45 minutes	27th of January	In preparations for the first game-based exercise, I took the time to prepare the classroom / computer lab for the first session – collecting laptops and accessories, starting the server, and connecting all computers.

While the 7th graders' game-based curriculum required preparations of in-game examples and assignments before each classroom exercise, the design of the 5th graders' long-form historical recreation exercise posed different requirements. While in-game examples and specifically designed assignments were rarely necessary, the classroom exercises required hardware preparations. The communal pool of laptops needed to be collected and set up before every game-based exercise, as they were often scattered throughout the classroom and adjacent reading and working rooms in the interim. Gathering the laptops and their associated equipment, starting them all, and setting up the server with the correct game world, usually took 15-20 minutes before each exercise, and another 10-15 minutes were spent shutting the exercise down.

The two classes represented two different types of challenges with regard to educational game integration, exercise preparation, and maintenance. From a technology and hardware perspective, the case of the 5th grade class was akin to a computer lab (although it needed to be set up and dismantled for each exercise), whereas the 7th grade case constituted a technology-integrated full classroom environment. Such an environment alleviated the need for me or the teacher to set up the computers before each game-based exercise, but required longer, less predictable and more laborious preparations before the game-based curriculum could start. Important to note is that the full classroom environment was also significantly more expensive to prepare. As opposed to purchasing game licenses for a smaller number of communal computers, it required the purchase of 26 game licenses: one per student, one for the teacher, and three backup accounts in case something went wrong with other ones). The cost of equipping the classroom computers with the educational game was approximately 430 Euros, whereas the cost of equipping the communal computers (six student computers and one server license for the teacher's computer) was approximately 150 Euros. The 5th graders' long-form project required different types of technical preparations, as the teachers were required to prepare the classroom (or computer lab) themselves. Thus, the more practical preparations for each individual session were more of a factor during the game-based curriculum, but the preparations before it started were easier to carry out, as hardware was easily accessible outside of school hours.

The two different classes also differed regarding their demands on exercise design and preparations. The stand-alone sessions and iterative pursuit of specific learning objectives in the 7th grade class necessitated more explicit briefings and debriefings. The teacher needed to be able to introduce new subject matter details as the students progressed through the curriculum (e.g. introducing length scaling, progressing to area scaling and later volumetric scaling, etc.). This necessitated designs of particular assignments and preparations of in-game examples of new geometric principles that could be used when briefing the students. The assignments had to be kept short and easily assessable, as they needed to be introduced and carried out in a span of 45-60 minutes. As previously mentioned, the process of preparation for each exercise was similar to the one experienced in the case study conducted in phase two. For the 5th grade class, the preparations were quite different. While the teachers and I still assessed student progress, in order to ensure that everyone was able to participate and feel included in the game-based exercises, very little work had to be done, in terms of assignment design and preparations of in-game examples for the different exercises. All things considered, the integration of the educational game into the full classroom setup was fundamentally more uncertain and difficult. Not having direct access to student computers outside of classroom hours made it difficult to prepare and test game software before the curriculum started. Issues also continued to crop up throughout the curriculum, which could have disrupted the students' progress and ability to participate, if the game exercises had been designed for individual execution. The integration of the educational game into the computer lab, on the other hand, required preparations before each exercise and overall more work from teachers. The students' server needed to be started, their progress had to be saved, and computers put in place and started up. However, the process was more reliable and technical issues were less complicated to deal with, as easier access to the computers made maintenance significantly simpler.

In summary, using games for educational purposes necessitates processes for the continuous management and maintenance of the tools that make gaming sessions possible, as well as the preparation, assessment, and design of the game sessions as they are conducted. The properties of the educational setting and the resources it makes available to the teacher were found to dictate how the game-based curricula could be designed and conducted. Digital educational games are complex pieces of software that require advanced hardware to function reliably and efficiently. Setting up and orchestrating these components in a classroom environment, even for rudimentary game-based learning activities, constitute a significant time investment and require a high level of technological proficiency. The poor game and technology literacy of the teachers made it highly unfeasible for them to start any type of game-based learning, if it were not for a couple of ameliorating circumstances: the presence of the researcher and the teachers' access to several students who were very proficient in both computer technology and the game used. The process of game integration thus relied primarily on the researcher, and when the researcher was not present, the teachers could receive some assistance from the more technology proficient students in the classes, if they ran into obstacles they could not overcome themselves.

12.2.4 STUDENTS' INTERACTIONS DURING GAME-BASED CLASSROOM ACTIVITIES

Through observations made during the game-based exercises, briefings and debriefings held with teachers, and the processing of audio recordings from the exercises, interesting differences in students' behaviours during the game-based activities started to emerge. Just as some of the teachers had suspected in the initial interviews, a large discrepancy between students' gaming efficacy and attitudes towards the game challenges revealed itself early on in the game-based activities. For the 5th graders, differences in the students' familiarity with the game – and what they expected from the game-based curriculum – became apparent in the first introductory lecture where I presented the game to the class. This was captured in the observation protocol kept during the session:

> "… the experienced gamers take up a lot of space. There were a lot of questions regarding *redstones*[9], commands, skin plugins, modifications, what version of the game we were going to use, and things of that nature. And I mean a lot of them. Enough so that I had to step away from actually fielding those questions (the limit of fielding the questions was reached when they asked me to start building specific redstone inventions they knew the schematics of by heart). It was all a very showy display (mostly in a good way), where the experienced students wanted to show off to their class-mates through me and the questions they could pose to me."

It was, of course, encouraging to see that the students were excited by the prospects of playing the game, but also worrying that they focused so heavily on the manipulation of game mechanics and game rules without much thought of how we were going to use it as a tool for history recreation. However, once the questions regarding esoteric details of the game started to subside, more general questions surfaced that the whole class could more easily relate to:

> "They would start asking general questions regarding what the game could do, like 'are there horses in the game?' and 'can you tie up horses [to poles]?' or 'are there flowerpots and things in the game?' – and I think a really good sign is that they often tied their questions back to the subject we were working with. For example 'knights need horses, so it's good that we have them', or 'flowerpots might be good, since monasteries were kind of decorated'. I also tried my best to continuously tie game-talk and questions back to the taught subject."

This oscillation between game properties that were sometimes thought of independently and sometimes as highly connected to the taught subject matter was a recurring theme throughout the game-based curriculum. The expert players sometimes manipulated game rules and mechanics to show off, for fun, or to provoke the teacher or their classmates, but they could also enter certain frames of thought where they contextualised their gameplay strongly within the subject matter. The above excerpts show one way in which the students approached the educational game differently, but many more approaches were revealed during the actual game-based classroom activities, which are described in more detail in the following sub-chapters. To contextualise the different transcripted excerpts that are used to exemplify different types of student behaviours and characteristics, Table 12.6 provides a brief presentation of the students who participated in the exercises and a brief description of their general "profile" during the curriculum.

[9] 'Redstone' is a material in *Minecraft* that can be used as a conductor of the game's equivalent to electricity. It is a fairly complex material to use properly, as it is a rudimentary emulation of some basic laws of electricity, but experienced players can use it to create advanced machines and circuitry.

Table 12.6: A list of the students that participated in the game-based exercises. Students are described by their pseudonyms/aliases, followed by information regarding my perception of their game skill level, and brief comments of how they tended to work during the exercises. Game skill is described as either 'Very low' (inexperienced with games), 'Low' (familiar with games, but not with Minecraft) 'Medium' (good grasp of the basics of Minecraft), 'High' (adept player, knows of obscure game mechanics), 'Very high' (expert player, highly proficient in the game, good grasp of esoteric game mechanics and modifications).

Class and Group	Alias	Game skill	Comment(s)
7th Grade	Aaron	Very high	Subject matter and game proficient, took control of exercises
7th Grade	Alfred	High	Easily distracted, focused on game mechanics
7th Grade	Alice	Medium	Rarely played, but had good subject matter focus
7th Grade	Anne	High	Good at collaborating, kept her classmate focused in the task
7th Grade	Archer	Very high	Focused on game mechanics, prone to 'grief' play
7th Grade	Beatrix	High	Proficient and good subject matter grasp and focus
7th Grade	Casper	Very high	Often focused on gameplay, disinterested in subject matter
7th Grade	Esther	Medium	Rarely played the game, preferred to spectate
7th Grade	James	Very high	Proficient, easily distracted unless supervised
7th Grade	Johanna	Low	Rarely wanted to play, some subject matter interest
7th Grade	Jonas	Very high	Disinterested in subject matter, focused on game mechanics
7th Grade	Julian	Very high	Disinterested in subject matter, focused on game mechanics
7th Grade	Lenny	Very high	Proficient, enthusiastic, good at sharing and tutoring
7th Grade	Liz	Very low	Low proficiency and low subject matter interest
7th Grade	Louise	Low	Reserved and quiet
7th Grade	Mark	Medium	Reserved and quiet
7th Grade	Marshall	Medium	Subject matter proficient, reserved and quiet
7th Grade	Peter	High	Eeasily distracted by game mechanics, prone to 'grief' play
7th Grade	Rose	Very low	Low proficiency but enthusiastic and willing to learn
7th Grade	Sarah	Low	Highly subject matter proficient, learned the game quickly
7th Grade	Terrance	High	Low proficiency but good focus on subject matter
5th Gr. Castle	Anna	Medium	High subject matter interest
5th Gr. Castle	Elmer	High	Efficient when supervised but easily distracted, prone to 'griefing'
5th Gr. Castle	Felix	Very high	Informally appointed leader, liked solitary play, helped teacher
5th Gr. Castle	Fran	Low	Good at sharing and discussing building plans
5th Gr. Castle	Irwin	Low	Subject matter proficient, driven, preferred to work on his own
5th Gr. Castle	Juliet	Very low	High subject matter interest, often frustrated by classmates
5th Gr. Castle	Laura	High	Good at sharing and discussing building plans
5th Gr. Castle	Martin	High	Proficient, often wanting to collaborate with Felix
5th Gr. Castle	Marvin	High	Reserved, focused, good at collaborating
5th Gr. Castle	Oscar	Medium	Easily distracted, prone to 'griefing'
5th Gr. Castle	Tanya	Medium	Good at sharing and discussing building plans
5th Gr. Monastery	Adam	Medium	Interested in subject matter, focused on maintaining the theme
5th Gr. Monastery	Dan	Very high	Very proficient, driven, and supportive – helped me/teacher
5th Gr. Monastery	Dylan	High	Good at subject matter, focused, good at sharing and discussing
5th Gr. Monastery	Ernest	High	Good at subject matter, focused, good at sharing and discussing
5th Gr. Monastery	Felicia	Low	Played w/ Miley, subject matter proficient, rarely wanted to play
5th Gr. Monastery	George	Medium	Low interest in playing the game, difficult to motivate
5th Gr. Monastery	James	High	Efficient player, also quiet and reserved
5th Gr. Monastery	Julie	Very low	Aesthetically driven, prioritised theme representation/portralay
5th Gr. Monastery	Louise	Very low	Aesthetically driven, prioritised theme representation/portrayal
5th Gr. Monastery	Marcus	Very high	Proficient and helpful, somewhat disruptive and hard to motivate
5th Gr. Monastery	Miley	Very high	Easily distracted by game mechanics, high game focus
5th Gr. Monastery	Peter	Medium	Interested in subject matter, focused on maintaining theme

THE RANGE OF STUDENTS' GAMING LITERACY AND PROFICIENCIES

Protocols and transcripts from classroom sessions clearly show that students had very different backgrounds when it came to technology and gaming proficiency. In early sessions, some students professed to not only playing *Minecraft* on their own at home, but that they also paid for dedicated servers and created gameplay videos and guides that they put up on YouTube. Simultaneously, the same classrooms also contained students that had never played *Minecraft*, or any computer game with a similarly advanced interface. For example, during the second classroom session with the 7th grade students, the observation protocol states that

> "A lot of students (around a fourth of the class) still don't know how to start the game or how to play, how to interpret the game 'blocks' as units of measurement, how to choose and place blocks in the game interface, or even how to steer their avatar (the combination of WASD steering and mouse movement is difficult for many), I spend a lot of time running around and managing those issues."

Many transcripts throughout the game-based curriculum from the same class continuously show that some students operated at a high level of proficiency, while others kept struggling with the game interface:

Excerpts from a 7th grade exercise on February 27th

Beatrix:	[To researcher] You have to help me! I don't know where I need to go [to start the game]… is it this one?
Peter:	[To classmate] What program are you using? WorldLevel?
Wallace:	It's spelled "WorldEdit" (the name of a popular *Minecraft* modification). But you have to know… you have to write it into google.
Wallace:	You can check out tutorials on YouTube on how to install it.
Peter:	Alright, WorldEdit. Here it is.
[A few minutes later, Peter still did not manage to get the modification to work]	
Wallace:	Go back *mouse clicks*… Yeah, you need to put it in the 'Versions' folder if you want it to work. You need to put it in 'Versions'.
[Rose is building a cube in Minecraft, and is placing blocks down – she encounters some issues when she needs to erase blocks that she misplaced]	
Rose:	I'm getting pretty good at this!
Rose:	Wait, I forgot how to do this…
[…]	
Rose:	This is the SECOND time I'm playing Minecraft!

While these discrepancies lessened somewhat over time, the differences in the students' proficiencies in navigating the game interface did not even out enough to stop significantly affecting how well students could participate in the exercises. For example, in the audio from the very last game-based session of the curriculum (after the game had been used in classroom exercises for approximately six hours), a student shows that they still had issues with one of the more basic functionalities of the game:

Excerpt from 7th grade exercise on March 20th

[A student is working on an exercise, and needs help using the basic 'tool belt' controls that allow you to switch between different blocks to build with. The tool belt is a fairly fundamental entry-level game mechanic.]

(F) Student:	*Shouting* Hey!…
Pause	
(F) Student:	Casper! How do you switch stuff out down here? So that you, like, can choose this other thing instead?
(M) Student:	Then you need to press to… check this out.
Casper:	You need to use the scroll wheel on… Or, you… like, use 1, 2, 3, to go between stuff.

Throughout the execution of the entire game-based curriculum, the students in the 7th grade class repeatedly showed how much their gaming literacy and knowledge of *Minecraft* in particular differed. The teachers tried to group students into different types of configurations that had proficient students helping novice ones, or that had novice students figuring out the game together, but results from these matchings varied greatly as well. As seen in later chapters, the differences in proficiencies in the game had a severe impact on how students in the 7th grade class approached the game-based exercises.

As was already observed in my introduction of the game and the project plans to the 5th graders, the discrepancies between the students' game proficiencies were quite prevalent in that class as well. Even before the actual game exercises started, one of the students (Miley) approached me with her phone, on which she had recorded a video of her playing *Minecraft* at home. In her video, she had made some preliminary plans for how she would design the stables she would be building together with her classmate (Felicia) during the actual classroom exercises. Similar unsolicited homework had been conducted by another game-adept student (Felix), who had prepared for the game-based curriculum by building a castle at home, and had practiced how he would implement esoteric game mechanics to improve the design of the castle. As the game-based curriculum progressed, the differences in the students' proficiencies remained quite significant. A note in the observation protocol from an early exercise with the 5th graders, for example, reads:

> "One group of boys (seasoned players) had a tendency to just veer off track and start using the bow and arrow and other game elements to pass the time and show off their skills [...] One person in this group was also fairly negative about the process, and I got the feeling that the student felt very restricted by having to work with his peers, and that their plans didn't really mesh with what he had envisioned."

Transcripts from the classroom exercises also capture some issues that students on the other side of the proficiency spectrum experienced:

Excerpts from 5th grade exercise on February 3rd

[Julie and Louise are in the process of decorating the sleeping quarters they're working on]

Julie: Alright, we need to come inside here then.

[...]

Julie: How do you open doors?

A door opening sound is heard

Julie: Alright!

Louise: Yes, there we go, indoors!

Julie and Louise: *Laughs*

Julie: Ok, beds then...

Julie: Do they have beds?

Louise: Um, we are going to have to check!

[...]

Louise: Maybe there aren't any? Or what?

Julie: But I think so. I don't know. We have to try.

Silence, loud mouse clicks are heard

Julie: There are no beds here... 'Transport' (referring to a category in the inventory system) had no beds.

Louise: Miscella... 'Miscellaneous'?

Julie: Click that one...

Louise: That's just a bunch of stu...

Julie: ... Stuff...

Pause, more clicking

Louise: Ummm....

Louise: There are some, like, build clock... build-.... Building clocks? Building blocks.

[The exchange goes on for a minute, until they call on the researcher for help. The researcher and the students talk for a while about beds in the medieval ages, and the researcher then directly shows them the beds in the game. After the researcher leaves the students, they try to remember how to access the beds.]

Julie: But now we have to switch [our inventory] so that we have the beds here.

Louise: Eeeh.

Julie: He pressed something here...

Louise: D, maybe?

Julie: D?

Louise: No, it wasn't D.

Julie: Nope.

Louise: But here on E... No, there you just get the regular stuff.
Julie: *sighs*
Louise: *Baaaaeeeeeeh*. *Sings*
Julie: B? Okay...

[Dylan and Ernest are building a big gate that leads into the group's monastery; they are debating how to create it. The regular doors in Minecraft are only large enough to let one or two persons through, and the students wonder how they could create a larger 'gate' door with the game's limitations in mind.]
Dylan: Yeaaa, but it's... Eh, you'd have to use like a thousand doors.
Dylan: Like this...
Ernest: Or, Researcher!... You could like, place Slabs (a specific shape of building blocks) and like, so that it would be a little bit open and a little bit closed, like this.
Dylan: Yeah, kinda.
Ernest: Like, build it out of wood, and not use any doors. It would look super strange.
Dylan: Or maybe build it out of wood like *this*, and then in the middle just place a metal door.
Ernest: *Unintelligible*... but then it would be as if it was just this tiny little hatch in it, right?
Dylan: Mhmmm.
Miley: (Shouting from across the room) But build it with a red carpet that goes inside!
Dylan: Or you could have... metal bars!
Ernest: But then enemies can get inside and stuff.

These excerpts exemplify how students can have a vastly different command of the objects available in the game and how the game works. Louise and Julie, two novice players, have issues finding materials, are unsure what types of materials and objects exist in the game, and need to spend time trying to understand the interface and learning how to interact with basic game objects (such as opening doors). Meanwhile, Dylan and Ernest, two medium-level players, know enough about the game to discuss and hypothesise how different materials would look and function if used to finish of their gate structure. Similar exchanges occurred frequently in the other group of 5th graders as well, and struggles with the interface and knowledge of game materials lasted quite long into the game-based curriculum:

Excerpt from 5th grade exercise on February 24th
[Juliet and her partner Anna want to use fences to keep animals in their building; they have been assisted by their classmates before on parts of the fencing, but now want to continue building more.]
Juliet: (Talking to the researcher) Ok so... Alright, how do I. Like, how do I find. Like, how do you set out fences like, like that
[Juliet gestures towards a fence and a fence gate in the game]
Researcher: How do you mean?
Juliet: You know, kind of like. A fence that can do like this.
Researcher: Oh, ok! That's actually not a piece of fence, it's a gate.
Juliet: Oh!
Researcher: So you have to go in here, and pick this...
[The researcher shows the item in the inventory menu]
Juliet: Ah.
Researcher: And there we go, there it is.
Juliet: Where is it?
Researcher: There we go. And then you put it down like that.
Juliet: Ok.

The observation protocol from the same session notes that other students in the classroom conversed at a very different level:

"Students start talking about other Minecraft-games they're playing, around 38:00 into the exercise. One of the students (Felix) says that he has paid for access to a dedicated server to run his own world on, and other proficient students join in and talk about their experiences playing on it."

This is an example of how some students in the class are highly proficient and invested in playing the game, while other students were still struggling with understanding it and navigating its interface. It is also an example of how students build their own communities around the game outside of the school. As described in later chapters, this can subsequently influence how the students behave and collaborate during the game-based classroom exercises.

ADEPT PLAYERS' GAMEPLAY AND HARDWARE EXPECTATIONS, AND MEANS OF IDENTITY REINFORCEMENT

The proficient players were often generally displeased with the constraints that the educational goals of the gaming activities placed on their gameplay. The observation protocols note several instances of game-proficient students shouting objections like "*this sucks*" during early gaming sessions, when they are informed of the goals of the early game-based activities. Teachers also frequently noted that the game-proficient students were the ones who were the most difficult to engage when it came to discussing details of the taught subject matter. The more proficient students were also more likely to be upset or distracted from the learning objectives by hardware they considered to be sub-par.

For the 7th graders, these expectations primarily emerged in conversations regarding the performance of their computers and related hardware, the *Minecraft* version we were using for the game-based exercises, and the designs of the game tasks. Examples of the first types of expectation issues followed along the lines of the excerpts below:

Excerpts from 7th grade exercises on February 20th

Jonas: Minecraft on the highest settings – that's what I'm running on my gaming computer at home. Desktop rig. No lag.
Jonas: Here it lags on the lowest settings…

[Aaron has just started up the game for the class exercise]
Aaron: Oh my god, my latency is super high. Check out my ping!
Aaron: Can you have a look at my latency? [directed towards the researcher]
Aaron: My ping is over a thousand!
[…]
Aaron: But like… I have 1600… my ping is one thousand one hundred and sixty two.

Proficient students in the 7th grade class continuously wanted access to game modifications and ways to cheat, in order to improve their gameplay experience and make it more similar to what they were used to at home. Some students, both in the 5th and 7th grades, would even start bringing in their 'gaming mice' from home, as they were displeased with the ones provided by the school. It is difficult to decide whether these complaints and solutions (e.g. loud complaining, talking about their personal computer setups at home, and bringing their own mice to class) were made in an attempt to improve their playing experience at school, or whether they were primarily a way to display their expertise. The transcripts cannot really account for intent in that regard, but my own personal interpretation of many of the situations was that students – just as the 5th graders did in the initial introduction of the educational game – wanted it to be known that they were familiar with the game beforehand. And, beyond that, it seemed as if they also wanted it to be known that they were 'better' at the game than could be expressed with the sub-par equipment they had to work with during the classroom exercises. For the proficient students in the 7th grade particularly, showing familiarity and expertise with the game (and trivia surrounding it), and at times even disdain for how the educational use of it 'bastardised' an activity they were deeply invested in, seemed especially important. As previously mentioned, some of the more proficient students loudly proclaimed that "this sucks" (or even "this [expletive] sucks!") when the assignments for the game-based exercises were described. Furthermore, some students also tended to exchange trivia around *Minecraft* or discuss other games in general:

> **Excerpt from 7th grade exercises on February 3rd**
> [It is the beginning of a classroom exercise, and students are getting into their working groups – while the class is moving around, some students strike up general conversations regarding games and Minecraft trivia.]
> Terrance: Did you know that the painting you can use in Minecraft are pictures from *CS:GO*[10]?
> Terrance: It's true, Jonas!
> [...]
> Terrance: Did you know that *Minecraft* is *unintelligible*?... for the graphics card.
> Jonas: It is different for each texture pack, you know...
> Terrance: But, like... (Terrance trails off)
> **Excerpt from 7th grade exercises on March 20th**
> (M) Student: Hey you... are you going to buy, what's it called again... Are you going to buy *Far Cry*[11]? It costs 2.99.
> (M2) Student: It's not worth it.
> (M3) Student: *Shouting* Not worth it!
> (M) Student: But what about you, Jonas, if I buy it, will you buy it?
> [...]

The less proficient students were never heard to explicitly complain that hardware, game versions, or the task designs failed to measure up to their expectations. This is not to say that they never complained, but rather that their complaints were never specifically directed in the same direction as those of the proficient students. Whereas proficient players were frustrated by how the gameplay experience differed from what they were accustomed to (in that it often fell short), the novice players' complaints focused more on how the educational game imposed certain limitations on their creativity or that it was frustratingly difficult to use.

In the 5th grade class, the proficient students' expectations, manifested in somewhat more palpable ways, were their high demands on how their computers performed. As opposed to the 7th graders who all had computers of an identical brand, the 5th graders needed to take turns playing on computers with different hardware specifications. Some of the communal computers were newly acquired by the school, whereas others had been used for several years without receiving any significant upgrades. The expectations of the game could sometimes lead to a negative atmosphere in the classroom. The proficient students' tendency to lament about hardware performance and the way the educational game was used could sometimes widen the communication gap that already existed between them and the novice students. The classroom could, in essence, be divided into two different groups that carried out a conversation at two very different levels. The proficient students would talk as the above excerpts show, whereas novice students would either sit by quietly or band together to talk about something completely different.

INTERPRETATION AND USE OF GAME OBJECTS

Previous chapters have covered the more superficial ways in which students' previously acquired gaming literacy correlated to their reactions to hardware and details of the educational game (e.g. game version or the design of game-based exercises). But, transcripts and observations from the exercises also reveal that students not only

[10] CS:GO, or *Counter-Strike: Global Offensive* (Valve Corporation, 2012), is a popular tactical online First-Person-Shooter game.

[11] *Far Cry* (Ubisoft Montreal, 2004-2015) is a series of open-world First-Person-Shooter games.

manipulated the game interface and mechanics with different levels of proficiency, but that they also 'saw' and processed game content differently.

To briefly summarise the difference, proficient players could think of game content (e.g. aesthetics and functionalities of game objects and different types of game mechanics) in figurative terms, whereas novice players tended to interpret them very literally. The proficient players' processes of interpreting game content were, for lack of a better word, 'fluid'. Depending on the situation and the context, game objects could simply be viewed according to all their immediate properties, with both their aesthetics and functionality treated as they were given in the game: a block of bricks is a block of bricks, and is useful to build house walls; a horse is a horse, and can be ridden; and a spider's web is what gathers in corners of old unused rooms. They could also solely be interpreted according to their functionality: a chest is a storage unit regardless of how it looks or whether its dimensions are suitable for what it is supposed to store; a coal torch is a useful source of light, regardless of its proximity to flammable material; and a magical block of luminescent ore can function as a lantern in a medieval home. Or conversely, the functionality of objects could be disregarded entirely, and interpretation instead focused solely on an object's aesthetic value; a spider's web can look like a puff of smoke coming from a chimney; a metal melting furnace can be a simple medieval hearth for kitchen use; a piece of wooden stairs can be a bench; and a floating enchanted tome can be a bible on a priest's lectern.

The proficient students seemingly switched between these different 'modes' of interpretation with ease. Interpretations were often guided by their previous knowledge of the game's limitations. If they knew that no game objects could approach a 'real- world' object with full fidelity, with regard to either aesthetic or functional representation, they could easily settle for the closest thing available. For example, the game does not have any storage compartments that would logically be used to store smaller objects in the real world (e.g. a person's clothes, pots and pans, tools, food, or trinkets). The game only provides the player with a couple of storage options, which all look like large treasure chests (which are either 1 or 2 cubic metres large). Proficient players would approach this object as a universal 'symbol' for storage and use it wherever they thought storage would be necessary (e.g. in storage sheds, kitchens, or armouries). Less proficient players, however, would have a hard time getting past the illogical dimensions of the object and often refrain from using it altogether, even in places where they felt storage would be necessary or important from a subject matter perspective. In a series of exercises with the 5th graders, these different interpretative abilities revealed themselves several times. In the excerpt below, two novice players are trying to find suitable decorations for their historical recreation:

> **Excerpts from 5th graders' exercises on February 3rd**
> [Louise and Julie, two novice players, have finished the foundation of their building (a sleeping cabin), and are looking for ways to decorate it further]
> Louise: Maybe there should be bookshelves, then? That's…
> Julie: Did they have those back then?
> Louise: What?
> Julie: Did they have those?
> Julie: Yeeees. They had a tonne of bookshelves.
> […]
> Julie: Alright, now let's have a bookshelf then. *sigh*
> Julie: There we go, bookshelf. This was much better.
> Louise: Should we place it, say, between [the beds in the cabin]?
> Julie: If we put it… we'll take it here.
> [… the students discuss placement for a few seconds, and finally place a bookshelf in the game world]
> Louise: If it looks too colourful we'll remove it.
> Julie: Should we put it on this side?
> *Pause* (mouse-clicks are heard)

Julie: Okay, so umm *laughs*... this is, like...
Louise: Looks a bit colourful.
Julie: Yeah.
Pause
Julie: Let's remove them.
Julie: Yeah.
[... the teacher comes over]
Teacher: Why did you remove [the bookshelf]?
Louise: Because it looks a bit weird.
Teacher: It looked a bit...?
Louise: It looked weird.
Julie: Yeah.
Teacher: A bit too modern, or something?
Louise: A bit weird... Like...
[The students move on from the bookshelves to other objects – they decide to see if a chest would look good at the foot of the bed as storage units for personal affects for the monks and nuns.]
Louise: But maybe if we take... Chests?
Julie: They had those!
Louise: Yes!
Pause
Louise: Maybe by the bed's foot! Like, chest...
Julie: ... They put their clothes in them.
[... the students go on to discuss the placement a bit further, and place the chests]
Julie: Over there!
Louise: There?
Pause (mouse-clicks are heard)
Julie: But that was really large.
Louise: Mmm.
Julie: It almost covers the whole bed.
Louise: Could it be on the side instead? That side, or something?
Julie: Yes. *Laughs*
[... a few more minutes pass, the students accidentally break some objects and need to replace them before they get back to replacing the chest in a different position]
Julie: But, the chests are really big.
Louise: Mmm.
Julie: They should have been smaller to have in front of the bed.
[... a few more minutes pass]
Louise: Let us not use the chests...
Julie: Let's build the roof instead.
Louise: ... because it becomes really...
Pause
Louise: Should we have flowers instead of chests?
Julie: Yes. *Laughs*

Julie and Louise kept experimenting with different objects and were never really pleased with any of them. In an exercise conducted a month later, the problem re-emerges:

Excerpt from 5th grade exercise, 2nd of March
[Louise and Julie are revisiting the subject of bookshelves and decoration for their sleeping cabin]
Louise and Julie: *Unintelligible* but, nooo, what...
Louise: It's just so darn boring.
[The teacher hears the students and walks over from the other side of the room]
Teacher: What's boring, Louise?
Louise: Um, Umm. A little... *unintellible*
Louise: Like, it's like *unintelligible* when we are trying to spruce it up a bit.
Teacher: Alright, how are you visualising it?
Louise: Like bookshelves, but they must be... they are just so darn big.

In the example of Julie and Louise, even a texture's colour scheme was enough to deter them from using objects, even when they wanted to incorporate that object 'type' into their creations. The too-colourful bookshelves were deemed anachronistic and they were not seen as appropriate for their historical recreation, and the students later went on to do something different with their building (but not before re-visiting the subject of the bookshelves several times throughout the curriculum). Conversely, the other excerpts show that other students are not concerned with illogical dimensions, colours, or functionalities. The object's traits that are not relevant in the context in which it is placed, or that do not correspond to the real-world object it is supposed to 'symbolise', are easily disregarded. From looking at the proficient students' buildings, it is clear that it does not matter that the bible on the priest's lectern happens to be floating and is enveloped in an ominous pulsing purple glow; the object is used to convey 'ceremonial book'. A spider's web can be placed mid-air above a chimney, as it carries a visual resemblance to a puff of smoke. And, a large 2000 litre chest can be used as any type of storage unit (be it for armor and weaponry, or for a few food items or articles of clothing), because the object 'means' storage in the game. Proficient players could negotiate the functions and aesthetics of objects, depending on what their current ideas demanded. Less proficient players would get stuck or frustrated that the game lacked either functional or aesthetic fidelity, making it difficult for them to convey subject matter details in the way they wanted to. This final transcript, a conversation between two collaborating students – one proficient and one novice player – encapsulates this contrast well:

Excerpt from a 5th grade classroom exercise on February 17th

[Felicia and Miley are building a storage room and Miley is stacking chests on top of each other to fill the room with storage compartments. Felicia is an inexperienced player while Miley is very adept with the game. Felicia is commenting on how illogical it is to stack chests on top of each other – realistically, the bottom chest should be impossible to open if another one sits right on top of it.]

Felicia: I don't think they had… um. Chests like that.
Pause
Felicia: I don't think they had the technology to do things like that.
Miley: Whaaat?
Felicia: I don't quite think that they had that technology – like, how are you going to open them?
Miley: *Unintelligible retort*
Felicia: *Laughs* … the one that's on the bottom?
Miley: *In a silly voice* Felicia you can build like that in *minecraaaaaaaft*.
Felicia: *Giggles* But if you put a thing down, super close to the other thing that can be opened. why… [Miley interrupts]
Miley: Oh come on, it- it- it- it's lagging!
Felicia: … can you open it? [Felicia finishes her sentence]
Miley: Like it- it- it double-clicks when you only click once…
Felicia: Shouldn't we also put in a monastery citizen? [Felicia keeps talking parallel to Miley]
Miley: … sometimes!

Felicia, the novice player, finds it thematically inappropriate that two chests would be stacked on top of each other. When seeing game objects as literal parallels to real-world objects, it would make little sense to stack two heavy storage chests on top of each other if they open at the top. Miley, the adept player, does not show any concerns about how it defies real-world logic. Instead, she aims to convey the sense of a storage room by using an abundance of objects that symbolise storage, and *Minecraft* does not simulate a chest's lid being weighed down by making it inaccessible. The excerpt also contains a brief example of how proficient players are more prone to react to hardware performance issues, as Miley is diverted from her discussion with Felicia, due to being frustrated with the performance of the hardware they are playing on. While Miley is talking about the troublesome hardware, Felicia tries to continue talking about how to improve the execution of their project.

GAME DISTRACTIONS AND EXCLUSIONARY BEHAVIOURS

The audio recordings frequently captured a 'layer' of gaming that happened in parallel with introductory lectures and student presentations. The more game and technology proficient students would often surreptitiously start up private gaming sessions while I or the teachers were distracted elsewhere, for example, when giving introductory information at the start of the game-based exercises. An observation protocol from an exercise on February 6th reads:

> "The adept players (exclusively boys in this class) are still playing together on a multiplayer server, and they're also doing it while the teacher is talking. I took a couple of sort of surreptitious walks around the classroom while the teacher was talking, and in the first 3 minutes [of the introductory lecture] I saw 4 students on their computers playing Minecraft [...] I took another stroll at 11 minutes in, and at that point 6 students were playing Minecraft during the teacher-led instruction."

Supporting this further is that the audio recordings often picked up faint mouse-clicks during briefings or debriefings, and student dialogue often made it apparent that students were primarily focused on playing rather than participating in classroom discussions:

Excerpt from a 7th grade exercise on February 6th
[The teacher is at the tail end of an introduction of new geometric principles that will be used in an upcoming game-based exercise. The class is quiet, but mouse-clicks have been audible throughout the introduction, and the students are all allowed to have their computers open.]
Teacher: What does the area scale become now? If each of our sides are enlarged by a factor of 8.3? What happens to the area scale, how can you calculate it?
Long silence
James: *Shouting* Hey!
James: Can you just stop that, Peter!
Peter: *Unintelligible retort*
Researcher: But neither of you are supposed to play right now.
Teacher: No.
Researcher: So stay calm.
James: Owned, Peter!
Peter: What about you?!
Researcher: Both of you.
James: I'm not playing, but you keep killing me all the time!
Teacher: What area scale do we have? If the length scale is...
[... The teacher continues the introduction, which ends a few minutes later]
Teacher: Good. We are going to move forward later, and we will start talking about volume scaling. But, now we'll take a quick break for a couple of minutes.
Chairs scraping. Students start walking out of the classroom
Lenny: What happened!?
Teacher: No one should stick around by their computers right now, take a little break and move around, everyone.
Lenny: Jonas, you were down there in the ground
Lenny: What the f*ck is happening here?
(M) Student: I have no idea, who is [Peter's screen name]?! Who is [Peter's screen name]?!
James: Peter!
(M) Student: Why did you kill me?!
James: He killed me too!
Jonas: He stood... He and Archer killed all the time!
Teacher: Peter.
Peter: Yeah?
(M) Student: Can't he be kicked out or something?!
Unintelligible shouting between the students

Teacher: ... Let's shut everything down, step away from the computers now and move around a bit. I don't want anyone to hang around the computers right now.
Lenny: Aw...
Teacher: Peter, let go of your computer, take a break.
Peter: Ah...
Chairs scraping
Lenny: Jonas, I'll borrow your wolf a little bit. But we...
James: Like, why did you kill me *unintelligible*?
Jonas: You killed me seven times, Peter.
Peter: But it was Archer!
Peter: I didn't kill you at all!
Jonas: Yes you did.
Peter: Okay, I killed you once, that can't be denied... Once!
Students' voices trail off as they walk out into the hallway
[... when the students are gone, the teacher and the researcher talk briefly]
Teacher: I think we will start. I think we'll start using your new figures here.
Researcher: Mhmm.
Teacher: And when we do that, all the computer lids need to be shut.
Researcher: I think that sounds sensible.
Teacher: Because there's no focus, I feel like.

Here, it seems that at least six students were playing in a joint multiplayer session throughout the introductory part of the lesson. These students were all part of the more game proficient 'clique' and often became distracted or devoted their attention to non-assignment relevant gaming. This untimely gravitation towards their computers and the game was difficult to monitor. The behaviour was not exclusive to the older and larger class either, as some students in the 5th grade class exhibited the same behaviour:

Excerpt from a 5th grade exercise on March 3rd
[The teacher is having a discussion with the whole classroom before the students start building on their projects. The teacher keeps going unabated, and at one point mentions a building in the group's creation that Oscar and Elmer had worked on.]
Anna: *whispers* But you are not supposed to play right now, Juliet.
Juliet: *quietly* Elmer.
Teacher: But this is an interesting idea. Because, don't you have a prisoners' dungeon inside the castle?
Oscar and Elmer: Yeah.
Pause
Anna: *whispers* Stop playing now!
Excerpt from a 5th grade exercise on March 12th
[The day's exercise is just about to begin, but the teacher has not managed to start the server yet, as she is trying to get it to work. Elmer is, however, already playing the game in a single player session.]
Juliet: Elmer, have you already begun?
Silence
Juliet: Martin. Martin!
Juliet: Is it 'Singleplayer'... or 'Multiplayer' isn't it?
Elmer: Multi.
Oscar: Multi.
Juliet: But you have already come into the server, what's the IP address?
Oscar: This is singleplayer.
[... a few minutes pass]
Juliet: But you... Elmer, you're playing *unintelligible*
Elmer: Yes, but it is my own account.

These distractions were difficult to deal with and made exercise introductions somewhat problematic. Both the 7th grade and 5th grade teachers imposed strict "do not start playing before we are all ready" rules early on in the project, but the behaviour persisted. In later exercises, the 7th grade teacher also intensified the rule, saying “do not open your computers until I say so” when the class sessions started. Even so, the attraction of the game or the computer seemed to remain quite potent, as the observation protocol at one time states that “even though the computer lids were all closed during the introduction, this time, one student (Peter), kept moving and clicking his mouse as if he was doing/playing something on the computer”.

The educational game could also be distracting during the executions of the game-based assignments, mainly because the proficient students had a tendency to focus more on manipulating game mechanics and game objects than following the exercise guidelines. As opposed to the distractions that occurred during the introductory assignment briefings, these types of distractions could be directly detrimental to the novice students’ ability to participate in the game-based activities:

Excerpt from 7th grade exercise on February 27th:
Anne: But like… this is boring as sh*t.
James: Not… not for me, because I know how I’m going to build. Check this out. [James then proceeds to invent a lava-based animal-murdering machine]
Excerpt from 7th grade exercise, 20th of February:
[Aaron and Sarah are working on an exercise where they are assigned to create up- and down-scaled versions of certain geometric shapes. Aaron is a proficient player, whereas Sarah plays at a low-to medium-level proficiency. I’ve noticed a lack of communication in the group, and Sarah looking disengaged with the task.]
Researcher: Are you building a cube each?
Sarah: No! I’m going around killing pigs.
Researcher: Alright, has something happened?
Sarah: Not really. First we started working on mine [her computer], but then he wanted to, um… do things his way.
Researcher: Oh, but this pink shape you have, is that one of your versions at least?
Sarah: Mhmmm. I worked on that one.
Researcher: So that’s your Area-version?
Sarah: Yes, that was mine.
Aaron: Nooo, I need to get one that has Strike [Strike is an enhancement for weapons that increase their damage]

Aaron focuses on esoteric aspects of the gameplay, while Sarah has attempted to collaborate on the assignment for the day’s game-based exercise. I encouraged the students to collaborate more closely, and Aaron was told to focus more on the exercise and listen to his exercise partner, but instead the group’s focus continued disintegrating. Three minutes later during the exercise, the group’s dialogue was exclusively focused on game mechanics and esoteric game objects:

Excerpt from a 7th grade classroom gaming exercise on February 20th
[Aaron and Sarah are playing together. Aaron is a proficient player, and is showing off his grasp of the game to his classmate]
Aaron: Take this one. And then you use them on the pigs here. Check it! They’re making babies!.. And then they fall off.
Sarah: Awh, those pigs are adorable! You’re not going to kill them are you?
Aaron: “/time set one thousand” [reading a console command aloud (/time set 1000) he is executing]
Sarah: What do you mean… ”set”?
Aaron: Now you’ll see something even cuter.
Long pause with mouse clicks
Aaron: Mushroom cows! You know, take ’em, take ’em, take ’em!’

Aaron clearly demonstrates that he is a proficient player as he knows specific console commands for the game, and also knows how to access relatively obscure game objects. Simultaneously, Sarah is not familiar with the language Aaron employs, showing the difference between the two students' game proficiency. Furthermore, the excerpt also exemplifies the issue of the breadth of the game mechanics distracting students during the game-based exercises. The game proficient student started focusing on showing off and experimenting with game mechanics rather than remaining in an educational frame of play, which in the end derails the activity for the group. There were also similar behaviours of excluding others from collaboration that were not as overtly tied to differences in gaming proficiency. It seemed that some students preferred to work on their own projects and tried to keep their classmates at a distance during the exercises:

Excerpt from 5th graders exercise on February 3rd
[Martin wants to collaborate on building different parts of the group project with Felix. Felix is a highly proficient player; the teachers also described him as an independent person with a high drive to do things in his own way.]

Martin:	*Shouting* Hey Felix, I'll help you build!
Felix:	No, I want to build on my own.
Martin:	*Shouting* What did you say?
Felix:	*Unintelligible*
Martin:	This tower, here? Yeah, but, I'll keep building up here then.
[…]	
Martin:	Felix, can I keep building up on this tower? You know, umm. Here. Look here.
Felix:	*Unintelligible*
Martin:	But Felix, you can't build every single one!
Felix:	Yes, but I want to build this one and you can build the other one.
Martin:	No, but I build this one?
Felix:	I want to build this one.
Martin:	But Felix…
Felix:	Let's just build.
Marvin:	*Shouting* But Felix, you're building here too. You're building almost everything now.
Martin:	Can't we build together, Felix?

As such, the gap between students caused by gaming proficiency was not the only reason why collaborations did not always work out well. There were, however, also several instances in which game proficient students worked well together with less proficient students, helping them find ways to become better at the game. This being said, gaps in game proficiency did seem to play a role in many disconnects between students. During the game-based sessions in which I was completely absent from the classroom, the teachers also noted that the allure of playing the game 'freely' had a strong tendency to distract the students from pursuing the prepared game assignments. In a protocol from the very end of the project (the 20th of March), Teacher E stated that:

> "The game can sometimes be a bit too tempting. A student might think that 'alright, while my classmate is looking up facts about the white house [in order to be able to create a scale model of it inside the game], I'll play around with the game'".

Teacher G had a very similar experience, noting that "Sometimes the students get distracted by the game, they start focusing on chickens and experience points and things of that nature". The audio recordings from those exercises ratify the teachers' observations as well, for example:

Excerpt from a 5th grade classroom exercise on March 2nd
[The class have been working on their exercise for 18 minutes without encountering any particular obstacles. The teacher takes the time to stop walking around the classroom, and decides to look at her computer and use her own avatar to walk around in the students' *Minecraft* world. Shortly after she switches her attention from the classroom to her own computer, the following exchange starts.]

Dylan:	We're planting thousands of seeds, and Peter is planting chickens. [Dylan and Ernest are preparing a wheat farm, and notice another player liberally placing chickens around their buildings]
Ernest	*Laughs*
(M) Student:	Check it oooout!
Dylan:	Plant more chickens!
Students:	*Laughing*
(M) Student:	Waaait. Everyone, such cute little buggers!
Ernest:	Yaaaaah!
Dylan:	But what *unintelligible*
(M) Student:	*Shouting* Noo, nooo, noooooo!
Ernest:	Peter check out the chicken! The chickens, they're invading the earth.
Miley:	So many chickens!
Peter:	What are you doing? What are you doing?! We cannot stop them!
Dylan:	Why are they standing on top of the fence? *Laughs*
Ernest:	*Laughs*
Dylan:	Ernest, it looks like a table, our chicken roost, if you look at...
Ernest:	But, kill the chickens!
Peter:	I'm spamming chickens into the house!
Ernest:	Aaah there's so many of them!
Students:	*Laughing*
Adam:	Peter, check out how many there are!
Peter:	Aaah, damn! *Laughs*
Ernest:	But that's enough, now! [Ernest and Dylan try to switch the focus back to the exercise]
Dylan:	You know that... it's going to start lagging a bit.
Peter:	I know.
Ernest:	A bit? You know that... look, there are a thousand chickens there.
Adam:	There's chickens over... But, what is [Miley and Felicia's screen name] doing?
Peter:	It's on 'E', right...?
Dylan:	[Miley and Felicia's screen name]!
Ernest:	It is, ummm. Marcus, or wait what am I saying. There are 80 chickens in there.
Dylan:	Miley!
Teacher:	Sshhhhhh!
Pause	
Teacher:	I think it's getting a little bit strange now, because now your discussions are about chickens – are you focused on the things you're supposed to?
Dylan:	Yes, we are working, and Peter was helping us, but everyone else is coming over to sabotage!
Teacher:	Yes, focus on the things we are supposed to be doing.

During the game-based exercises, students becoming more focused on doing odd, silly things in the game was a recurring event. Some students certainly seemed to be more prone to it than others, but there was no general correlation between students' gaming proficiency and their tendency to goof around. For example, Dylan and Ernest, who are proficient players, want to keep focused on the task, and try to tell their classmates to calm down and focus. Gaming proficiency may simply make it easier for students to engage in distracting and silly game activity, as they have the knowledge to access and use tools that let them do so. Less proficient students certainly became distracted during the game-based exercises as well. However, they did not vent their boredom, frustration, or lack of interest in the given assignment in the game environment, but instead in more 'traditional' ways (e.g., general banter, listening to music on their phones, doodling with a pen and paper, or browsing the internet). Unproductive play and behaviours thus stemmed from a few different sources. Some students became distracted due to disinterest with the provided assignment (as often displayed by the 7th graders). Others seemed to veer off from the assignment as soon as there was a lack of supervision and guidance (which seemed to be the case with the 5th graders).

12.2.5 TEACHERS' ROLES DURING GAME-BASED LEARNING ACTIVITIES

As previously stated, the teachers entered the project with an interest in educational games, but with limited technology and gaming literacy. As the game-based learning projects progressed, the teachers increased their understanding of the used educational tool. As I reduced my involvement in the classroom activities, the teachers were able to step in and take more and more control, and ultimately took the exercises in new directions.

The game-based exercises show that classroom gaming requires the teacher to be versatile, as they need to carry out the necessary preparations before gaming sessions, but also act as game administrators during them. The teacher also needs to tutor students both in the subject matter being taught and in the gameplay of the chosen game, but will also need to step into an authoritative role whenever necessary to keep students focused. Observations and transcripts from the study clearly show that teachers wielded a lot of transformative power during the game-based exercises. Their interventions could turn disruptive behaviours into something positive, failures and frustrations into learning moments, or make even hard-to-motivate students focus on exercises. As already shown, even a smaller number of students will present the teacher with many challenges, as they represent a wide range of playing and learning styles, expectations, and behaviours. In this sub-chapter, the different ways in which these challenges affected teachers' roles during classroom activities are described.

STUDENT TUTORING

One of the more obvious, and debatably the most time-consuming responsibilities that the game-based exercises required teachers to assume was tutoring the students, both in how the educational game was played and how the game-based challenges could be approached and solved. As previously noted, the students were at vastly different levels of game proficiency throughout the game-based curriculum – the same was true in regards to the students' understanding of the taught subject matter.

As previously mentioned, the observation protocol from early sessions highlight that a lot of the interventions made during the exercises were 'game tutoring' ones. There were many students in each class who were unfamiliar with *Minecraft* or computer games in general, and getting these students to a level of proficiency where they could participate in exercises was a high priority. As the proficiency gap between students was seen to often negatively impact students' collaboration processes, reducing this gap remained a high priority task as the curriculum progressed. However, as also mentioned previously, while the differences between the proficient students and the novice students decreased over time, the gap could not be closed completely during the conducted game-based curriculum, and was seen to affect students' ability to participate and collaborate in the exercises until the very last ones.

This particular role of tutor put great demands on teachers' knowledge of the used game, which made it somewhat difficult for the teachers to take on themselves. During the early exercises where my presence in the classes was more overt, I would take care of many of the interventions that involved helping students understand the game. A majority of the interventions I made in the first half of the game-based curriculum consisted of administering quite straight-forward game tutoring; what buttons to push to access the inventory, helping students change game settings or controls when necessary, how to control their avatar, and how to start the game or connect to the game server. This was not a trivial task, and could keep me occupied for long periods of time, thus making it difficult to assist the class in other ways. But, it was also a task that had to be prioritised, as an inability to even navigate the collaborative environment or understand the tools to complete a game-based assignment completely excludes a student from participating in their own education. As the curriculum progressed, students naturally became more proficient, and while the students' different levels of proficiency was still noticeable towards the end of the curriculum, the vast majority of students had at least improved their proficiencies enough to not be totally excluded from the exercises. An ameliorating circumstance was also the presence of the more proficient students, who became a valuable resource, as they could tutor their classmates when the teacher did not have the knowledge or time to help them. In the exercises where I was totally absent, students often turned to each other when they were uncertain how different game mechanics or interface elements worked.

The novice students were not the only ones in need of tutoring during exercises. Many of the proficient students required a lot of help in connecting the game content they were familiar with to the taught subject matter. Here, teachers' gaming literacy did not come into play as much as their grasp of the subject matter being taught. A basic grasp of the type of objects the game included, and the types of expressions it allowed, were enough for teachers to be able to link subject matter details to the game content. The two different subject matters being taught (history and geometry) required vastly different types of tutoring in this regard. In the history curriculum, the teacher frequently linked game content to the historical context, by encouraging and guiding students to consult textbooks and online sources on how they could design and plan their buildings. When decisions arose regarding building materials or the types of set-pieces to include in the historical recreations, the teacher would contextualise the discussions in the historical subject mater.

Excerpt from a 5th grade gaming exercise on February 3rd

[The exercise for the day has recently begun for the group who is building a monastery, and students are still at a phase in their projects where they need to choose furniture and architectural design elements of their buildings. The teacher is walking around and talking to the students.]

Dylan: Can't we have, like, some metal bars there and trees in between them, so that you can peek through?

Ernest: Ummm *unintelligible*.

Teacher: There were three of them in the books.

Dylan: Yes.

Teacher: Dan, where did you put your book?

Pause, the turning of pages can be heard

Teacher: Okay, see it doesn't need the same type of defences as a castle would have. Monasteries didn't really work in the same way.

Dylan: Mhmm.

Teacher: But you don't have to feel as if… look here, things were of ordinary and simple. They didn't have any army or the same type of battle readiness as a castle.

[a few minutes later, the teacher approaches a different group]

Teacher: You're working on the sleeping quarters, right?

Louise and Julie: Yes.

Teacher: Have you read about how they used to sleep?

Louise: Yes, they kind of didn't really sleep like, very good.

Julie: They slept very little.

Teacher: On hay and on the floor, and things like that. The boys usually slept in cells, and the girls would sleep in large sleeping cabins.

In essence, the history curriculum required the teacher to help students imbue history into their game creations and the game objects they were choosing to use. In the geometry curriculum, the "symbolism" and aesthetic or functional appropriateness of game objects was not an issue, as the students were not recreating objects or structures from a specific real-world context. Instead, the teacher needed to focus his attention on explicitly clarifying geometric principles, and how the students could use them to guide their creations in *Minecraft*. Completing the assignment in the geometry exercises was based more on the students having a prior and good understanding of the relevant geometry principles. Thus, the subject matter tutoring needed during the 7th graders' exercises was more overt and focused more on making sure that students understood the mathematics required to complete assignments, rather than on guiding students' creativity.

HELPING STUDENTS CONNECT GAME CONTENT TO LEARNING OBJECTIVES

The teachers' need to tutor students in the subject matter being taught can be expanded into a larger challenge: making sure that the contents of the educational game remained contextualised in history and maths. Students were often in situations where their ambitions with a project did not match the intent of the exercises, or where it was difficult to associate game content to the subject matter. The following transcript excerpt, which is a continuation of the transcript provided on page 151, contains an example of the former. Here, two students are displeased with what they have built and feel they should improve it to make it look more aesthetically pleasing. The teacher steps in to both help the students see what they have created in the context of the subject matter and turn the students' frustration into a subject matter-relevant discussion:

Excerpt from a 5th grade gaming exercise on March 2nd
[Louise and Julie are disappointed that bookshelves don't fit as decorations in their sleeping cabin that is part of the group's monastery.]
Louise: It's just so darn boring.
[The teacher hears the students, and walks over from the other side of the room]
Teacher: What is it that's boring, Louise?
Louise: Um, Umm. A little... *unintellible*
Louise: Like, it's like *unintelligible* when we are trying to spruce it up a bit.
Teacher: Alright, how are you visualising it?
Louise: Like bookshelves, but they must be... they are just so darn big.
Teacher: Ah. But how do you think it really was, if you think back on how it was during this time period in a monastery?
Louise: Well, it was probably kind of boring.
Teacher: But you are absolutely right – they had books [back then].
Louise: Yes.
Teacher: Otherwise there's not that much you can [use to decorate]... they couldn't really go straight to the [local, modern, home-decor store] and buy table cloths and potted plants and things.
Julie: No.
Louise: No.
Teacher: So I understand how you're thinking, that it does look a bit dull... But maybe that's the way it was?
Louise: Yeah.

In this example, the bookshelves' proportions in the game clash with the subject matter (medieval history) and the students are struggling to find ways in which they can decorate their fairly plain interiors. The teacher steps in to discuss whether the spartan layout should really be considered an issue and reassures the students that what they have managed to achieve is actually a fair representation of the setting they were assigned to recreate. A commonly recurring scenario was also players' use of objects that would have been scarce in the setting they were trying to recreate. Here, *Minecraft* itself does not impose any limitations to, for example, how many horses you can create in the world, or the availability of different types of materials. Also, when there are no game mechanics that help maintain the fidelity of the subject matter being represented (e.g. by making certain items scarce, or more difficult to use), the teacher and the students need to create their own 'contract' with each other regarding how certain game objects can and should be used:

Excerpt from a 5th grade classroom gaming exercise on February 3rd

[Louse and Julie are debating what type of door to have on their sleeping cabin.]

Julie: Now I'll attach a door.

[...]

Julie: 'Wooden' door, or 'Steel' door?

Louise: Eeeeeeh...

Julie: What kinds of doors did they have?

Pause

Louise: Yeah, what kinds of doors did they have?

Julie: (Talks to the researcher) Should we have a wooden door or an iron door?

Researcher: I feel like wood was much more common. It's really difficult to create things out of metal, especially so during those days.

Louise: Yeah.

Julie: Let's go with the wooden one.

Excerpt from a 5th grade classroom gaming exercise on February 24th

[During an exercise, Dan is working on a stable for a farmhouse near the group's monastery. A couple of other students, Peter and Adam, note that Dan is filling the stables up with horses]

Peter: Dan, the horses were super expensive.

Teacher: Expensive?

Dan: Yeah...

Adam: Yeah, and we have a whole bunch of horses.

Peter: Don't you remember that, Dan?

Adam: We have them in the stables too.

Peter: They cost like 200 pigs or something like that.

Adam: Or five cows.

Teacher: Yes, they were really expensive.

Adam: Yes, it was probably more common to have like three or four horses.

The teacher's task in these situations is to maintain the established 'contract' which states that the fiction of the subject matter is to be maintained, even when the game itself does not enforce it in any way or even tempts students to break it. For example, steel doors are no more difficult to access or place in Minecraft than wooden ones, making them functionally similar, but by discussing the subject matter, the students start imposing constraints in the service of subject matter adherence. These types of interventions and techniques were important in helping students see how their use of game objects was tied to the subject matter. As the curriculum progressed, students became more adept at making connections between game objects and the subject matter being taught, and they started managing each other without input from the teacher.

Relying on the subject matter as an anchor for gaming activities could also be useful when handling the more proficient students' tendencies to start focusing a lot of attention on achieving something impressive from a gaming standpoint, sometimes regardless of its relevance to the subject matter being taught. Students working on the medieval castle, for example, started debating ways in which they could implement a vast subterranean railroad system that would be used for transportation. In that situation, the teacher needed to step in and discuss with the students whether those types of structures were used during the medieval age. Similar learning situations occurred when proficient students got carried away with their ambitions regarding what to construct:

Excerpt from a 5th grade classroom gaming exercise on March 2nd

[It is one of the last exercises for the group and Miley is done with her own project and is browsing around in the game world, trying to invent new things to do.]

Miley: Okay... but... where is the smithy?

[...]

Marcus: We don't have a smithy.

Miley: What?!

Miley: But we have to have a smithy!

Marcus: Naaawh – why do we have to have a smithy?
Pause
Miley: But we'll build a smithy then, because we have to have one.
Marcus: No, we're not really making any weaponry.
Teacher: Miley, we won't really start up any big projects like that now.
Pause
Teacher: How could you handle things if you didn't have a smithy in your monastery, Miley? How would you solve that?
Miley: Umm…
Marcus: You headed into the big city…
Miley: You went out to trade?
Teacher: Yes, so then you would have to solve it with the help of the villages and farms in the surrounding area, in case there was something you needed.

Continuously reinforcing the context of the game-based exercises by reminding students how they could or should interpret and think about game objects was a valuable way for teachers to discuss subject matter details with their students. Many of the learning opportunities that occurred during the exercises happened because students came to a point of uncertainty, where they would be unsure whether or not certain game objects were appropriate for the historical setting. Or, when students encountered limitations in the game which made it difficult to accurately represent something, the teacher could encourage the students to think of the game objects in different ways, or revisit their textbooks to see how things could be conveyed differently.

ESTABLISHING AND MAINTAINING THE LEARNING 'FRAME' OF GAME-BASED EXERCISES

Another important role the teacher served in the classroom was to establish and maintain the educational framework of the gaming exercises and combat students' tendency to become distracted by aspects of the used game that were irrelevant to the established learning objectives. As observed in the case study conducted in phase two (see chapter 10), and noted by Teacher E in the initial interviews of these case studies, using games as educational tools introduces a potential issue in that students may not know whether to approach game-based exercises as activities of leisure or of learning. As mentioned previously, many of the more proficient students had a tendency to let exploration or mastery of game mechanics take precedence over the learning objectives that the game-based exercises were designed to pursue. This could sometimes turn into a problem, as students could spend an entire 45-60 minute session only focusing on manipulating game mechanics. However, the teachers could combat this tendency and redirect the students gaming towards the learning objectives, sometimes by directly addressing the issue or just reminding students of their presence:

Excerpt from a 7th grade gaming exercise on February 27th
[Anna and James are meant to be building a scale replica of a real-world object of their choosing inside of *Minecraft*. The exercise has been going on for nine minutes and James has been spending most of the time using TNT to blow up things in their *Minecraft* world, while Anna has been trying to get him to focus more on the assignment]
James: I'm going to do an awesome thing.
Silence, with lots of mouse-clicks in the background
Anna: Teacher! Can we get some help?
Pause, the teacher comes over
Anna: What do you mean by "Settle on a scale"? (She is referring to a part of the assignment, where the students need to decide what scale their model of the real-world object will be in)
Teacher: Have you decided how to scale the object you're building?
Anna: Yes.

Teacher: Have you decided how 'large' your blocks are [in Minecraft]?
Anna: ... No.
[...]
Teacher: You need to decide the measurements of your blocks.
James: Oh, how large they're going to be?
[From this point, James joins the teacher and Anna in the discussion of the assignment, and they start planning how to conduct the exercise together]

In this example, the teacher did not need to directly address James, or comment on his playing, in order for him to start engaging in the discussion around the learning objectives of the game exercise. The efficiency and importance of teachers' presence, in reinforcing the learning 'framework' of exercises, can be seen in the previous example of the 5th grade class being disrupted by a student-created chicken invasion (see page 171). An otherwise focused group quickly turned their attention to a distracting element, after the teacher's attention was diverted from the classroom. More and more students were 'pulled into' the distracting activity while the teacher had her focus elsewhere, but when the teacher's focus returned to the class it was handled swiftly. In the larger classroom of the 7th graders, maintaining the rigour of the educational framework was a bigger task. Both the teacher and I needed to continuously patrol the classroom and try to spot where students' collaborations had broken down or veered off track.

There are several examples from the protocols and transcripted exercises where the teachers either spotted these types of situations themselves, or were called upon to mediate by students who wanted their partner to focus. In many examples the teacher is utilised by some students as a 'technique' to get their more game-focused working partners to focus on the assignment. These situations most frequently occurred in groupings where more proficient students with a tendency to be distracted were matched with less game-proficient students. Important to note is that a high level of gaming literacy was not necessarily required for the teacher to be able to identify and handle these types of activities. The ability of teachers to just 'read' the classroom as per usual seemed to be sufficient for them to be able to identify and handle many types of distracting or exclusionary behaviours caused by the game. However, there were also some more subtle types of distractions that the teachers seemed to have a harder time identifying. While a good understanding of the classroom atmosphere often worked well, some students engaged in unproductive gaming more surreptitiously. This happened more often in the 7th grade classroom, as students sometimes set up local area network servers and played together, communicating quietly via the text-chat rather than shouting at each other across the room. These types of distractions, where the students knew they were doing something they were not supposed to, and employed certain tools and techniques to avoid detection, were harder for the teacher to mitigate.

The educational framework could also be supported by distinguishing the educational game experience from the gaming experiences the students were familiar with at home. In the case of the 5th grade class, the server was set up in a way to disable text-chat and the presence of monsters. I had primarily implemented these changes to avoid disruptive play and unnecessary distractions (zombies and walking skeletons had no relevance to the subject matter). However, in an interview held after the the conclusion of the curriculum, Teacher G noted that:

> "I think, just as you have switched [game components] off, there needs to be a focus on [the school subject]... Because, when they play on their own, a part of the whole thing, a part of the whole game is to survive, or avoid zombies coming to get you, or something else. But now we didn't have that, because now 'it was school', kind of. Because you need to feel that difference, that 'now the focus is on [school, and not the game]'."

While the student interactions that were observed and recorded during the different exercises show that the educational framework was quite fragile, the teachers did have tools and techniques at their disposal with which to strengthen it and to combat student distractions. Sometimes, the teachers just making their presence known would combat distractions. Presenting the educational game in a different 'format' also helped to clarify to the game proficient students that it was not to be played in the same way that the students usually played the game at home. However, if students deliberately played to avoid being noticed by the teacher, the distractions were more difficult to tackle. To efficiently combat those types of behaviours, teachers would need a high level of gaming literacy, in order to quickly distinguish whether students' playing was productive or not.

ENCOURAGING STUDENTS THROUGH EXERCISE AND CURRICULUM DESIGNS

A less easily identified role that the teachers took on was finding ways to encourage and engage their students through modifications and twists in the exercise and curriculum designs. One particularly efficient method of encouraging students and keeping them focused on the educational use of a game they were familiar with was to have regular presentations of their work in front of the class. These presentations both seemed to engage the students, as proficient players had an opportunity to 'show off' their skills at playing the game, and also helped unify the classroom groups, by letting students see what their classmates were working on. This was exemplified in the game-based exercises with the 7th graders:

Excerpt from a 7th grade classroom gaming exercise on February 6th

[The teacher has repeated some important subject matter details from the last session, and the day's exercise moves on to a segment where students show off a geometric object they had planned and built to show their classmates. The classmates were then supposed to calculate the measurements of the object.]

Teacher:	Now we have caught up with the lesson we had last Friday, right? We were right here then.
Researcher:	Should we go over some of the 'hidden' scaled objects that they have built?
Teacher:	Yes, let's see here. You all got the assignment to complete this task we just went through. And, to also create an enlargement that we would figure out the scale of, or a minimisation that we were going to figure out the scale of. Both the length- and area scales.
Pause	
Teacher:	Is there anyone who, who could get their stuff out, that you have saved?
Casper:	I have mine here!
Archer:	Yes!
Teacher:	Good, Casper!
Lenny:	Yeah, it is totally enormous!
Teacher:	And Archer had one too? Should we go through two of them?
(F) Student:	But Archer wasn't here last time!
Teacher:	No, but Archer might have one anyway.
[...]	
Lenny:	This is going to be so damn difficult, I know how many blocks he used!

What was surprising about this exchange was Casper's and Archer's eagerness to show their prepared objects to their classmates. These two students in particular had been very vocal about how displeased they were with the boring way in which *Minecraft* was being used (yelling "this sucks!"), and often seemed disinterested and nonchalant regarding assignments during the exercises. Here, Lenny shows that he knows what Casper has prepared (suggesting that it has been talked about beforehand), and Archer has come prepared as well, even though he was not present during the exercise when this assignment was started. The observation protocol from the occasion describes the events that followed, as well as my own interpretations and reactions to them:

> **Observation protocol from the 6th of February:**
> The first student (Casper) had built a massive structure, scaling up the 12x12 base structure 15 times (he made a 180x180x180 cube, which is very impressive and must have taken quite a while). This student was one of the ones I had thought to be very disengaged and bored with the exercises, because he was a very good *Minecraft*-player beforehand. [...] He was very eager to show off his structure though, and quickly yelled that “I have one!” when the teacher asked “does anyone have one they want to show?”
>
> The student showed off his structure [on the classroom projector], and we calculated its scale together. I tried my best to vocalise how impressed I was with what he had built, but I don’t know if it came across that well. I need to be better in nurturing that kinds of things more, I think.
>
> The second student (Archer) had a similar build, and had made a 100x100 area (not a cube), and was also very willing to show it to the class.
>
> A problem with the presentation was that both players were doing it while still connected multi-player servers, and other “pro” players in the class were very disruptive during the showing of the shapes. [...] An interesting note, though, is that the first pro student (Casper) replied to the disruptive players in the game chat, saying things along the lines of: “Focus on my building”, and “Focus on the exercise!” He seemed adamant to get some recognition for what he had done, which I think is good change since he seemed so disinterested before.

This moment, even though it was somewhat brief, signifies the clash of many different types of behaviours and personalities in the classroom. A previously disengaged student had worked hard when he knew that he would be able to show off his work to his classmates. And, when other proficient players in the classroom displayed disruptive behaviour (which was very much the same type of behaviour that Casper himself usually engaged in), the student told them to focus. These types of presentations were somewhat time consuming, but were helpful in creating assignments that resonated with the proficient students.

In the 5th grade class, a similar technique was used; every exercise was concluded with a brief walk-through of the students’ game world. The students got together and looked at each others’ buildings, one by one, and had an opportunity to both show improvements they had made and talk about how they planned to proceed. This was important and not only served to motivate the students to keep working on their assignments, but also to bond the group together. The teachers also further contributed to the curriculum by having their students write detective stories that were set in the societies and buildings the students had built. Thus, the students needed to think about their *Minecraft* creations from a new perspective, as set-pieces for a mystery, and to once again connect the game content to the historical theme in a new way.

Playing an educational game, such as *Minecraft*, is a somewhat partitioned activity. Students work in small groups or individually and primarily focus on their own game progress and projects. By giving the students an opportunity to zoom out and see the broader context in which their gaming was taking place, or using what they had done in the game on the outside of the game world, the game-based exercises became anchored in the social and physical environment of the classroom. Furthermore, for some proficient students, such as Casper or Archer, being able to show off their expertise to their classmates made assignments that otherwise were deemed dull become more engaging.

12.2.6 SUMMARISING THOUGHTS FROM WORKING WITH EDUCATIONAL GAMES AND GAME-BASED LEARNING

While the events that transpired during the game-based exercises revealed the different types of challenges and possibilities educational games brought to classroom teaching, another important aspect of the study was to examine how they were understood by teachers. This was examined through interviews and discussions with teachers outside of the game-based curriculum, where some of their general experiences and perceptions of how educational game use impacted their own work and their classroom environment were gathered.

The teachers were generally positive about their experiences of conducting a game-based curriculum. Similar to the outcomes of the previous case study, Teachers G and H cited a heightened student engagement and interest in school activities as a noticeable result of the curriculum. Throughout the curriculum, the teachers frequently said that they saw how the students' attention and participation in the group work were elevated. Students that they normally had trouble reaching out to and engaging in exercises would become enthused and had the confidence to participate in activities in ways the teachers had rarely seen before. Teacher H's experience was that "this has given them so, so much. As much knowledge they have about the medieval ages now, they'd never know otherwise. And there's been such a 'lift'. Like the mystery stories they've written, it has been fantastic." Teacher G added that the game-based curriculum had a positive impact on the students' attitudes in other subjects as well: "It has also been noticeable in other subjects; they have gotten a better attitude towards school." The positive effects were noticed by the students' parents as well, who had been surprised at how quickly their children had developed new skills during the school term. Teacher G noted parents were very positively surprised "like 'wow, we used to struggle writing single sentences, and now they've written a whole book'!" So, it seems that the positive developments during the term have been very noticeable. My own observations during this project and previous work with educational games in classrooms also corroborate this. It should be noted, however, that while the effects of the project were positive, the resources, knowledge, and effort needed to use educational games were still seen as unachievable.

Excerpt from a post-curriculum interview with Teachers G and H

Researcher: Okay, so I would just like to ask you to consider how you feel about the way I have been working. Do you think something like this would have been possible for you to do without my involvement?

Teacher G: Well, it has all been kind of dependent on you.

Teacher H: Yes, [our] trust has been on you there.

[...]

Teacher G: I can sometimes feel a bit guilty [that you had to put in so much work]. Like, I should have done more...

Researcher: Well, do you think I should have done more to try and involve you in the processes more deeply? Like inviting you more into how things were established, or described the technology and the game to you in more detail.

Teacher G: Well, it is as... It just places such high demands on you, if I had known more. It would have taken so much – that is, under a school day. This was one part of a school day, there are so many things you need to do and keep track... Yeah. It's just so much over the course of a day and everything. So... yeah, I don't know, it would have just taken so much *much* more if I were to do it.

Teacher H: Yes. To me it's like you're tasked to learn Mandarin, it's sort of the same thing. It is such a huge thing. So if you had told us "now I've purchased this game, and it works like this, and this is what we can do", I don't think that would've helped. You need to have a certain level of understanding and know quite a lot first, *before* you can start understanding the next part, so to speak. It requires that you... If this was a different situation, with [teachers] who knew a little bit more, then maybe that would have worked ok.

Teacher G: Yes, to educate yourself, and to simultaneously keep the group on track like that... You would need to be able to focus ONLY on yourself, in a way. So it's a little bit like, when you arrive here [to work with our exercises], you don't really know what has happened earlier in the day, or what types of tensions have been building up or… Yeah, it would have taken so, so much *much* more. Even though I, of course, wish it could be [easier]…

Teacher E expressed similar sentiments regarding the effort required to use the educational game, stating that the project was not without some frustrations and occasional setbacks, while reflecting upon the values the educational game added to his maths curriculum, in relation to the effort expended to use it:

Excerpt from a post-curriculum interview with Teacher E

Teacher E: Sometimes you could feel as though… like, that it took kind of… that it kind of took a lot of circuitous effort for a small amount of output. You'd feel like that at times, that it was a bit ineffective. But… on the other hand, when the students actually got to work, during that working effort they could be focused, and that it all paid off a little bit.

[…]

Teacher E: Sure there'll be a little bit of frustration as a teacher, that feeling of "what did we actually achieve today…"

Researcher: I could feel the same way at times – "did we achieve our objectives, or did we mostly play around"

Teacher E: Yes exactly. Yes, that, *that* frustration was definitely felt, that kinda "what became of this" and "did we get really anything out of this?", or "awh well, today there was just a bunch of trouble just because some computer was troublesome, or that [the students] fell into…" But that could happen in a regular lesson too, that maybe you didn't bring a paper and pencil or so… so lots of things can happen.

Teacher E went back and forth in his reflections regarding the educational games' usefulness and how he felt about the game-based curriculum. At times, he would bring up some of the technical difficulties and frustrations felt during the project, but he also anchored them in some benefits or some difficulties that could happen during "regular" classroom teaching as well. Nonetheless, the challenges involved in setting up and executing the game-based exercises were frequently brought up by all the teachers, and seemed to be some of the more memorable 'take-aways' from the projects.

Just as in the previous case study, the teachers also acknowledged that the heightened engagement and attitudes they noticed in their group of students may not have been an effect of the used educational tool, but rather the novelties it was surrounded by:

Excerpt from a post-curriculum interview with Teacher G and H

Researcher: From my perspective, the educational game required a lot from you as teachers. You kind of have to have the game content in mind, and tie it together with the subject matter… So how do you feel that…

Teacher G: … But then, I don't think it's comparable. […] I think, even though you've arrived and know all this stuff… When a new person arrives, with different ways of doing things, and with a different drive… That itself is a point.

Teacher H: Mhmm.

Teacher G: And you do have a great way with them, and you've seen their capabilities. But the fact that an expert comes in like that…

Teacher H: Yes, Exactly.

Teacher G: You know, because we [the teachers] are kind of decent at a lot of different things, but when someone arrives with that level of specialised expertise.

Teacher H: And it also has led to them feeling 'specially chosen'. They have really been waiting, for "*when is Björn coming? When is Björn coming?*"

Teacher G: Yes, absolutely. And they have been so happy that we have had this opportunity to be involved in something like this.

This effect could be seen directly in the 7th grade class as well, as many students frequently enquired about my own engagement with the games industry. Even with my very modest pedigree, proficient gaming students would be excited just by knowing that I was familiar with, and even had some experience, working on something that was of great interest to them. I was asked about the types of game industry personalities I had seen, talked to, or worked with – and when my work would take me to various conferences, it seemed to further heighten the students' feelings of being specially 'selected' by someone in the field of games. While the effects that the novelty-generated excitement had on the impact of the game-based curriculum would be difficult to measure, it cannot be denied that it does influence students in some ways. As Principal B pointed out towards the end of the previous case study, a lot of the positive impact on students' engagement and interest in school activities could just be a "flavour of the week" effect.

Even after experiencing the entire game-based curriculum, teachers' perceived grasp of the educational game, and the technology required to use it, was still insufficient for them to feel confident enough to use it. That is not to say that their knowledge had not improved, but it was still at a stage where the process seemed intractable and uncertain. It should also be noted that the teachers' concern regarding the reliability of the tool was also strongly tied to the complex technology it required, and was not particularly connected to any kind of negative aspect of games as a medium. This became evident when the teachers began to discuss how it felt to start using technology for simpler exercises, after the game-based curriculum ended:

Excerpt from a post-curriculum interview with Teachers G and H

Researcher: If you'd see this as a tool you would like to use long-term, do you think you have the material to do that. Do you have support in the organisation to keep things "alive" in an adequate way?

Teacher G: My opinion is… now that we have written the detective stories and needed to get a lot of computers together, it has been a *total disaster*, so I think it's been a miracle that it has worked the way it has. And then [in the writing exercise] we were only using *Word*, but all of a sudden some computer won't find the network, and that computer won't start, and all that kind of stuff. So I don't think that [it has worked well]. So I think it's been a fantastic stroke of luck that it has worked the way it has.

Teacher H: Yes… I wonder why it's been like that…

Excerpt from a post-curriculum interview with Teacher E

Researcher: Now that we've concluded the curriculum. Does it feel as if… do you feel as though you could have conducted this work on your own?

Teacher E: No. No, I could not have sorted it out.

Pause

Researcher: Was it the technological aspects of it or…?

Teacher E: Yes… Or, maybe it is also that feeling that "I [need to] understand the game environment"

Researcher: So do you feel as if you would be able to work with games now, after the project?

Teacher E: No. No. *Laughs* No no.

Researcher: *Laughs* So it's still a no?

Teacher E: I feel… I feel as though if I would do a thing like this, then I would kind of have to lock myself in a room for a week, and then have someone standing next to me to explain like, "if you want to move from here to there, you push these keys", or "if you are going to build, you can start out like this" – to kind of submerge myself in the game, so that I master it.

In summary, the teachers' experiences echoed those that teachers and principals have detailed in previous studies. But, these interviews also highlighted how difficult it is to integrate teachers into all the underlying processes that are required for educational game use. The teachers understood that this was an issue and acknowledged that my presence was an absolute necessity for this project to get off the ground to begin with. Teacher E also firmly stated that if he were to make good use of educational games, he would require a lot of institutional support, in terms of working hours and workshops that could be devoted to helping him understand the game better. Furthermore, just as in the previous study, it was hypothesised that it was my own presence that could be a large part of why the students were energised by the game-based curriculum. Those effects could be tied to the general sense of novelty and the extra attention the students were given, and it is unlikely that the effects were brought forth solely by qualities of the games medium.

PART IV

RESEARCH OUTCOMES AND KNOWLEDGE CONTRIBUTIONS

The research questions guiding this thesis research focused on understanding the challenges and possibilities that arise when games and formal education merge together. This thesis pursued these questions by examining how developers approach the challenge of creating games that adhere to educational demands and how educators evaluate and integrate new educational tools, and subsequently participating in projects where educational games were integrated and used in formal educational settings.

In the following chapters, the knowledge contributions generated throughout the research process will be described and contextualised in the broader field of educational games research. The chapter will be initiated with a general summary of the actors, components, and processes that make up the development and use of educational games. These different elements will then be described individually in more detail, before they are ultimately aggregated into a comprehensive systems-oriented description of educational games and game-based learning. Finally, before concluding my research outcomes and contributions and moving on to the thesis's conclusions, a short discussion of the methodology employed during the conducted research will be presented.

CHAPTER 13
FRAMING EDUCATIONAL GAME RESEARCH, DEVELOPMENT, AND USE

In the initial chapters of this thesis I described the reasons that fuel educators', researchers', and developers' pursuit of making educational games fit into formal educational contexts, and subsequently delved into the more obvious practical obstacles that made this process difficult. The practical obstacles produced by the realities of formal educational contexts have been examined by researchers before (cf. Egenfeldt-Nielsen, 2008; Macklin & Sharp, 2012; Squire, 2005), and researchers as well as developers have also started to produce guidelines on how to circumvent them (Linehan et al., 2011; Westera et al., 2008). Both previous research (cf. Backlund & Hendrix, 2013; Morgado, 2013; Squire, 2005; Squire et al., 2004) and results from my own case studies have shown that games remain on the fringe of formal education, and that they are still primarily used to capture students that traditional educational means have failed to motivate. In my research, I have examined the details of the practical obstacles introduced by the formal education setting and the ways educational games are currently being used and developed for education with the aims of a new model for understanding educational games, both as games and as educational utilities.

The research was initiated with a foundation primarily built on serious games research and studies on game design and development, but it quickly expanded to include fields of research that could account for the organisational and sociotechnical aspects that I found useful for understanding all the peculiarities of educational games. These different disciplines and the way they have come to merge in this thesis are:

Game design and development continuously influences the way educational games are made, and their growing popularity and technological sophistication inform the interest and expectations that educators and students have in them.

Serious games and educational games research and design guidelines are useful for explaining how educational games foster learning and engagement, and what learning principles they can serve.

Instructional solutions design and information systems can provide theories and frameworks for understanding how information technology and instructional solutions fit into organisational contexts (e.g. in formal education), and how design and development processes can make the process of implementation smoother. Another important take-away from ISD/IS research is that software interventions and organisations need to be considered as a cohesive unit rather than two separate entities, and that the situational factors and structures of organisations can influence the characteristics of the software and vice versa.

This chapter discusses the findings produced through the systematic combination of the theoretical framework gained from literature studies within the three disciplines, and the results produced from case studies conducted throughout my two years of research. My interpretation of these results and their implications on educational games as educational tools and game development projects is presented along with a critical examination of my chosen research methodology and its execution.

13.1 EDUCATIONAL GAMES: MEANINGFUL LEARNING FROM UTILITY AND GAMEPLAY

To encapsulate the discussions and conclusions of this penultimate thesis part early on, I would like to present the first model that I devised during my previous thesis work (Berg Marklund, 2013; Berg Marklund, Backlund & Engström, 2014). The intent of this early model was to describe the different participants and concepts that converge during educational game projects (Figure 13.1). Previous research in serious games and educational games has emphasised the compromise between educational and engaging content, and there have been many suggestions regarding how to reach optimal compromises through appropriate design decisions. While this may be a reasonable approach for games that are not intended for use in formal educational contexts, it is insufficient when strict parameters for a game's use are introduced. No matter how well the developer manages to strike the difficult balance of providing transferable learning and an engaging game experience, the utilitarian aspects of the game will determine the impact the game will have in the educational environment. The intent of the model was thus to codify the many crucial components of educational games into an easily accessible format. The model both explains the relationships between actors, participants, and purposes that are a part of the makeup of educational games, as well as the tensions and dilemmas that can arise between them. Thus, both the purpose and the final appearance of the model share many commonalities with Harteveld et al.'s (2010) Triadic Game Design model (as shown in sub-chapter 6.3).

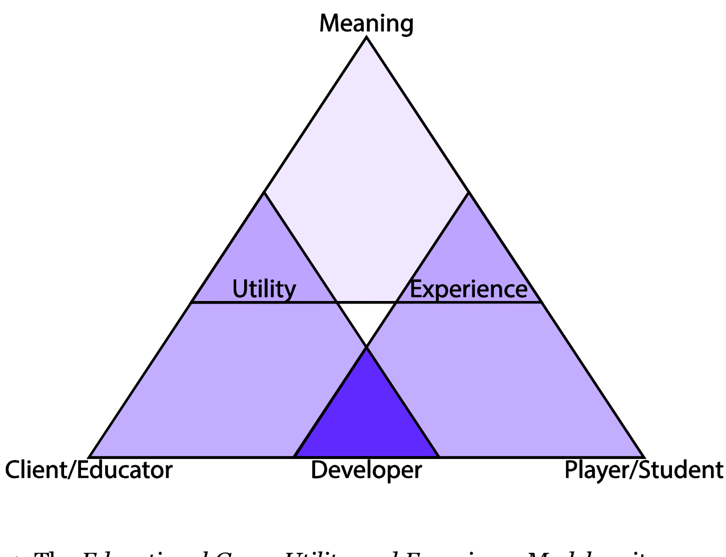

Figure 13.1: The *Educational Game Utility and Experience Model*, as it was presented in Berg Marklund (2013).

The model intends to depict how the different participants and values that are present at some point in an educational game's lifecycle relate to one another. I argue that the concept of educational games is based on a merger between experience, utility, and meaning.

Experience refers to the dynamics and aesthetics of a game, and the engagement and enthrallment the game world provides players who enter it. In essence, experience refers to game experience.

Utility refers to the way the game fits into the broader formal educational context, the aspects of the game that transform it from a leisure activity to an educational instrument; reliability, means for assessment or monitoring, and administrative tools for teachers are examples of the utilitarian aspects of educational games.

Meaning refers to the educational significance of the game's contents, and is affected by the interplay between experience and utility. While the aesthetics of the experience and utilitarian additions can sufficiently encapsulate the "physical" appearance of the game, the meaning refers to the learning derived from play sessions (e.g. subject matter representations, collaborative problem solving, communication-driven challenges).

While these are the three cornerstones that I consider constitute an educational game, the properties of experience and utility are results from collaborations between the actors participating in the creation and use of the educational game. The lower part of the model not only describes the way the different actors fit together and what they produce (e.g. developers and clients come together to create an object with utility), but is also meant to indicate how the collaborations can be understood.

When it comes to constructing experience, developers often directly collaborate and conduct playtests with the intended players of the educational game, or they indirectly analyse their target audience to understand what type of experience would be appealing to them. To understand these relationships, we can return to the theories presented in the background of entertainment games. The MDA framework (Hunicke, LeBlanc & Zubek, 2004) can be seen as an explanation of the way the developer and player/student produce an experience together. The descriptions of pleasurable experiences in flow theory (Chen, 2007; Cowley et al., 2008) and the 'theory of fun' (Koster, 2005) can provide guidelines to crafting engaging games by understanding the psychology players. And, finally, the patterns of game design vernacular, developed in Björk and Holopainen (2005, 2006), can be useful for planning the types of experiences that a game aims to provide and for understanding how the relationships between different types of game mechanics can be utilised to achieve those experiences.

Utility, on the other hand, is a product of collaboration between clients and the developer. The client brings a specific organisational context to the collaboration and developers need to understand the culture, environment, and infrastructure of this context, in order to create something that provides utility. Here, models such as Alter's work systems framework (Alter, 2008b, 2010) and models from instructional system design (Gustafson & Branch, 2002; Moore, Bates & Grundling, 2002), can be useful for explaining the process of developing these types of utilitarian educational games and the context in which they are to be used. Another important step in ensuring utility is to acknowledge that the design and development of a system do not end once a product has been created, and that it has a chance to evolve inside its intended organisation. An important part in the ADDIE model (Gustafson & Branch, 2002; Molenda, 2007) as well as the work systems model (Alter, 2010) is their emphasis on the continuous evaluation and refinement of developed information and instructional systems.

So, both utility and experience are created in collaborations between developers and their clients, and between developers and players. Nonetheless, clients and players not only assist in creating these elements of educational games, their properties and characteristics heavily influence the games' utility and experience. The role of the developer is not only to collaborate with both clients and players, but also to interpret their characteristics and tailor the experiential and utilitarian aspects of the developed educational games accordingly. Through the subsequent use of the game during school activities, experience and utility will be provided to educators and their students, which in turn combine to produce meaningful play sessions.

While the Educational Games Utility and Experience model presents a way to characterise the anatomy of educational games for formal education and hints at their complex makeup, it does not present challenges and concerns specific to the different "sectors" of the model. In general, the model is too crude to provide much value beyond a shallow description of educational games and the actors and purposes involved in making them useful and meaningful, and to also state the fact that educational games constitute something more than learning-infused game experiences. Fleshing out the different parts of the model with more useful details was thus essentially the focus of the final research phase. After the results of the different studies have been codified, an updated, more nuanced version of the model is presented. First, however, the research process and results are anchored in the broader field of educational games research.

13.2 THE DISCREPANCY BETWEEN LITERATURE AND REALITY

The literature review conducted during this thesis work indicates that there is an overemphasis on examining the educational effects of playing games, matching game characteristics with pedagogical principles, and finding ways to improve the design of games, in order to find a balance between engaging game mechanics and learning content. While a lot of attention is being directed towards those research areas, less research effort is devoted to understanding the contexts of educational game playing. While games are used in various degrees in classrooms today (cf. Egenfeldt-Nielsen, 2011; Stieler-Hunt & Jones, 2015), the prophesised impact of educational games on education has not yet been as significant as many would have hoped or anticipated (Egenfeldt-Nielsen, 2010, 2011; Klopfer, Osterweil & Salen, 2009; Tan, Neill & Johnston-Wilder, 2012; Young et al., 2012). This slow growth can be attributed to several factors. Papers from 2003 (Kirriemuir & McFarlane, 2003) and 2005 (Becker & Jacobsen, 2005) brought some basic practicalities of formal contexts up for discussion, but without much elaboration or explanation. The same issues are, however, also raised in later publications as being relatively novel (Petley, Parker & Attewell, 2011; Tan, Neill & Johnston-Wilder, 2012; Wagner & Wernbacher, 2013), which suggests that little progress has been made towards solving the various practical issues that educational games manifest. The discourse is becoming more sophisticated, however, and tends to use a more nuanced rhetoric when it comes to describing the reasons why educational games are difficult to employ in formal educational settings. Older publications tend to lament the resistance of educational systems to readily employ educational games and attribute it to educators being misinformed or stubbornly resistant towards accepting the educational potential of games (cf. Becker, 2005; Becker & Jacobsen, 2005). Newer publications tend to take a more nuanced approach and consider eventual shortcomings of educational games to be a product of dubious ad-hoc development processes, the impractical nature of games as educational tools (Backlund & Hendrix, 2013; Egenfeldt-Nielsen, 2011; Young et al., 2012), and that games may not be as inherently conducive to learning as previously thought (Egenfeldt-Nielsen, 2004, 2010; Frank, 2012; Linderoth, 2009, 2010, 2012; Shaffer, 2012).

On this note, the previously popular argument that teachers are averse to using digital games as part of their curriculum does not seem to be particularly accurate. In a study conducted in 2009, by Wastiau, Kearney and Van de Berghe (2009), showed that the majority of teachers in Europe are interested in starting to use games in their teaching, and that 70% of them had some minor previous experiences with trying to do so. A similar research effort done in the US reached similar conclusions regarding teacher attitudes towards games (Ruggiero, 2013), but had lower percentages in regards to their experiences of using games (46%, as opposed to Europe's 70%). The majority of teachers in both Europe and the US thus seem to have accepting attitudes towards games. The interviews conducted with developers and educators during this research resulted in similar findings, as none of the encountered educators were dismissive of games as educational tools due to negative connotations with games as a medium (e.g. games being frivolous, juvenile, addictive, or violent). Any concerns regarding the viability of games as educational tools centred on whether they could feasibly function reliably in educational organisations, or teachers were worried that their limited gaming literacy would be a hindrance to how well they would be able to use them.

Claims that educational games' progress into formal education is primarily hampered by teachers' unwillingness or adversity to using them, because they are considered decadent or frivolous, thus no longer seem valid. The apprehensions that educators do have can instead be connected to more practical concerns that largely tend to be glossed over in the general educational game discourse. While researchers have constructed many guidelines describing how educational games can be designed to be both engaging and educational, guidelines for producing educational games with high practical utility are almost non-existent (Egenfeldt-Nielsen, 2008; Heintz & Law, 2015; Linehan et al., 2011). This has landed educational games in an odd situation. They are simultaneously being promoted for their theoretical educational potentials, but little consideration is being given to whether they are realistically achievable. The few studies that do attempt to develop and utilise games in and for formal settings highlight this dichotomy as well. As concluded by Wagner and Wernbacher's study (2013), the processes required to successfully integrate and use educational games in formal settings make it "difficult if not impossible to achieve economies of scale in educational game development."

After having experienced the processes required to establish a few (moderately successful) educational game systems in a formal educational setting first-hand, the limitations of the common research approaches in the reviewed literature were even more evident. Beyond the problems related to the exclusion of real-world applicability, there is also an inherent problem in the way that the effectiveness of games as teaching tools is described. The problem is that the properties of educational games as teaching tools are often evaluated in 'artificial' educational environments. In order to make a game scenario work well enough to be tested, researchers often contribute significantly to the infrastructure of the educational context. The researchers often step in as game and technology experts and assist in setting up the correct technological infrastructure to make play sessions work smoothly. They also often supply the educational game to be studied, which alleviates any monetary concerns of acquiring licenses, thus influencing educators' perceptions of return on investment. While the current state of the average classroom environment makes these interventions necessary for studies to be carried out at all, it is problematic that the interventions are seldom subject to critique or discussion in educational game research or elaborated upon in the research results of individual studies.

Constant proclamations of the virtues of games as learning environments can be a major disservice to educators, if they are not also followed by clear declarations of the types of use-contexts from which the positive conclusions are drawn and where similar results can be expected. Researchers seldom make the distinction between structured formal usage and informal play. Furthermore, conclusions made regarding the educational potential of educational games are often derived from artificially supported teaching contexts that do not represent the average educational environment. This leads to a situation where the primary output from the research community is that games are potent and useful learning environments that should be used, which encourages educators and developers with little practical knowledge of what is required to develop, implement, use, or sell educational games to pursue them.

Much work has gone into detailing and mapping out the internal structure of educational games as “game products”, but comparatively little work has been done to understand them as objects in a context of use. A municipality, school, or classroom environment is not an empty vessel into which an educational game is poured, and a game’s impact will not be determined solely on how well it balances subject matter representation with notions of good game design. The context matters. It contains factors that put constraints on what an educational game is “allowed” to do, but also elements that can facilitate play sessions and alleviate some of the pressures of what educational games need to convey through their design (Egenfeldt-Nielsen, 2010, 2011).

Educational game studies need to produce more research that examines the practicalities of using games as teaching tools. Creating good educational games is not just a matter of design choices that improve the dynamics between the game and its player or find a balance between engagement and learning principles, it is also a matter of working with the peculiarities of formal education as a context of use. Bogost describes the fundamental concept of educational games as “a massive rejection of the customs of both videogames and education. … If we want to have educational videogames, we are using games against the grain, and education against the grain” (Bogost, 2008, p. 161). Working with formal contexts not only requires concessions in how we think about gameplay and game design, but also how we think about educational practice and organisation (Bogost, 2008; Egenfeldt-Nielsen, 2011). The formal context is not always a constraining factor; it provides several unique opportunities that can create new types of gaming scenarios and ecosystems. The case studies conducted in this thesis attempt to target that knowledge gap, by providing some examples of why it is problematic and negatively affects educators and developers.

CHAPTER 14
DEVELOPING AND INTEGRATING EDUCATIONAL GAMES IN FORMAL SETTINGS

The observations made during this research show that formal educational settings introduce a wide range of parameters that educational games need to accommodate, in order to be considered useful. No matter how well the developer manages to strike the difficult balance between providing transferable learning and an engaging gameplay experience, the game's ability to accommodate more practical aspects will determine the impact the game will have in the educational environment. But, it is important to add that the formal educational context is not always detrimental to educational game development and design; it can give developers several opportunities to elevate the quality of their products. This chapter presents a more detailed description of several considerations regarding how the formal educational setting impacts the development and design processes of educational games.

14.1 INTEGRATING GAMES INTO FORMAL EDUCATIONAL SETTINGS

Formal educational settings impose some restrictions on how a game can be played, as well as requirements on how it needs to function. As such, educational games are no different from other types of software that are to be developed and used in organisational settings (Alter, 2006, 2008a, 2010; Clarke & O'Connor, 2012; Silvius & Stoop, 2013). For educational games, the infrastructure of formal education presents many significant challenges. Infrastructure is a combination of local and broader situational factors, such as national or regional parameters. Local parameters can, for instance, be the local culture and social attitudes towards games in education among teachers, legislators, and parents, or individual teachers' game and technology literacy. National or regionally dependent parameters can be curriculum guidelines, budget constraints, or school term schedules. The local parameters are, on the one hand, somewhat malleable, but can, on the other hand, severely limit the broader applicability of an educational game since it is difficult to create a game that can accommodate the differences between different educational institutions. Properties of national parameters are comparatively reversed; rigid, but largely uniform between different educational institutions. Table 14.1 is a summary of the more prevalent situational factors related to formal educational infrastructures identified through the interviews and case studies conducted in this thesis work.

Table 14.1: A broader categorisation of the three aspects of formal educational settings that needed to be taken into special consideration during educational game integration and use.

Category	Situational factors: participants, technologies, and practices
Human factors	Cultures and attitudes
	Parental considerations
	Students' interpersonal relationships
	Students' proficiencies and preferences as learners and game players
	Teachers' experience and expertise: • Gaming literacy • Technology and computer literacy
Technological factors	Device availability (e.g. PCs, tablets)
	Network availability and security
	Technology reliability
	Information storage and access
Organisational structures and praxis	Schedule constraints
	Classroom sizes and Educator:Student ratio
	Curriculum guidelines
	Management and supporting entities

The infrastructure factors that affect the application of educational games can be divided into human, technological, and organisational factors. Some examples of human factors are a teacher's experience of and expertise in using educational games, students' gaming literacy, or developers' and educators' ability to communicate across their respective disciplines. The teacher needs to understand the game, in order to understand what students are doing within it and to be able to translate game progress to curriculum progress and learning objectives. The teacher also needs to be proficient in setting up play sessions in a limited amount of preparation time, as well as assign tasks and support their students during the play sessions. Teachers are also important conduits between the learning context and the play context, and need to know how to contextualise the game content to the subject matter being taught (Alklind Taylor & Backlund, 2012; Alklind Taylor & Backlund, 2011). An understanding of the game being played can also be important for evaluating a student's progress through the curriculum (Bourgonjon & Hanghøj, 2011; Kickmeier-Rust & Albert, 2008; Law et al., 2008). The integration of the educational game and the designs of the game-based exercises it is going to be used for, also need to allow for students' familiarity with games as well as the taught subject matters. Finally, it is also important that the game software is well linked to the educational setting, which the communication between the developers and educators can greatly affect.

The culture and attitudes in an educational institution must also be receptive to games as a medium. As previously mentioned, the acceptance of games has increased significantly in recent years and current research points towards a high degree of acceptance of games as potential teaching tools by parents and teachers (McClarty et al., 2012; Wastiau, Kearney & Van de Berghe, 2009), and the interviews held with educators during this research ratified this. The teachers as well as the principals included in the case studies had primarily experienced enthusiasm towards using educational games among their colleagues in previous discussions. However, the enthusiasm was often coupled with some apprehensiveness, since adopting any new educational tool always entails the introduction of a few challenges. The teachers uniformly stated that they had not themselves, nor their colleagues or the parents, expressed any doubts concerning whether one could learn something by using games, but also added that they were still concerned about the feasibility of game use in educational environments, given the many practical considerations that game use entails. The interviewed principals also stated that there is some trepidation among other principals and teachers regarding the adoption of instructional solutions whose inner mechanics are largely indecipherable to them, due to the opacity of modern technologies. In short, adopting games in a classroom can feel like relinquishing some control over teaching processes, since teachers may not know the inner workings of the tool being used.

Regarding the technological side of educational games, it is undeniable that teachers need to be able to orchestrate a lof of complex technical components if they are to use digital game-based learning as a part of their teaching process. During the conducted interviews, teachers frequently stated that 'reliability' and 'stability' were crucial requirements for any educational game to be an attractive or even feasible proposition for classroom implementation. Seemingly simple practicalities like device availability and reliable ways of conducting play sessions can be difficult to maintain, but are crucial to retaining continuity in game-based lessons (Egenfeldt-Nielsen, 2008). There are also more complex matters of being able to monitor play sessions, either in real-time in order for teachers to moderate classroom activity, or retroactively for the assessments of students' progress in the curriculum. It is important to realise that traditional means of education provide easy methods for assessments and evaluations and, in contrast, educational games can seem overly complicated and difficult to codify. To support these processes, educational games need to be developed with teacher involvement in mind and provide specific guidelines regarding how the teacher can discuss game-based exercises with students, and how they can evaluate students' progress during a game-based curriculum. For example, the game *Global Conflicts: Palestine* (Serious Games Interactive, 2007) takes this approach, and provides instructional manuals for teachers that explain how the game-based activities should be introduced and how debriefing classroom discussions can be conducted. Another approach that is somewhat more advanced and technical is to implement ways of tracking various metrics from play sessions, for instance, providing data of students' destinations in a game, the characters they encountered and the dialogue options chosen, or how the student interacted with the game world (Kickmeier-Rust & Albert, 2008). Making such data available for teachers is, however, only valuable if the teacher knows how to interpret it, so it can require some training on the part of teachers. Nevertheless, incorporated means of student assessment can be a potential way of making an educational game more appealing to teachers (Alklind Taylor, 2011, 2014).

The organisational practices common in formal education are, in general, somewhat antithetical to the way games function 'naturally'. School days are normally scheduled in a way that fragments play sessions. If lessons within a specific school subject are spread out over an entire school term, there will be few classes per week for the subject. This has some implications for how games need to be designed in order to provide a solid game experience and meaningful learning activity rapidly. In entertainment games, players can spend several consecutive hours becoming immersed and engaged by a game experience, as well as familiarise themselves with the game mechanics and interface. Placing fixed limitations on the length of play-time and long interims between game sessions interrupts the rhythm of gameplay. As seen in the case studies with educators (see chapter 10 and 12), organisational working processes and structures greatly influence the design of a game-based curriculum, as well as the individual game-based exercises it contains. Merely designing a game with subject matter content and game mechanics in mind may thus not be enough to ensure that a game can have an impact in formal educational settings. Managing to integrate an educational game into a formal educational setting, and reaching the objectives that one might strive for when doing so, require that developers and educators either restructure obstructive organisational elements or implement solutions in the used software to accommodate them (see Figure 14.1). As seen in the case studies, even using *Minecraft*, an immensely popular and acclaimed game, did not result in a universally positive gameplay experience, since the classroom environment, coupled with early exercise designs, was frustrating for many of the students. But, restructuring the game exercises slightly and leveling the gaps in the students' gaming proficiency helped to improve the gameplay experience over time. Similar issues and solutions were found, when it came to increasing the utility and meaningful classroom scenarios provided by the educational game.

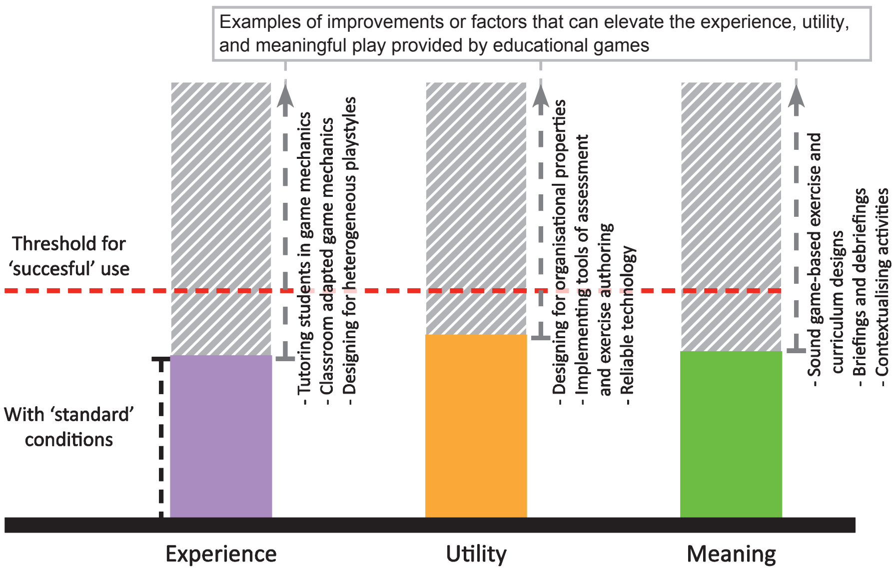

Figure 14.1: A visualisation of what types of improvements can be needed for educational games to have a successful impact in formal educational settings. Across the various case studies, the educational setting was rarely found to be able to make good use of educational games without significant interventions made to improve technological infrastructure, restructuring working processes, and redesign their curricula.

The conducted case studies made it evident that integrating educational games into formal settings is a work-intensive process. Taking a thorough inventory of the available hardware and resources as well as researching what to expect from the software being integrated are crucial for making the process of integration as smooth as possible. Even so, new obstacles and special considerations arose during the different integration processes experienced during this research, although the same game was used in all case studies. The average classroom environment, or educational organisation, does not inherently possess all the necessary technology and working structures that can be necessary to accommodate digital game-based learning. Each and every classroom situation also presents unique preconditions that will affect the process of educational game integration. This is, again, a problem that is exacerbated by the lack of research on the practicalities of formal educational settings as gaming venues. In situations where educational games have been put to use, parents, teachers, principals, students, or researchers may have done a lot of important ground-work that can be difficult to identify, since the focus is generally on the end-results of the integration and use process. When developing or attempting to use an educational game, the strengths and shortcomings of the recipient organisation need to be used as a starting point. The organisational structures, culture, working processes, and technological infrastructure need to be thoroughly inventoried before the integration of an educational game can be initiated. The process of integration itself also requires a lot of resources. To reach a point where an educational game can provide teachers with utility, and become a platform for meaningful educational experiences, an organisation needs to be ready for them.

Educators and developers should be aware that educational games require a great deal from a school's infrastructure and organisational culture in order to work well. An awareness of these concerns can be as important during educational game development projects as understanding the subject matter being taught. However, it is important to look at the organisational aspects mentioned here as adaptable, even though changing them may seem overwhelming in the short term. The flexibility of organisational structures is a core principle in the field of IS, where organisations are not considered as static constructs for which new software solutions must be precisely sculpted. The implementation of new solutions can reveal shortcomings in organisational practices and encourage improvement (Alter, 2010; Gustafson & Branch, 2002). Educational games can influence the organisation of formal education the same way, but developers still need to be aware of the details of their clients' traditions in order to start experimenting with ways to gradually change them. As new technologies, such as educational games, make their way into formal educational settings, organisational practices and structures will likely start changing to make better use of them.

14.2 CO-DESIGN METHODS FOR USER ACCEPTANCE AND USABILITY

Attempting to use educational games in the classroom is a risky endeavour. While educators in the studies were primarily positive about educational games, the requirements placed on their performance as teachers by national and regional educational standards were an added hindrance to using them. It is an understandable concern; to some extent educators throw guidelines and regulations to the wind when using educational games instead of traditional educational methods. If curriculum goals are then not achieved, the teacher, or principal, is the one held accountable which, without the defence of having operated within the boundaries of established guidelines, puts the educator in a vulnerable position. This may be the reason for why digital game-based learning projects are often conducted in classes and cases where the teachers are already operating outside the realms of their traditional formal guidelines (e.g. special education, or non-graded and non-mandatory courses). For educators, these are safer petri dishes in which they can experiment with new types of educational tools. In larger classroom contexts, the stakes are higher, which is compounded by the fact that introducing new types of tools is more cumbersome and involves more complex logistics when 20-30 students are involved than the smaller number of students in special educational settings.

Theories of technology acceptance, found in the field of IS (described in chapter 7), state that facilitating conditions within organisations, social influences from co-workers and the expectations of required effort and end performance of solutions are all significant factors that can make or break the introduction of new technologies in organisational structures (Davis, 1989; Venkatesh et al., 2003; Venkatesh, Thong & Xu, 2012). The facilitating and constraining conditions that teachers and principals are subject to are not only dependent on regulations established within their own institutions, but also on performance pressures from parents, as well as grander, politically established national guidelines and performance requirements. Factors such as these influence the intentions educators have to utilise educational games, as well as how they ultimately utilise them once provided with the opportunity. In the interviews, all the educators brought up concerns regarding their institutions' accommodation for using educational games, other teachers' and parents' opinions on the matter, national curriculum specifications, and increased workloads as potential hindrances to using educational games, on several occasions. As previously stated, the concerns of acceptance were rarely rooted in scepticism regarding the validity of games as learning tools, or stigmas traditionally surrounding games in general, but rather their ability to provide a valuable service in an efficient and reliable manner.

These issues are far from unique to educational games, and are similar to issues faced by any technology or system that is to be implemented in an organisational environment. Avison and Fitzgerald (2006), for example, state that the attitudes of the end-users of an IS are heavily influenced by cultural and social trends in their organisational environment. When faced with a new IS, users can feel that they are being burdened with extra effort as their working routines are changed, or they can feel that the freedom and independence of their working situation are compromised. These are pressing issues that seldom make themselves known before a significant amount of resources have been spent to design, develop, and implement the IS. The execution of the IS certainly plays a crucial role in how it will be accepted by the intended users, and competent design can alleviate some of the issues with user acceptance (Venkatesh, Thong & Xu, 2012). However, a more efficient and accurate method to increase acceptance is to have the IS design and development process open to meaningful user participation (Gustafson & Branch, 2002; Mumford, 1983).

User participation can be included in development processes in several different ways. Some good guidelines are, for example, provided by Mumford (1983), who presents three different ways of being user inclusive that can be useful in educational game design processes as well: consultative participation, representative participation, and consensus participation (described in more detail in sub-chapter 7.2). These IS principles of co-design could likely be used to effectively alleviate issues in the application of educational games as well. The more experienced of the interviewed developers attested to this, as they had used co-design methods to good results before, and felt that their games had longer-lasting use as they were more suited to their clients' working situation.

Inviting teachers to co-design educational games may also directly bolster their quality. Working towards formal educational settings as a game developer is not only about navigating constraining conditions and requirements; educational settings also contain resources and factors that can elevate the design and usefulness of an educational game. Educators are highly familiar with these resources and factors, and know how to either work with them or circumvent them, and they can thus be valuable contributors to developers' working processes. When a teacher is invited to participate in the design process, they can contribute ideas that can improve the educational game's performance in its intended setting both as a game and as a teaching tool. For example, they can describe what types of contextualising activities the game can be designed to accommodate, which gives developers the liberty to be more abstract, conceptual, and symbolic in the design of the gameplay. Without the presence of a teacher to provide contextualisation, an educational game needs to represent the details of a subject in high fidelity and with clarity to ensure that the information contained in the game is accurate and that it cannot be misinterpreted by the students. When a teacher is involved, however, they can step in and contextualise game-based exercises and tutor students who may have trouble navigating the game content or understanding its bearing on the subject matter being taught. Thus, designing educational games together with educators that have a good grasp of their context of use and of students' needs, can be a way to improve the educational game while also reducing design complexity.

14.3 FORMAL EDUCATION AS A MARKET FOR GAME DEVELOPERS

As described in sub-chapter 6.2, game development is a time consuming and resource intensive process that requires a wide range of expertise. Creating any type of game constitutes an investment in both time and money. While the market for entertainment games can make these investments worthwhile (given that the developers' product resonates with an audience), the market for educational games in formal settings works quite differently - often to the detriment of educational games' viability as business ventures. In Wagner and Wernbacher (2013), it is concluded that the realities of formal educational settings have significant implications regarding how educational games function as a market commodity. The authors go as far as to ponder whether it may actually be "impossible to achieve economies of scale" (Wagner & Wernbacher, 2013) with educational games, given the difficulties they themselves encountered when developing an educational game for use in formal education under relatively favourable conditions. The studies conducted during this thesis ratify these concernsand also provide some more nuance to why the issue might be even more prominent than previously thought. The case studies presented in chapters 10 and 12 especially show the fundamental incongruities between games and formal education, as well as the demands that the introduction of game-based educational activities place on a teaching environment and its actors.

The effort and resource investments that schools are required to make to enable the use of educational games in positively impactful ways make the marketplace somewhat inhospitable. Many schools are, much like the ones studied during this research, largely unable to use educational games, without the involvement of outside help, thus limiting the market size considerably. Another issue is that the schools which may be able to receive educational games also work under very different requirements and organisational processes. The learning objectives and working processes of a specific Swedish school is likely to be quite different from a school in a different municipality, let alone a school in a different country. In essence, the 'open market' for educational games may be smaller than one might expect. The differences in local conditions also make the audience highly heterogeneous, which makes it difficult to create products that all potential customers (of this already small market) will be able to use.

When looking at the outcomes of the studies including developers, two broader categories of design processes, for the application of educational games in formal settings, emerged that seemed to be a symptom of these market realities. The developers either focused on providing a game that is tailored for a specific segment of an educational process or even for a specific school, or they provided a more general game 'framework' that educators could then adapt to their individual infrastructure and teaching needs. In the following examination, the two approaches are dubbed tailor-made and adaptable games respectively.

Both of these approaches have their own benefits and shortcomings. Tailor-made games will often adhere to local school practices and infrastructures well directly as they come out of development. They will likely require little preparation and general gaming-knowledge from the receiving educator, since the game has already been specifically adapted to the subject matter and organisational setting in which it is to be used. These types of games are usually expensive for educators to acquire, since they will either need to specifically commission the development of the game, or the market for the game will be so specific that the developer is forced to put a heftya price tag on it. Educational games with a more general and adaptable design are probably cheaper for educators initially, since development has, in effect, been taken care of by the developers, without the financial involvement of the school.

The difference between tailor-made and adaptable games is primarily how the investment is distributed between the game's developers and the receiving educational institution. For educators, adaptable games are cheaper regarding game development and maintenance costs. However, the infrastructure, teaching-styles, and student characteristics that are unique to the specific school are not directly catered for, so the schools need to make these adaptations and re-interpretations of the game content themselves, to make it usable for their teaching goals. Tailor-made games, on the other hand, take the specific concerns of the educator into consideration to a much further extent, and are often also built together with the educators that intend to use them. This leads to a more directly usable game once it has been developed. Nonetheless, educators will need to invest funds and effort in creating and maintaining the product's functionality (e.g. spending teachers' work hours on workshops and testing of the game, and paying developers through the development process and for long-term maintenance). Compounding this issue is the fact that educators usually do not have assets available for the experimentation and development of new educational tools, as stated by principals in the interviews. This severely limits the possibilities of establishing the long-term maintenance of a tailor-made title, and can be prohibitive to incremental and evolutionary development along the guidelines established in the field of instructional system design. For instance, all but one of the developers (Experienced 2) interviewed during this study had all their educational game development tied to specific projects where a piece of software was the end-goal. However, no further plans of establishing long-term collaborations with the educators for continued product refinement or maintenance was mentioned.

From a developer's perspective, the difference between tailor-made and adaptable games lies in how they provide revenue. Tailor-made games are usually created as a commission from a client in education. The created game's general marketability and potential as a long-term revenue stream are likely to be severely limited, and the bulk of the revenue will be derived from the development process paid for by the client. Adaptable games, conversely, have a wider marketability after their completion and can be a worthwhile pursuit for companies that do not wish to work on a contractual basis with different clients – but development costs often fall upon the developers themselves.

Both of the experienced developers interviewed during this research stated that they had some difficulties remaining profitable. The developers had widely different business strategies, one selling licences of their educational game to schools and the other looking for clients that could commission projects from them. The difficulties of the educational games market boils down to the size of the market, the properties of the costumers, and development costs. The amount of money a school can spend on material for individual students, or entire subject matter curricula, is often severely limited. For example, Principal A stated during interviews that the budget for new 'teaching materials' (i.e. not counting teachers' salaries and various administrative costs) in Swedish schools is approximately 1000 SEK (~115 €) per calendar year for each student in grades 1-6, and 1750 SEK (~200 €) in grades 7-9. Further research on Swedish investments in teaching materials revealed that a mere 27 SEK (~3 €) had been spent on acquiring digital teaching materials in 2012 (Svenska Läromedel, 2014a). In the subsequent years, digital teaching materials were included under the same budgetary posts as textbooks and other types of teaching supplies (which makes tracking the acquisition of digital tools harder); an average of 546 SEK (~60 €) was spent per student in 2013 and 568 SEK in 2014 (Svenska Läromedel, 2014b). The money made available from these budgets needs to be distributed over all the subjects a student takes throughout a year, therefore, buying individual game licenses for students in specific subjects may require the game to be sold quite cheaply. The alternative is to buy more flexible school licenses not bound to specific students, which can allow developers to increase the price of licenses, with the caveat that they will have fewer long-term sales. Currently, the market is also limited in size, as the number of schools that are viable customers (i.e. schools that fulfil the necessary preconditions to feasibly support the use of educational games) is probably quite small.

One way to tackle the inherent discrepancies of the educational games market is to decrease development costs as much as possible. One way in which developers can do so, without significantly compromising the production qualities of the educational game, is to utilise and modify pre-existing game titles to give them an 'educational' veneer. The game used during my own case studies, *MinecraftEdu*, is one example of that strategy. But, there are many other examples of recognisable commercial game titles being modified and used for educational purposes, such as *Portal* (Shute, Ventura & Ke, 2015; Valve Corporation, 2007), *SimCity* (Maxis, 1989-2014; Nilsson, 2008), *Kerbal Space Program* (Corriea, 2014; Squad, 2015), and *Civilizations* (Firaxis Games, 1991-2014; Squire, 2005). Appropriating an already developed game title for use in educational settings, which a couple of the interviewed developers did as well, may reduce development costs, but introduces potential costs for purchasing the license to use the game or paying royalties to the original developer. It also limits the possibilities of what can be done as a developer, since some games may be constructed in a way that limits the adjustment of game mechanics to make them suitable for various educational means. One of the experienced developers, Experienced 2, had taken an interesting approach to the issue of the limited market size, by attempting to 'build' the market themselves. As their process to educational game development was to modify pre-existing game titles (thus reducing development costs) and provide a broader game 'framework' that catered to a wide range of schools rather than specific clients. Their revenue model was thus based on a large amount of educators purchasing their products. This meant that their individual product costs had to be kept relatively low (to compete with other teaching materials), which in turn meant that their revenue model relied on the existence of a sizeable market. Their aim was essentially to sell many adaptable products for a competitive price, rather than sell a few tailor-made products for a high price to niche clients. As previously mentioned, however, schools do not necessarily constitute a particularly large market. The developers response to this was to provide schools with workshops and tutorials on how their products could be used, thus building up their own market. In a way, the decreased cost of developing the educational game could instead be spent on cultivating a market capable of receiving it. This approach captures the current state of educational games rather well, and also highlights the importance of the formal educational settings, when it comes to the properties of educational games as commodities.

The other approach of working on commissioned development projects and creating tailor-made educational games (i.e. being paid for your services as a developer rather than the end product) has its own quirks. Working on commissioned projects gives developers a stable income during project months, but setting up projects in sequence to ensure a stable income is difficult. When educators find good reasons to create an educational game to support their teaching procedures, a laborious process of finding money to support development needs to be initiated and finalised before development can actually start. This means that projects do not start on the basis of developers and educators meeting up and starting projects together. Instead, they are the results of needs being identified by educators, who then find a supporting organisation that can supply them with the necessary funds with which to pursue their ambitions and then recruit suitable developers for their project. The process prevents developers from pitching ideas to educators and creating their own project opportunities. Briefly summarised, the money available in the market is not stable and reliable for developers, and few developers can build a permanent business model around commissioned work from educators. There are a few exceptions of notable studios building a reputation in the educational games industry, giving them more gravitas when it comes to finding commissions (e.g. the Danish development studio Serious Games Interactive), but newer developers without brand recognition may have a harder time finding projects.

In summary, the market for educational games that are to be used in formal educational settings is quite different from the entertainment game market or the market for educational games that are to be used in informal settings. The market size is limited by the high requirements educational games put on schools' technological infrastructures and organisational strategies. It is also highly internally incongruent, due to differences between various countries' curricula as well as organisational cultures and working processes. This is further compounded by the budget constraints that limit what schools can spend on teaching materials. Developers thus need to sell their products cheaply enough to be feasible from a budgetary stand-point, and they do so in a market that is limited in size by the various practical constraints that make schools unable to use educational games, and fragmented by the large differences in conditions and requirements that individual schools work under. Using the same types of revenue models as entertainment games and for customers on an 'open market' is thus difficult. Developers that create adaptable games for these markets may combat these discrepancies by circumventing development costs through modifying previous game titles, or creating their own markets by preparing schools to receive their educational games. The other, seemingly quite limited, revenue model available to developers is to focus specifically on creating niche tailor-made products on commission.

CHAPTER 15
USING GAMES IN FORMAL EDUCATIONAL SETTINGS

Just as the formal educational setting presents developers with certain unique challenges as opportunities, so do educational games present challenges to teachers who attempt to use them. The challenge of designing a game-based curriculum that intertwines the taught subject matter with the experience and themes conveyed by the gameplay, without sacrificing the integrity of either, is difficult. In this chapter, the factors that affect the process of putting educational games to use in classrooms are described.

15.1 STUDENTS AS A GAMING AUDIENCE

From the participation in different game-based curricula throughout this research, severe differences in students' proficiencies, preferences, and approaches to gaming could be seen. The heterogeneity of the average classroom constitutes a fundamental challenge that needs to be overcome whenever one attempts to use educational games, and both proficient and novice students presented their own set of specific challenges.

A major discrepancy between educational games for formal education and games used in informal settings or as leisure activities is the audiences they are obligated to cater to. In the case of entertainment games, or educational games that are not bound to a specific educational context (e.g. games with educational elements purchased for home use), the audience is opt-in consumers. Here, developers have the creative license to focus their game aesthetics so that they resonate with a certain type of individual. In these cases, developers are not obligated to cater to everyone and the consequences of focusing their product only mean that consumers that are not attracted to the game concept and engaged by its contents simply will not purchase the game. Educational games for use in formal education, however, have far more specific requirements of audience appeasement, and a more heterogeneous audience they need to appeal to. As stated by the principals during the interviews, new educational methods and tools need to work for every student in a classroom, in order to be considered usable.

The problem for educational games here stems from the fact that the average classroom consists of individuals whose primary unifying characteristics are their age and geographical location. If you look at a classroom of 20 or 30 students, you will probably find that there are 20 or 30 individuals with varying interests, backgrounds, degrees of computer and gaming literacy, as well as different levels of knowledge within the subject area being taught (Kickmeier-Rust et al., 2011). Trying to cater to all these individuals with a game title is an immense undertaking, and a game that is not thoroughly adaptable or player-driven will probably not work well in a classroom environment.

As an example, in an attempt to use the complex historical strategy game *Europa Universalis II* (Paradox Development Studio, 2001-2013), educational game scholar Egenfeldt-Nielsen (2008) observed significant differences in how quickly students were able to learn the game, some spending several weeks trying to grasp the basics of the game's interface. For these students, just getting to the level of expertise needed to interact with the content of the subject matter being taught consumed several valuable classroom-hours (Egenfeldt-Nielsen, 2008). Instead of being able to discuss the subject matter, teachers also had to spend a significant amount of their student-teacher time teaching the students how to play. Granted, *Europa Universalis II* is a complex game, but it is unlikely that reduced complexity and difficulty in educational games is a solution to the problem. For example, Minecraft is arguably a much more accessible game than *Europa Universalis II*, but the gaming activities in this study were still beset with the same issues that Egenfeldt-Nielsen encountered. This shows that games do not have to be overly advanced to make classroom gaming problematic.

The principle of 'flow in games' (described in sub-chapter 6.1.3) provides another framework that describes the classroom audience and presents some unique difficulties when it comes to designing educational games and game-based exercises. If a player's engagement with a game depends on the relationship between the intensity of the game's challenges and the player's skill, and if players' skills vary greatly in your intended audience, creating an engaging game becomes very difficult. There are also several parameters other than player skill that dictate game enjoyment and that vary greatly between individuals in a classroom as well (Kickmeier-Rust et al., 2011; Squire, 2003). Subject matter familiarity, gaming literacy and proficiency, and computer experience will certainly all have their averages that you can cater for as a designer or developer. However, depending on the type of classroom, it is difficult to create games that do not alienate some individuals, due to the fact that they have widely different preferences and abilities (Law et al., 2008). For this reason, it is likely easier to use educational games in more "focused" types of educational settings. For example, a niche program in secondary education may attract a certain type of student, and the game audience is thus slightly more homogeneous as compared to the ones found at lower tiers of education.

Observing students playing during the game-based exercises also revealed that more proficient students are prone to focusing more on self-actualisation through manipulation of game mechanics than playing for learning objectives. This is similar to Frank (2014) fidings in his research on game-based military training, where cadets would enter a state of play that he dubbed 'gamer mode'. When in gamer mode, participants play with "an extreme rule-focused interaction, meaning they behave rationally with respect to game rules but irrationally with respect to the portrayed real-life situation they are training for." (Frank, 2014, p. i) The students observed in this research would at times enter a similar state of gaming, where proficient players would sometimes ignore learning objectives and subject matter representation in favour of showing off their mastery of game mechanics (e.g. wanting to build electricity-powered railroad networks in a medieval castle, putting objects in unnatural configurations, or just playing around with game objects not relevant to the exercise).

The studies also revealed that students at either end of the proficiency spectrum would engage with game content in very different ways. Novice students would interpret game objects as very literal parallels to real-world counterparts, and thus encountered problems when faced with game objects that had low functional or aesthetic fidelity. Game objects that failed to represent real-world objects accurately enough would be avoided, which made some students' work on their historical recreations quite difficult. The proficient players did not display this type of interpretation, and would choose objects either according to their aesthetics or functionality depending on what a specific context called for, or when there were no game objects available to represent a specific real-world object. Novice students could, for example, avoid using objects because their colours seemed anachronistic to the setting they were reproducing, or when the objects' dimensions were deemed to be slightly illogical. Proficient students, on the other hand, had no problem using spider webs to represent puffs of smoke, due to their visual similarities, or using an enchanted tome to represent a bible on a lectern. This is essentially a symptom of different levels of gaming literacy. Proficient students seemed to have developed the ability to 'read' or interpret game objects in a way that accommodates limitations of the game system. Having a higher level of gaming literacy allowed proficient students to view the characteristics of game objects in a more fluid and figurative sense, where an object's functionalities would sometimes be disregarded if its aesthetics were useful for representing something, or vice versa.

The differences between the various students' gaming proficiencies presented challenges in many different ways. Creating engaging gameplay experiences with educational games in classroom environments is difficult. Unless the classroom is homogenous or if the educational game is made highly adaptive to individual students' needs and preferences, a significant number of students may rapidly become disinterested in the educational game experience. Much research has focused on procedural adaptivity in serious games (e.g., Kickmeier-Rust & Albert, 2008; Lopes & Bidarra, 2011), which can provide parts of the solution. But creating games that adapt to the personalities and proficiencies of individual players is difficult and time-consuming and requires a thorough understanding of how to assess player behaviours, in order to know what adaptive measures need to be taken (Kickmeier-Rust et al., 2011; Schoppek & Tulis, 2010). Nonetheless, as noted by Egenfeldt-Nielsen (2008) and Squire (2005) in their studies on the implementation of educational games in classrooms, failing to motivate is not the only challenge of catering to these environments. Time spent on mastering game mechanics, for instance, is time taken away from learning the subject matter (Egenfeldt-Nielsen, 2008; Macklin & Sharp, 2012; McClarty et al., 2012; Squire, 2005).

The outcomes of this research also have implications for the fundamental viability of the concept of 'digital natives' that still persists as an axiomatic truth among scholars and practitioners in the game-based learning community. While some scholars and practitioners maintain that everyone belonging to the 'net generation' (due to being born after technology and connectivity had become ubiquitous) has an innate ability to grasp technological interfaces and a desire to engage with them (e.g., Annetta, 2008; Baron & Amresh, 2015; Chu, Jeng & Chen, 2015; Huynh, 2014; Malliarakis et al., 2015; Prensky, 2003), placing a game in front of a classroom of students quickly reveals the spuriousness of those claims. From the participatory observations and analysis of transcripts from classroom gaming sessions, the students were not found to share an innate affinity or desire to interact with technology interfaces. The proficient students often found gaming activities too trivial and constraining, while the novice students often found them intimidating or frustratingly difficult. This often complicated the game-based learning process, as creating assignments that simultaneously cater to students who have trouble controlling their avatar and students who are very game proficient (and become bored with very trivial gameplay) is a very difficult task. This research outcome echoes conclusions drawn from research on students in higher education environments (e.g., Guthrie, 2014; Jones et al., 2010). In a study of university students' uses and perception of technology Jones et al. (2010) concluded that "the [new] generation is not homogenous nor is it articulating a single clear set of demands" (Jones et al., 2010, p. 731). Similarly, Guthrie (2014) concluded that "Technology matters for some students, but not for all." Guthrie

(2014). Terms such as the 'net generation' or 'digital natives' insinuate that today's youth constitute a monolithic, technology-savvy entity, which oversimplifies the challenges that educational institutions face when it comes to accommodating student needs.

15.2 TEACHERS' WORKING PROCESSES DURING GAME-BASED LEARNING

By collaborating with teachers during game-based learning projects, this research could reveal several important roles that teachers need to take on when integrating and using games in their educational environment. The skillsets needed to perform the roles well were also found to be quite diverse, as they involved technological know-how, gaming literacy, subject matter expertise, and, naturally, a strong pedagogical foundation. The task of integrating games into an educational setting is, as previously described, a demanding one, as it requires teachers to orchestrate a myriad of complex organisational resources to make game-based exercises possible. Teachers need to have a certain amount of gaming literacy, in order to actively supervise, support, and guide their students before, during, and after the play sessions. The teacher also needs to be proficient in setting up play sessions in a limited amount of preparation time and tackle eventual technical difficulties. Beyond these demands, teachers also need to serve as a conduit between the learning context and the play contexts, which requires the knowledge to continuously contextualise game activities and the content that students experience in the subject matter being taught. As the processes involved in integrating an educational game into a formal educational setting are described in chapter 14, this sub-chapter focuses on the working processes teachers employ when progressing through a game-based curriculum.

When conducting the game-based classroom activities, the teachers were seen to take on a wide range of roles, in order to successfully and significantly integrate the educational game into their classrooms. During a typical game-based exercise, teachers had to act as game administrators, lecturers, game tutors, subject matter anchors, and authority figures that kept students in an educational mode of play. Teachers could rely on their ability to 'read' the classroom atmosphere to a large extent when maintaining the educational mode of play, and to see when students were distracted or disengaged from the exercise. In a big classroom, however, it could be difficult for teachers with poor gaming literacy to recognise situations where novice students were struggling with the game interface, or when students were not working towards educational goals. Absolute knowledge of a game's mechanics and the different ways in which to use them may not be necessary for teachers to utilise educational games. Nonetheless, teachers need to have enough experience with them so that they understand how gameplay can be contextualised in the subject matter being taught and the types of activities that students engage in when they work towards established learning objectives. As put by Bourgonjon and Hanghøj: "teachers don't necessarily need to become experts with every new medium, but at the very least need to know what is going on [...] in order to participate" (2011, p. 71).

Gaming literacy, or at least their knowledge of how the game content could convey aspects of the taught subject matter, also played a role in teachers' ability to plan and conduct contextualising activities 'around' their gaming sessions. For example, the 5th grade teacher introduced the students to the medieval history concepts they were going to be working on in *Minecraft,* long before the gaming sessions started. After the gaming project was over, the teacher also took aspects of the buildings and societies the students had created into other school work. Although these surrounding exercises were not highlighted in this research, they played an important role in exploring more intricate details of the subject matter. Constructive learning situations arose occasionally during gameplay as well, but the surrounding exercises provided the necessary contextual knowledge that allowed such situations to occur. The 7th grade teacher made contextualising activities and lectures into a more integrated part of the game-based curriculum. Since the curriculum was designed as a series of stand-alone activities, the teacher could make regular assessments of students' progress and introduce new subject matter content (with accompanying game-based challenges) as the curriculum progressed. The gameplay itself did not have much intrinsic educational value, but when it was contextualised appropriately and executed purposefully, it played an interesting and valuable part in larger learning processes. The processes from which meaningful game-based exercises can be created out of the gameplay and the utility provided by games vary from context to context. With regards to this, Alklind Taylor's (2014) model for instructor roles provides valuable insights of how teachers (or instructors in Alklind Taylor's case), facilitate the processes of educational game use:

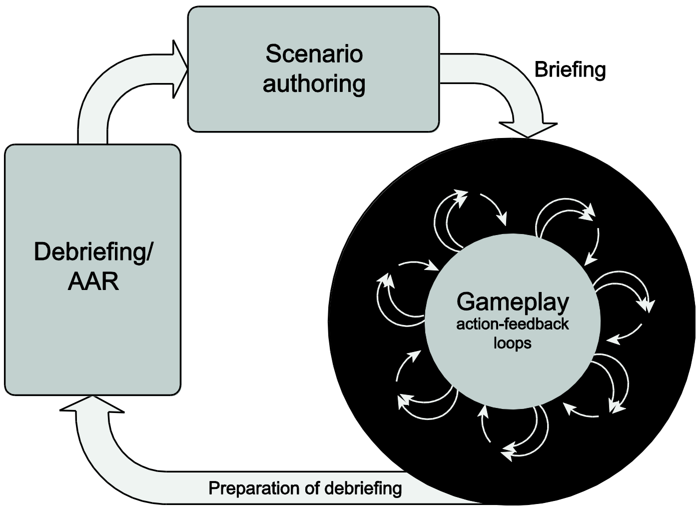

Figure 15.1: The *Coaching Cycle Model* as presented by Alklind Taylor (2014) (used with author's permission).

In essence, the actual execution of the game-based exercises play one part in a continuous cycle of activities, during which instructors contextualise game content, assess participants' progress, and author and design new exercises. As shown in these studies, a similar cyclical process, in which the execution of the game-based exercise only constituted one part, needed to be employed when conducting a game-based curriculum (see sub-chapter 10.2.2).

During the game-based classroom activities, the teachers' responsibilities primarily involved tutoring students that were new to the educational game, as well as supervising and guiding the way more proficient players engaged with game content. Some of the more obvious tutoring interventions that teachers needed to perform were to teach novice students how to play the used educational game, help students start up the game, or troubleshoot any encountered technical difficulties. During early exercises, the gap between individual students' gaming proficiency varied greatly within a single student group. As the game-based curricula progressed, and novice students were tutored in the basics of the educational game's interface, the proficiency gap lessened, and a wider range of students were able to effectively participate in the exercises.

Another type of tutoring that the teachers had to administer was to help students bridge the gap between the game content and the details of the subject matter the game was to teach. As previously mentioned, students' abilities to use game objects in their exercises varied greatly between the game proficient and the novice students. Games rely a lot on abstractions and representations, and players continuously 'translate' game actions to real-world actions; if the game action is very dissimilar to the real-world action, there is always a risk that things are lost in translation or that students are unsure how an object should be interpreted. If a game is not specifically designed to teach the details of the subject matter with a high level of authenticity and fidelity, the task falls on the teacher to draw connections between the game content and the subject matter (Alklind Taylor & Backlund, 2012). In situations where a student is unable to make connections between the game's presentation of an object and its real-world counterpart, the teacher needs to step in and provide some context to fill the gap. The need for contextualisation to compensate for limitations of game content also echoes previous research conducted by Nilsson (2008). Nilsson observed that a game's limitations could lead to important learning situations, as they often necessitated discussions and contextualisation, either between students or between students and the teacher (Nilsson, 2008; Nilsson & Jakobsson, 2011).

The teacher had to conduct similar acts of tutoring when the more proficient students used game objects in ways that were inappropriate for the subject matter. While novice students were sometimes too conservative when interpreting game objects, proficient students sometimes used game objects too freely, without much consideration of how well they correlated with the subject matter context. The task of the teacher's in these situations is to maintain the established 'contract' which states that the fiction of the subject matter is to be maintained, even when the game itself does not enforce it in any way or even tempts students to break it. For example, steel doors are no more difficult to access or place in *Minecraft* than wooden ones, making them functionally similar. Thus, in early sessions, steel doors could sometimes be used because they are, from a strict game mechanics perspective, superior to wooden doors. But, after the teachers helped students to anchor their use of game objects in details of the subject matter being taught, the students started to analyse and interpret game objects according to their appropriateness in regards to the setting and theme they were trying to convey.

The design and execution of the game-based curricula in this thesis shows that educational games place a lot of responsibilities on teachers, requiring them to take on many different roles which all require a specific skillset. For game-based learning to move forward, teachers need to have a better understanding of games and how to work with them, and game creators need to understand teachers' working conditions and know how to accommodate the varying characteristics of formal educational settings in their products.

15.3 USING COMMERCIAL OFF-THE-SHELF GAMES

An aspect of the case studies conducted here that needs to be acknowledged and discussed is that the educational game used in the studies was a modification of a commercial off-the-shelf entertainment game. As described earlier in chapter 14, educational games come in two general varieties: tailor-made titles that are specifically created to suit particular learning objectives of settings, and adaptable titles that provide a set of tools or a 'framework' that educators themselves then customise to suit their needs. *Minecraft* (or the modified educational version *MinecraftEdu*) is a clear example of the latter category. While it is difficult to say precisely how the game choice affected the outcomes of the game-based curricula, it did introduce some special considerations during the integration and use processes. The broad adaptable nature of the game meant that the game-based exercise design became a matter of 'stripping away' parts of the game and focusing solely on the game components that were useful for conveying aspects of the subject matter being taught. As seen in the transcripts and the teachers' experiences of the game-based curriculum, this was a difficult task to achieve, since students often switched their focus back onto game components that were irrelevant to the pursued learning objectives. Using a game that was so widely recognised by students seemed to further impact the studies in at least three ways: the gap between students' proficiencies was exacerbated; the educational 'framing' of the game-based exercises was more difficult to maintain; and students' previous familiarity with the game made them valuable resources as tech-support and game tutoring during the curriculum.

As mentioned several times throughout this research, the observed classroom exercises revealed a wide discrepancy between individual students' abilities to navigate the virtual world and interface of the used educational game. The students who were at the bleeding edge of this proficiency spectrum had extensive previous experience with *Minecraft* in particular, and operated at a level of play that sometimes exceeded my own grasp of it. These students' familiarity with the game was mostly positive, as they needed little tutoring (and could in fact help out and tutor their classmates) and provided their group projects with some guidance and well-informed ideas. Their high level of expertise did, however, present some challenges, as they needed to play alongside students who had never played the game before, or any game with a similar type of interface. As previously mentioned, the audience heterogeneity has severe implications for how game-based exercises can be designed – and the use of an educational game that some students were previously familiar with may have exacerbated the heterogeneity of the classrooms. Using an educational game with which no student is familiar may level the proficiency gap and make the task of designing game-based exercises somewhat easier.

As also previously mentioned, teachers were often observed as being crucial for maintaining the educational framing of the exercises. From observing students' discussions surrounding *Minecraft*, however, it seems likely that using a game with which students were very familiar may have complicated this task for the teachers. As teachers were wont to point out in the interviews, a concern when planning and executing the game-based curricula was that students would not "*take the exercises seriously*", or that they would expect it to be used just as they played it at home. As noted in early exercises, several students complained that the game exercises felt restrictive and dull compared to the challenges they would usually tackle in the game. Furthermore, students would often be distracted from the pursued learning objectives of the exercises, and instead focus on experimenting with 'irrelevant' game mechanics. It is likely that these behaviours were exacerbated by students' previous familiarity with the game, leading them to have a pre-developed framing of *Minecraft* as a leisure activity rather than a school exercise. This complicated the use of the educational game, as we (the teachers and I) wanted to utilise the creative aspects of *Minecraft* and still ensure that students' engagement was focused on the established learning objectives. A few minor tricks were used to try and 'distinguish' the educational use of *Minecraft* from the way students used it regularly – for example, the game's text-chat was disabled to encourage verbal communication, as were the monsters, some competitive elements, and the ability to start fires or use explosives in the game (i.e. health bars and experience points). This may have been helpful in subtly communicating the differences in playing the game in the school setting. Nonetheless, the students still tended to be distracted from the assignment, by the need to show off their *Minecraft* proficiency to classmates or experiment with its mechanics.

While I cannot make any definite statements, a game with which students have no previous familiarity may reduce some of these observed challenges. Using a more obscure educational game may level the playing field for students. It may reduce the severity of the gap seen in students' gaming proficiencies, and remove the need for expert players to show off their knowledge of secrets in the game or mastery of various game mechanics. A classroom of students may thus be able to explore and familiarise themselves with the educational game together as a group, rather than having a small group of experienced players take a leading role in exercises, or make it difficult for novice players to partake in the discussion. On the other hand, students' familiarity with *Minecraft* occasionally proved to be a valuable resource for teachers. During exercises where I was not personally present, students would often assist teachers in solving technical difficulties, or tutoring their classmates in playing the game.

CHAPTER 16
COMPILING THE RESULTS

With the outcomes of the various studies as a fundament, this chapter describes how the different actors' working processes and the situational factors of their working (and play) environments converge to affect educational game development and use. After the system of actors and processes has been described, some identified guidelines for how educational games and game-based learning processes can be conducted to increase their chances of success are presented.

16.1 A SYSTEMS-ORIENTED VIEW OF EDUCATIONAL GAME DEVELOPMENT, USE, AND PLAY

Previous research on educational games, and in the larger field of serious games, has focused on examining how educational and engaging content can be made to co-exist within a singular piece of game software. There have been many suggestions regarding how to optimally balance these two, seemingly incongruent, concepts through appropriate design decisions (Egenfeldt-Nielsen, 2011; McClarty et al., 2012; Young et al., 2012). While this approach is reasonable for games that are not intended for use in formal educational contexts, this research shows that it is insufficient when stricter frameworks for a game's use are introduced. Regarding the game itself as the primary conduit for educational material and engaging content disregards the important transformative potency of teachers and classroom settings. No matter how well the developer manages to achieve a balance between providing transferable learning and an engaging gameplay experience, the system surrounding the game will determine the impact the game will have in a formal educational environment. It is also important to point out that the formal educational setting not only presents the design and development of educational games with constraints. Formal educational settings contain several situational factors that can elevate the quality of educational games when utilised correctly; the presence of teachers, the social classroom environment, and an educational system can alleviate some of the onus put on educational games, regarding the functionalities that they need to contain.

A game's educational impact is not decided in the development studio, nor is it solely decided in the classroom – it is shaped and reshaped throughout its lifespan. No singular actor in the process has the exclusive privilege of declaring the educational significance of a game, as developers, educators, and students all make contributions to the final 'meaning' that a game conveys. Developers may have an important role in setting the stage, but educators have the capability of transforming it and deciding what types of performances it will host, and ultimately students bring meaning to it with their performances. With this in mind, I do not consider an educational game and game-based learning to be capsules containing a cocktail of engagement and learning. Instead, they constitute a system of processes that serve utilitarian purposes, experiential purposes, and meaning-making processes. Only when these elements are orchestrated well can an educational game have long-term impact.

The combination of interviews, observations, and participatory studies conducted during this thesis project made it possible to identify the relationship between the actors, processes, and situational factors that contribute to an educational game's impact. These findings are codified in Figure 16.1.

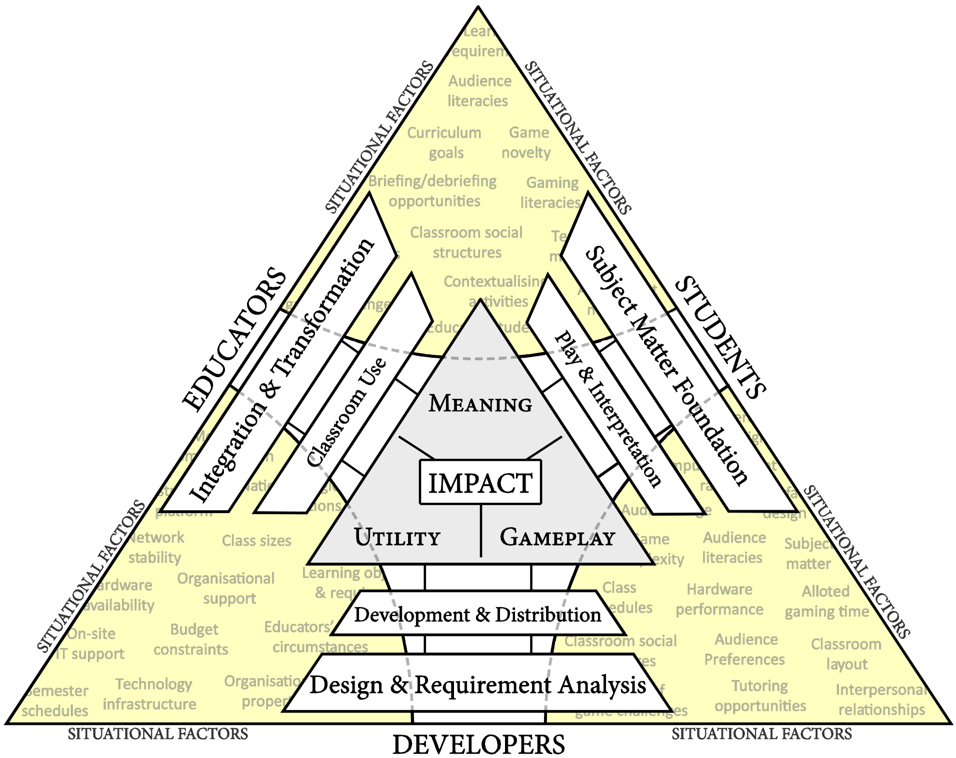

Figure 16.1: The Utility, Gameplay, and Meaning (UGM) model. At the centre of the model are the objectives that educational games need to achieve to be impactful both as educational tools and development ventures. At the outskirts of the model are the different actors that play an immediate role in educational game development and use. Between the actors and the objectives are the processes that the actors go through to achieve the objectives, and in the corners of the model are some examples of the many situational factors that influence these processes in different ways.

The purpose and appearance of the model share some similarities with Harteveld et al.'s model that describes the dilemmas involved in serious game design (as described in sub-chapter 6.3) and Alter's model that describes the relationship between actors and environments in an information system (sub-chapter 7.2). However, rather than focusing on design dilemmas or actor relationships separately, this model includes what I argue is the entire system that surrounds educational games' development, use, integration, and play. The model depicts how the different objectives, actors, processes, and situational factors, present at some point in an educational game's lifespan, relate to one another and affect the impact that an educational game might have in a formal educational setting:

Objectives: In order for an educational game to be impactful, it needs to be a reliable and efficient utility, an engaging and accessible gameplay experience, and it needs to be meaningful with regard to the subject matter it is being used within. To provide utility for its users, the educational game needs to fit well into the formal educational context or be flexible enough so that educators can transform and mould it to fit their working processes and organisational structures. The educational game can also further its utility as an educational tool by ensuring reliability and ease of use, providing means for assessment or monitoring, and making administrative tools accessible. Gameplay[12], on the other hand, refers to the types of challenges, activities, and themes that the educational game presents to students. Finally, the game becomes meaningful once educators and students use it, and when it is integrated into game-based exercises or a larger curriculum. The educational game's ability to provide meaning is thus also highly influenced by its successfulness as a gameplay experience and a utility.

Actors: Educational games constitute a collaborative effort between developers, educators, and students, who ultimately aim to achieve impactful learning experiences and organisational change. Each actor contributes to an educational game in different ways, and enters the educational game 'system' with different preconditions. As shown throughout the case studies in this thesis, each individual student brings a different set of expectations, preferences, and proficiencies to an educational game curriculum and its exercises. The same is true for developers and educators, who approach the design, creation, distribution, acquisition, integration, and use of educational games differently, depending on their experiences of game design and education.

Processes: The actors contribute to these educational game objectives through the processes they work with during the use of an educational game. Initially, developers need to design the game itself, according to a requirement analysis, before continuing on to develop and distribute it to clients and educators. The educators need to practically integrate the educational game into their teaching environment and 'transform' the educational game to suit their specific needs, before moving onward and putting the game to use during classroom exercises. Students need to be given an entry-point to the subject matter that is to be taught through the educational game and informed of the context for the game-based activities, before they can play the game and interpret game content as representations of the taught subject matter.

Situational factors: The processes, objectives, and actors are all highly affected by the various situational factors of the environment(s) in which the educational game is being used. The properties of the situational factors vary greatly, depending on local circumstances of the educational setting, the specific subject matter being taught, and the actors' working conditions. The factors that are part of educational game use range from larger ones that can make or break the educational game, or smaller details that will only

[12] The term 'Gameplay' substituted the term 'Experience' used previously in the Educational Game Utility and Experience Model (Figure 13.1) and in Figure 14.1. The reason for the substitution was that 'Experience' was too broad a term, causing some ambiguity regarding whether it was the experience of engaging with learning, play, design processes, or whether it just referred to accrued knowledge. Gameplay was chosen because it encapsulates the educational games' purpose of conveying subject matters through game mechanics, challenges, themes, and aesthetics.

slightly affect it. Examples of the former can be the overarching learning objectives and curriculum goals that the game needs to accommodate, the reliability of the available hardware in the educational setting, developers' experience with educational processes, or the characteristics of the audience that are going to be playing the developed game. Smaller details can be matters such as the design of specific game components or the game's interface, subject matter details that need to be conveyed, or properties of smaller parts of the organisation that are using or developing the game (e.g. scheduling of classroom hours, or the physical layout of the classroom).

The model has both a descriptive and prescriptive purpose: it can be used to describe the current state of educational games as educational tools and as development projects; it can also be seen as a prescriptive model in that it gives a broad conture of the processes and complexities that educators and developers need to keep in mind when working with educational games. The remainder of this chapter expands on these two model purposes by way of example.

16.2 DESCRIBING EDUCATIONAL GAMES' CURRENT SITUATION

As shown throughout chapters 13, 14, and 15, there are many situational factors and actor characteristics that affect the success of educational games, both as educational tools and as marketable products. Any given educational game is affected by the characteristics and propensities of the developers, educators, and students involved in its creation and use, as well as the situational factors that make up their working environments. For example, limitations in educational institutions' technological infrastructures not only make it difficult for games to be reliable assets for teachers, but also impedes the distribution of developed games. While online platforms for game distributions are undeniably popular and successful for entertainment games, the online distribution of educational games is hampered by the technology and resource limitations of schools. Online distribution not only requires stable networks, but it is also often heavily reliant on various forms of digital rights management software or account registrations that can complicate the processes of purchasing games, as well as preparing individual game-based exercises. As mentioned in the case studies in chapter 12, the processes of account creation and authentication were some of the bigger sources of technical issues faced during the preparation of the game-based curriculum. Many practical challenges of that nature still remain, and it is difficult for educators to integrate and use educational game solutions, without major investments and organisational restructuring. These challenges, as described in chapter 6 and examined first-hand in chapters 9, 10, and 12, may be laborious enough for educators and developers to largely negate the positive effects educational games may have. However, technology expertise is slowly improving among teachers, as is the quality of the technological infrastructures of schools, so some of the conditions necessary for educational games to be more viable as teaching tools are constantly becoming better. Situational factors, however, include much more than the local or regional circumstances of schools. National legislation, developers' working praxis, expertise, and equipment, students' preferences and literacies, as well as larger socio-economic and socio-cultural considerations also have a tangible effect on the usefulness of educational games. Some of the many ways in which the actors, processes, and situational factors contribute to the educational game 'system' are outlined in the sub-chapters below.

16.2.1 EDUCATIONAL GAMES AS TOOLS FOR LEARNING

This research shows that no singular actor has the sole responsibility or authority to decide the ultimate impact and pedagogical value that an educational game holds. Developers, educators, and students all make important contributions to the educational game system and depending on the specifics of the educational game project the interplay between these actors will affect it and each other differently. Sometimes, developers, educators, and students work closely together throughout an educational game's lifespan, and create, integrate, and make use of the game collaboratively (a common approach in research projects, for example). In other cases, the process is less collaborative. Developers can create a game product independently and focus on creating a game with a more general educational framework in mind. The game can then be purchased and adapted by educators and students so that it fits their settings and working processes. But regardless of how it is conducted, it is during development that the stage is set for the types of exercises that an educational game is suitable for: a linear story adventure game is not conducive to open creative recreation of a subject matter, but may be useful for language learning and letting students experience stories or texts through interactive storytelling; a shoot-'em-up math quiz game is not conducive to long-form collaborative projects, but may be useful for practicing maths; and a grand strategy game is not conducive to short-form exercises of history trivia, but may be used by students to collaborate on recreating historical events or experimenting with counter-factual histories. But, the stage set during development can be modified and transformed by educators so that it fits the unique situational factors, requirements, and students they are working with. Educators integrate the educational game into educational contexts and devise the curriculum in which it is going to be used. As teachers and students go through exercises together, the game content can be contextualised by the subject matter, or vice versa. Educators can help students add significance to game objects and game mechanics that may not have been predicted in development. During the case study where one of the classes used *Minecraft* during a history curriculum, for example, game objects were imbued with historical meaning, even though the game itself did not specifically present them as historical objects. As the educational game is put to use in the formal setting, it can thus generate meaningful learning situations, either by introducing students to new subject matter details, or letting students use previous knowledge to inform their interactions with the game.

The process of creating situations of meaningful play is essential in ensuring that an educational game actually is *educational*. As described through previous literature in sub-chapter 5.2 and as shown directly in chapter 12, having students interact with educational games is not necessarily a recipe for learning to occur. For example, Turkle (1995) and Linderoth (2009, 2012) have posited counter-arguments regarding the perceived inherent learning potential of games, assumed by researchers such as Gee (2003) and Annetta (2008). The critique, ratified by other researchers as well (e.g., Egenfeldt-Nielsen, 2011; Kirriemuir & McFarlane, 2004), in essence comes down to what a game actually teaches its player, and a distinction is usually made between learning 'game mastery' and learning transferable, subject matter-relevant knowledge. The issue that educational games often face is that they can only reliably account for the former, whereas the latter is both more difficult to evaluate in research and to ensure through game design and implementation. For example, the game designer Koster (2005), who I consider has implicitly followed the same line of reasoning as Turkle and Linderoth, has defined games as systems that teach, but adds that they ultimately only teach the player to identify game patterns and to hone the skills necessary to perform well in the confines of those patterns.

This is where the formal educational context can be beneficial, as the presence of a teacher, who is better able to connect the gameplay to the subject matter, encourage reflection, and direct debriefing sessions, can alleviate some of these issues (Alklind Taylor, 2014; Bourgonjon & Hanghøj, 2011; Hanghøj, 2011). Developers cannot account for how players interpret representations or themes in games, but teachers can guide students' processes of play towards specific educational goals and, thereby, meaningful learning situations can be created. By contextualising game content and encouraging reflective play, teachers have a lot of power to 'transform' game content into something that is relevant to the subject matter being taught and meaningful to individual students and their overall curriculum. This is one way in which formal educational contexts provide educational games an opportunity to elevate themselves as educational tools. In informal contexts, which have no structures in place to contextualise material, or assist reflection and discussion, the requirements demanded of the game are quite exacting, as it needs to represent subject matter materials accurately and deeply incorporate them in core game mechanics. The game in informal contexts needs to motivate, instruct, introduce and represent subject matter accurately, within the confines of the game experience, whereas games in formal educational situations can rely on teachers to play an active part in the play sessions and assist these processes.

16.2.2 EDUCATIONAL GAMES AS PRODUCTS OF DESIGN AND DEVELOPMENT

In previous research, educational game development and design practices have been directly inherited from practices found in entertainment game development (Harteveld et al., 2010; Klopfer, Osterweil & Salen, 2009). However, as the studies in the thesis have shown and as the presented model attempts to visualise, using games in formal educational settings presents unique challenges that make it problematic to base development practices and the evaluations of educational games on entertainment games as the primary reference point. A classroom of students, when seen as an audience for a game, is one of many examples of how formal educational settings present challenges that are not found in the development and distribution of entertainment games. The thoroughly heterogeneous properties of the classroom audience put certain demands on what games can and should do, in order to be useful and engaging tools for learning. Relying on processes and models of game design and development that have proven successful in entertainment game development may thus be problematic. Entertainment games are often generated as a result of ambitions stemming from the developer. Many developers use "I'll make a game that I would enjoy playing" policies and do not start out with a clear market target in mind, while others may attempt to claim openings in the market or use pre-existing licenses to attract an audience (Hagen, 2009; Rollings & Adams, 2003). Provided that the game is well executed, the first model of development will rely on the game finding its audience simply by existing, since there are people with similar tastes as the developer. The second, more commercially centred, development style will try to reach its intended audience through audience-appropriate designs, marketing and/or brand recognition. Although quite different in what they want to achieve with their development (e.g., monetary success, crafting a great gaming experience, sharing a story, etc.), both types of entertainment games are created as an incentive from the developer. Contrary to this, educational games are subject to stricter requirements of audience appeasement, and developers have less freedom in choosing the game's target audience. While educational games can be developed for an 'open market' as well, there are several conditions that affect the nature of that market, one being schools' capabilities to purchase and use the created game. Given the current incompatibility between games and formal education, a game needs to be made highly adaptive to a wide variety of educational settings and subject matters, in order to reach a wide enough audience to create revenue. Educational games can also be developed on commission from an educator or some other external actor who has identified a need in a specific area. A school, institute, or organisation will approach educational game developers with a problem, and the developer is tasked with creating a game that aims to address it, by informing or educating personnel, students or trainees in an engaging way. Here, educational game development may seem to be a fairly straight-forward proposition, as the developer is directly informed of the characteristics of the game's audience beforehand and can adapt the game content accordingly. However, as seen in the case studies presented here, the reality is that classroom audiences are extremely heterogeneous, when it comes to thematic preferences, levels of gaming literacy, proficiency in different subject matters, and many other characteristics. This often leads to issues, such as difficulty with maladjustments that disrupt flow (Kickmeier-Rust et al., 2011), content that is not compelling or does not represent the subject matter in a way that resonates with students (Engström et al., 2011), mismatches between the games' hardware requirements and the technology availability in schools (Morgado, 2013; Morgado, Manjón & Gütl, 2015), just to name a few.

Once again, formal education is not only a source of complications, but also provides opportunities that can facilitate the success of educational games as tools and products. The social environment of a classroom, as well as the presence of teachers and knowledgeable students, can both alleviate some of the issues caused by the students' varied game proficiencies and provide more ways in which to engage with the game than purely tackling pre-designed challenges. The exchange of ideas and collaboration between students, or a sense of competition, can add additional layers to the gameplay created by the developers, and elevate the enjoyment and experience provided by even rudimentary game mechanics. Understanding both the constraints and the new opportunities that the formal education context brings to educational games, instead of trying to preserve values inherited from entertainment games when they are combined with learning content and objectives, is an aspect which I claim is a necessity for the field to progress. Likewise, understanding the opportunities games bring to formal education contexts is equally important.

16.2.3 THE BOTTOM LINE: RETURN ON INVESTMENT

Given the severity of some of the identified challenges inherent in the merger of games and formal education settings, one might question whether educational games are a worthwhile investment for either developers or educators. Increased motivation, retention, deeper learning, and the ability to interact with and experience a subject as a participant are some of the benefits usually touted when the merits of educational games are promoted. However, if one considers the issues of audience heterogeneity, practical obstacles inherent in formal education, and high development costs juxtaposed with a limited market, can educational games provide enough return on the significant amount of investment needed to create, implement, and use them?

Return on investment is essentially a two-variable equation, and for interviewed principals and teachers the return is not "what does the game teach students?" but "how much better does the game teach students compared to previously used methods?" In evaluations of new teaching tools, pedagogical value is not judged in a vacuum, but in comparison to other available methods, primarily those already being used. Educational games for formal education are always competing against other methods of education, and it is an uphill battle in many cases, as the infrastructure of educational institutions is built to support traditional educational methods. Educational games need to burst through a context that is not currently built to support them, and in that context perform better than the means that teachers and students are familiar with and adept at using.

The teachers that I collaborated with during the processes of integration and use of educational games (as presented in chapters 10 and 12) stated that they were very positive regarding the outcomes of the game-based curricula. Among their statements was that the educational game projects had impacted their working situation and the general classroom atmosphere very positively, and that the students' engagement and general attitudes towards school had improved noticeably. In the words of Teacher G, from an interview conducted after the conclusion of the game-based curriculum, the project had "Given [the students] so very much", but she also added that it "required so much work and effort." And, important to keep in mind, is that the teachers all considered that the extra work and expertise needed to conduct a game-based curriculum made using games unfeasible, given their current working conditions and the structures of their organisations. Also important to note is that the teachers felt the projects took an alarming amount of effort, even after I conducted most of the integration and provided a significant amount of assistance during the game-based exercises. Furthermore, the teachers and principals also acknowledged that some of the positive outcomes of the projects (e.g. increased student engagement, and more positive attitudes towards school) were probably the result of the student being able to participate in something a little bit out of the ordinary. As put by Teacher H, the students seemed to be thrilled by being 'specially chosen' by someone with a considerable level of expertise in a field with a high novelty value. In other words, my own presence as a researcher seemed not only to alleviate the effects of more obvious practical factors in the educational setting, but also affected students' perception and experience of the game-based curriculum.

While the research presented here cannot provide a definitive answer to whether educational games are worth the price of admission, my understanding of the situation is that educational games are, at the very least, in a troublesome position. The positive outcomes of educational game use are difficult to pinpoint, whereas the investment threshold for conducting relatively rudimentary game-based activities is high enough to make teachers consider them entirely unfeasible, unless they receive considerable support (which is currently usually provided by third parties, such as researchers). If educational games are to be widely applied in formal education, the entry barriers need to be lowered (e.g. more accessible game interfaces, and lower-maintenance products) and ways of providing efficient institutional support for teachers who are interested in using educational games need to be found.

16.3 PRESCRIBING RECOMMENDATIONS FOR EDUCATIONAL GAME DEVELOPMENT AND USE

During the various collaborations and discussions with educators, students, and developers that this thesis work involved, different ways of managing the identified process and situational factors also emerged. With the UGM model (as shown in Figure 16.1) as a framework, this sub-chapter provides an overview of some of the many varied processes involved in educational game development, use, and play, and provides some recommendations regarding how they can be conducted to accommodate the many situational factors identified during this thesis research.

The processes are categorised according to the type of objective that they primarily serve, and are coupled with a list of the more prevalent situational factors that are relevant to their execution. Process descriptions are also coupled with a referral to the thesis chapters that either detail the studies in which the processes were explored or describe previous research relevant to the process. For example, the process of integrating educational games in classroom environments were examined and described in chapters 10 and 12, but previous research in the fields of information systems and instructional solutions design, as presented in chapter 7, is also relevant, as it details how new instructional solutions can be integrated into organisations. Brief examples of why the processes are important for educational game development and/or use and recommendations regarding how they can be approached are also provided.

The breakdown and description of the various processes are not intended to be taken as step-by-step guidelines for how to conduct educational game development and use in an ultimately impactful way, but rather as an abbreviated summary of the challenges and considerations encountered during the various case studies presented in this thesis. If it is one thing that the conducted case studies have unequivocally taught me, it is that local situational factors and circumstances significantly influence the way an educational game can be integrated and used in formal education. Thus, I would argue that there is no way to produce definitive, directly applicable guidelines for how to manage processes of development, integration, and use. As described previously, educational games are developed and used in many different ways, and the properties of both development studios and formal education settings differ to such an extent that processes will probably differ just as much between educational game projects. That being said, some commonly recurring themes and patterns emerged from the case studies, which I have summarised into a series of recommendations and considerations that developers and educators need to be aware of when embarking on educational game projects. While it is thus unlikely that they would all be present during any one educational game project, I argue that a sub-set of them will be present in some combination. For educators and developers interested in working with educational games, examining the processes and deliberating on which ones may be applicable to their unique working situation can hopefully be helpful in avoiding some of the more common pitfalls that I experienced together with educators and developers during my research.

16.3.1 PROVIDING UTILITY IN EDUCATIONAL SETTINGS

Providing utility with an educational game is crucial, if it is to be accepted and used in a formal education setting. During the interviews and participation research, the teachers frequently stated that 'reliability' is a necessity if a tool is to be considered usable. Making sure that the educational game is easy to acquire and install, does not require much maintenance (e.g., frequent software patches), and is as free from bugs and other issues as possible should be a high priority for any developer who aims to work with educational games. Educational organisations also need to deliberately work towards establishing environments that can make good use of educational games as well, as a stable and functioning technology infrastructure and reliable institutionalised support systems are a necessity for teachers to be able to use educational games.

Involved process	Chapters	Situational factors
Analysing risks and requirements posed by formal education structures and classroom audience(s)	9, 10	Means of communication Legislated learning objective requirements Formal education legislations Project aims and ambitions Audience properties Parental considerations Degree of risk

Conducting a thorough analysis of risks and opportunities associated with developing (or re-purposing) a game for educational use is a crucial first step. For developers, an understanding of the audience and the culture and structure of the end-use environment can significantly reduce the complexity of the development and design process, and ultimately lead to a more accessible and usable product. For educators, it is an important step in building realistic expectations and anticipating obstacles from the outset of a project.

Involved process	Chapters	Situational factors
Developing the educational game	6, 9	Developers' expertise Development team size Target audience's properties Available software licenses Available reusable assets Project goals Available project resources Educators' gaming literacy Means of communication Broader market realities

The process of developing the educational game is highly dependent on the game's purpose and the context of development. Communication between educators and developers can be important for conducting game test sessions and ensuring that the game and the formal education setting can merge well. If educators are included in the development processes, they also have an opportunity to adapt their educational environment to be more receptive to the developed game.

Involved process	Chapters	Situational factors
Distributing the educational game and providing accessible means of purchasing and distribution within organisations	10, 12	Educational game quality Hardware specifications Payment methods and terms Network stability Municipal network regulations Teaching-material budgets Degree of risk

Distributing an educational game as a developer, or purchasing one as an educator, is a process and decision that is highly influenced by the technical infrastructure and resources available in formal education organisations. Developers can make a game more accessible by ensuring that it works reliably on inexpensive hardware and that it is easy to find and acquire. Educators need to know the limitations and possibilities of their work setting, and make decisions regarding organisational restructuring or game purchases accordingly.

Involved process	Chapters	Situational factors
Inventory of organisational properties and available resources	7, 9, 10, 12	Available support tools Management structures Organisation culture Human factors IT-support availability and expertise Students' gaming/technology literacy Technology infrastructure Hardware availability Hardware performance and reliability

In order to integrate a pre-existing game or newly developed game well into an educational setting, facilitating and constraining factors present in the context-of-use need to be well known. Educators need to know the possibilities and constraints of their work setting, in order to plan a game's integration into it. Important considerations are: technology availability, teachers' attitudes towards new tools, available support structures and competencies in the organisation (which can be students' gaming and technology literacies).

Involved process	Chapters	Situational factors
Integration of the game into the formal educational setting	7, 10, 12	Installation tools/wizards On-site IT support Educational game quality Technology infrastructure Learning objectives Assessment tools Organisation size and structure Parental considerations Educators' technology/game literacy Students' proficiencies

While educators are usually ultimately responsible for the integration process, developers can accommodate it with the design of their product. Reliability is highly valued by educators, so a game should be as easy to use, quick to start up, easy to trouble-shoot, and reliable as possible. Educators need to know how to utilise resources identified during the inventory of their work setting, and may need to develop new organisational resources and restructure old ones. If a pre-existing game is used, more effort will be needed to adapt its environment of use. If a game is specifically developed for the environment, the process of integration can be easier.

Involved process	Chapters	Situational factors
Designing educational game content	5, 6, 9, 10, 12	Learning objectives Specificity of target use context Exercise authoring tools Modularity and adaptability Audience properties and preferences Assessment tools Subject matter and game design pattern couplings Subject matter representation Subject matter's fidelity requirements Curriculum application Contextualising activities by educators

While attitudes are generally positive towards educational games, there are still a lot of uncertainties involved in using them. Co-designing solutions together with educators and students can make a game more adaptable to the peculiarities of the educational setting, as well as alleviate educators' trepidations regarding the game's content and applicability to their working processes. The heterogeneity of student audiences needs to be well known and accommodated as well, while being aware of means of support, present in the educational environment (e.g. teachers and proficient students), and designing games that incorporate them can reduce design complexity.

Involved process	Chapters	Situational factors
Structuring and designing a game-based curriculum and its exercises	5, 10, 12	Learning objectives Taught subject matter Educators' game literacy Educators' subject matter expertise National requirements Students' proficiencies and knowledge development Students' interpersonal relationships Needs for assessment School term scheduling Organisational structure and processes Exercise authoring tools provided by the game

Practical considerations, such as scheduling, learning objectives, and hardware availability, are highly influential when structuring and designing a game-based curriculum. Depending on the context, requirements on curriculum results might be very strict and formalised, or more flexible and open-ended. Furthermore, depending on the subject matter being taught, it might be more suitable to rely on stand-alone game-based exercises rather than an overarching game-based project or a cohesive long-form game narrative. Stand-alone activities have the benefit of being easier to assess, and the curriculum can be re-structured depending on identified needs. A long-form project requires more preparation, as restructuring the work process in the middle of a curriculum becomes more difficult. All of this is, of course, also highly reliant on the educator's gaming literacy, as they need to understand the game tool to know how to make use of it.

16.3.2 DESIGNING GAMEPLAY FOR EDUCATIONAL SETTINGS

Creating good gameplay experiences, while also making sure that the subject matter is represented and that the game content is accessible and inclusive, is another big challenge for educational games. Here, the heterogeneity of the student audience is one of the bigger situational factors that both educators and developers need to be aware of. While I was prepared for some variation among the student groups, I was often surprised at how much students' proficiencies and preferences varied, even in smaller groups of players. Being able to create game content and game-based exercises that cater to a wide array of students is challenging, but the formal education environment can be a valuable resource if it is utilised thoughtfully. Teachers, students, and the social aspects of an environment can facilitate gameplay; teachers and students can invent 'house rules' and contextualise activities for game-based exercise challenges together that include the entire student group in interesting ways that the game designer is not able to anticipate. The teacher and more proficient students can also be useful as they can actively tutor novice players.

Involved process	Chapters	Situational factors
Analysing the classroom audience(s), and designing accordingly	6, 9, 12	Audience preferences Audience proficiencies Audience age and cognitive abilities Classroom atmosphere Students' collaboration and reciprocity Classroom layout(s) Scheduling constraints Hardware availability and specifications Parental considerations

Creating gameplay that is suitable for a classroom audience is vastly different from designing entertainment games for a more 'open' market. The audience in formal education settings (especially K-12 classrooms) is highly diverse, and an educational game cannot only cater to a smaller part of it. Understanding the audience's preferences and proficiencies (even though they cover a wide range) is important for providing gameplay challenges that are engaging to student groups. It is also important to understand the basic layout of classrooms, and how students play together within them, so that game challenges can incorporate the context of play. Students' ability to master game interfaces is also highly correlated to their age, and knowing what to expect from students, in terms of fine motor skills and cognitive ability, is important when designing game challenges.

Involved process	Chapters	Situational factors
Designing good gameplay experiences and content that represents subject matter details	5, 6, 12	Developers' preferences and expertise Developers' subject matter knowledge Audience preferences and expertise Learning objectives and game design pattern couplings Subject matter representation Subject matter's fidelity requirements

Focusing on creating gameplay challenges that require a wide range of skills beyond just mastering game mechanics (e.g. subject matter knowledge, an eye for aesthetics, storytelling, etc.) can help foster collaborative and engaging problem-solving. By also incorporating the formal education context, gameplay can be designed to accommodate contextualising activities (e.g. lectures, films, collaborative non-game exercises), which in turn alleviate the game's obligation to convey subject matter details.

Involved process	Chapters	Situational factors
Developing accessible and inclusive educational games	9, 10, 12	Audience heterogeneity Game complexity Payment methods and terms Distribution methods Hardware availability Special needs considerations Representation of players Socio-economic circumstances Cultural contexts

Educational games exist under much more intense scrutiny and moral obligation than entertainment games. Since educational games in formal education settings are essentially 'mandatory' activities, ensuring that all the students who are meant to engage with them are treated fairly and respectfully is crucial. Being mindful of the representation of players is thus a very important trait for a good designer and developer. Furthermore, socio-economic circumstances should also be taken into consideration; not all students have the possibility to play games at home, and educational games might not, for example, function as an egalitarian platform for home-work assignments. Educational games can widen inequalities in classrooms if they only cater to students with favourable circumstances; therefore, considering a game's accessibility and role in the education system is important.

Involved process	Chapters	Situational factors
Guiding play during game-based activities	10, 12	Hardware availability Hardware performance and reliability Students' gaming literacy Educational game complexity Educational game content novelty/familiarity Differences in students' game proficiency Students' interpersonal relationships Educator:student ratio Differences in students' subject matter knowledge Fidelity of subject matter representations

While developers "set the stage" for the types of game-based activities that the educational game can be expected to support, the final value of the educational game's gameplay is ultimately based on the students' interactions with and within it. Students' engagement in game-based activities is, however, quite fickle. It is highly susceptible to hardware performance and the game's complexity and novelty value. An educational game that is similar to well-known entertainment games might be appreciated by students who feel they have a high level of proficiency playing it. However, students may also become easily frustrated whenever the familiar game mechanics are used in a way that is considered too 'easy' or dull. Creating a novel game experience may not be judged the same way, as there is no clear frame of reference to judge it by. Game complexity is also important to consider, as many students may have little familiarity with games in general, and find advanced interfaces (e.g. WASD steering) and inventory management difficult to grasp.

16.3.3 CONDUCTING MEANINGFUL GAME-BASED EXERCISES

Conducting meaningful game-based exercises that make good use of the 'stage' set by an educational game requires the collaboration of educators and students. Understanding the used game well is important, as the educator needs to know what learning objectives it might be applicable for, and knowing its shortcomings (e.g. in fidelity or accessibility) can be useful when designing the contextualising activities around the game. Teachers also need to be able to facilitate students' meaning-making processes, by maintaining the educational 'framing' of the game-based exercises and ensuring that discussions around the game, and interactions within the game, are connected to the subject matter being taught.

Involved process	Chapters	Situational factors
Contextualising activities	5, 12	Debriefing and briefing methods Scheduling constraints Taught subject matter Organisational structure Organisational resources Available teaching materials Educator's gaming literacy Educator's subject matter expertise Students' proficiencies and knowledge development

Anchoring game-based exercises in the taught subject matter is crucial for ensuring that the exercises are meaningful from an educational perspective. Contextualising activities has great transformative power, as almost all types of game content can carry an interesting educational meaning, if it is presented with good subject matter anchoring (e.g. considering *The Sims* (Maxis, 2000-2015) as allegorical of household resource management, or as a commentary on consumerism). When designing the structure of a game-based curriculum, it is important to consider the game-based exercises as one part of a larger chain of activities and to also give students ample time to reflect on their game-based exercise experiences.

Involved process	Chapters	Situational factors
Designing and conducting game-based classroom exercises	10, 12	Educator:student ratio Educator's gaming literacy Educator's grasp of hardware Students' interpersonal relationships Students' proficiencies and knowledge development IT-support availability and expertise Hardware reliability Learning objectives Game content and subject matter couplings Exercise authoring tools Modularity and adaptability Audience properties and preferences

The design of individual game-based exercises is highly dependent on the structure of the curriculum in its entirety. For a stand-alone exercise approach (which might be suitable for mathematics, physics, or language learning), the game-based exercises can incorporate iterative introduction of new subject matter details and game content based on assessments of students' progress through the curriculum. With stand-alone exercises, planning briefing and debriefing sessions and other contextualising activities can be easier and be tailored to accommodate student needs identified through assessments. Stand-alone game-based exercises can thus be easily bookended with contextualisation provided by the teacher and classroom discussions of the subject matter. For more long-form projects (which might be suitable for more 'conceptual' subject matters such as history or sociology), the exercise designs adhere to the pre-set curriculum structure.

Involved process	Chapters	Situational factors
Assessments and curriculum re-adjustments	10, 12	Educator:student ratio Educator-student interactions Educator's gaming literacy Educator's subject matter expertise Curriculum design Game content and subject matter couplings Assessment facilitating tools Learning objectives Organisational structures Students' proficiencies and knowledge development

Being able to assess students' progress through a curriculum is important for several reasons. Assessments are needed in order to gauge whether students are achieving learning objectives and at what rate of progress. This is important, in order to ensure that the game-based curriculum is progressing according to organisational standards, and that the teacher is able to re-structure and re-design the curriculum, the exercises, and the contextualising activities. In order to assess students' progress through a game-based curriculum, a certain level of gaming literacy is helpful, as it enables teachers to compare students' in-game achievements with learning outcomes. Gaming literacy also makes it easier for teachers to know what in-game achievements and behaviours are not conducive to the pursued learning objectives, and can thus make adjustments and new rules for the game-based exercises if needed.

Involved process	Chapters	Situational factors
Student collaboration, communication, and reflection	5, 10, 12	Educator:student ratio Students' heterogeneity Students' interpersonal relationships Students' proficiencies and knowledge development Students' gaming literacy Curriculum design Exercise design Educational game complexity Educational game quality Game content and subject matter couplings Classroom layout(s) Subject matter contextualising activities Briefing and debriefing methods

While the design and development of the educational game affect the types of exercises it is suitable for, educators' ways of incorporating them into the classroom environment are highly influential when it comes to fostering student collaborations. This can be done by constructing a game-based curriculum which includes many types of creative learning activities. Game-based exercises can, for example, be linked to storytelling activities (e.g. writing or film-making) where students can re-contextualise and use their gameplay experiences in non-game activities. Letting students talk about their own game experiences with their classmates in various ways (either through presentations for the class, discussions, or show-and-tell seminars) can elevate the way they approach the game-based exercises and also anchor the exercises more solidly in the educational context. Another method of fostering positive student collaborations is to be mindful regarding how students are divided into teams for game-based exercises. Pairing students with different levels of proficiency has certain benefits (as one student can tutor the other), but might also lead to an uneven collaborative dynamic.

Involved process	Chapters	Situational factors
Interpretation of game content	5, 12	Educator:student ratio Educator-student interactions Student-student interactions Educator's gaming literacy Students' gaming literacy Students' subject matter knowledge Context of play Game content and subject matter couplings Time for reflection

Students' interpretation of game content is highly dependent on the individual student's gaming literacy and subject matter familiarity. Students with good subject matter knowledge and poor gaming literacy may interpret game objects too literally (and become frustrated when they do not correspond precisely to reality). Students with high gaming literacy are more adept at viewing game objects as abstractions and representations. Facilitating activities and discussions that help these two types of perspectives to collaborate is important, as is contextualising activities and providing opportunities for joint discussions and reflection (e.g. briefing and debriefing).

16.4 SUMMARY

The development and use of educational games constitute a complex system of actors, processes, and situational factors. There are practical factors within the realms of formal education, social factors among teachers, discrepancies between the traditions of education and games, as well as theoretical considerations that make successful and impactful use of educational games challenging. Furthermore, there are various market realities that impact their development, design, and viability as business ventures.

When it comes to constructing gameplay experiences, developers either collaborate directly with students by conducting playtests, or they do it indirectly by analysing their target audience, in order to understand the type of gameplay that would appeal to them. Utility is a product of collaboration between educator and developer. The educator brings a specific organisational context to the collaboration, and developers need to understand the culture, environment, and infrastructure of this context, in order to create something that provides utility. It is important to point out that this collaboration, just as the one between students and the developer, can be direct or indirect. Developers and educators can collaborate directly throughout a development project (e.g. a game developed during a research project, or a regional development project), or it can be a more metaphoric collaboration, in the sense that the educators make use of a product that has been created by developers they are not in direct contact with. So, both utility and gameplay are created in collaborations between developers and their clients, and between developers and players. But, educators and students not only assist in creating these elements of educational games; their characteristics and the situational factors that make up their working environments heavily influence the way utility and experience should and can be provided.

Using the UGM model described in Figure 16.1, the various obstructing or facilitating processes and situational factors involved in educational game development and use are described as parts of a larger unified system. The model also aims to describe how the relationships between the model's various components affect the ability of the educational game to fulfil the objectives that signify impactful development and use. For example, the factor of organisational standards and structures relates to the utilitarian aspects of educational games, and is also primarily controlled by the clients who want to use educational games. If the developer, in an attempt to make sure the educational game provides utility, focuses too much on catering to these processes, the gameplay experience and the player/student will be underrepresented and, as a result, the educational game will provide less value in that area of the model. An example of how situational factors can effect actors, processes, and objectives positively, is how teachers' presence, or social aspects of the classroom context, can elevate certain qualities of educational games. Here, the client contributes to the utilitarian aspects of the game by assuming some of the 'duties' the game has to perform. With teachers guiding the play sessions and encouraging reflection and deliberation in their students, the game does not have to be as heavy-handed in its design to ensure positive learning outcomes. The developer is able to focus on maintaining engaging gameplay (while still, of course, being aware of some utilitarian aspects and the context of the game's use) and the client is able to contribute to the game's utilitarian aspects. While gameplay and utility can be pursued in these ways, meaningful play sessions occur in the formal education setting in collaborations between teachers and their students. Thus, the processes involved in creating impactful educational games have as much to do with designing curricula and exercises, and of tailoring the educational setting for educational game use, as they do the design of the game artefact. As put by Squire (2005), "as challenging as it is to design a good educational game, it may be more challenging to design a good educational system for an educational game to flourish in."

CHAPTER 17
METHOD LIMITATIONS AND CRITIQUE

As described in chapters 3 and 8, the methods employed during this research were iteratively refined, as the research progressed from one research phase to the other. When the research began, an exploratory approach was employed to create a broader understanding of the more superficial challenges and requirements that developers and educators need to take into consideration when working with educational games. As the research progressed, the research questions became more in-depth and detailed, and thus the methodological toolkit used had to be expanded and improved upon. The final phase of research was the most detailed and structured, and thus produced the greatest amount of presentable data and knowledge contributions. While outcomes of the first phases may be less prevalent traces in the ultimate thesis results, they were highly influential in the refinement of study designs and the used research methods. I thus felt that it is important to include them as integral parts of the thesis work.

The methodological developments also bear witness to why the abductive research strategy was a suitable and realistic approach to deal with the broadness of the chosen problem area and research question. As previously stated, the research process was conducted to initially produce a somewhat blunt but comprehensive overview of the larger educational game system, where developers, educators, students, and the surrounding situational factors of their work contexts are all important contributors. The process was continuously and iteratively honed to a more precise point, where smaller segments within this ecosystem could be studied in more detail, after they were identified as important and interesting during the 'broader' research phases. As such, the employment of the abductive research strategy in this research allowed for data triangulation, both in terms of including different actors, settings, and perspectives in the research process and in terms of including different types of research methods.

A limitation of the studies has been that the 'student' category of actors was primarily examined indirectly through the educators' and my own interpretations of how students experienced the game-based exercises. While observation protocols and transcripts from recordings made during the exercises provide some indication of what happened in the classrooms, the students' internalisation of the processes has not been explored. An inherent flaw in using audio recordings in particular is that the quieter students are less 'present' in the gathered data, and there is thus a risk that they become an unrepresented demographic in the overall research and its conclusions. This was alleviated somewhat by the link with the participatory observation protocols. However, conducting interviews or surveys with the students themselves might have captured some of the unrevealed opinions and attitudes of the students who were more reserved or otherwise were barely present in the recordings. The students' thoughts and experiences are thus based on the teachers' perception of how their behaviours and attitudes differed during the game-based curriculum, compared to their regular lessons, as well as my own experience working with them and my interpretation of the transcripts.

Another limitation of the conducted research that is important to point out, is that the case studies in phases two and three were performed at the same Swedish municipal school. The teachers, principals, and classes of students involved were different between each study, but the studies during phase three may have been affected by my previous presence at the school. From my own point of view, it seems that my involvement with the school during phase two was largely unknown to the educators I worked with during phase three. Nonetheless, my familiarity with the school probably expedited the processes of game software integration: partly because I had previous experience of the organisations' processes and could navigate them somewhat more efficiently, but also in a more palpable manner in that the schools' network had been opened up for educational game use (e.g. websites important for the educational game integration had been unblocked in the previous studies).

Another limitation that impacts the transferability of this research is that the same game, *Minecraft* (or rather its educational modification, *MinecraftEdu*), was used in the case studies of phases two and three. Using a range of game titles may have revealed whether the encountered challenges should be considered specific to *Minecraft*. The game's highly open-ended nature, for example, can have exacerbated the issues of student distractions during the game-based exercises. In short, the open and player-driven nature of the game may have made it more unwieldy than more linear and 'focused' ones, since student skill development and task participation may be more difficult to both guide and assess. The choice of using *Minecraft*, however, was largely the result of a 'grass-roots' decision-making process that originated from the teachers and students I collaborated with. *Minecraft*'s popularity is undeniable and it has also received a lot of intention as an educational tool; teachers recognise the game by name and often stated in interviews that they had previously read about *Minecraft* being used in classrooms. From a personal standpoint, *Minecraft* was also a fairly safe choice, due to my own familiarity with the game and its installation and maintenance processes. It also has many benefits compared to other games that, for all intents and purposes, make it a good educational tool. For one, the educational version of the game (*MinecraftEdu*) does not have any particularly complex, copy protection or digital rights management controls that complicate the installation process, making it relatively easy to distribute amongst computers in a classroom. And even though we encountered some performance issues, the game is fairly well optimised for use on older computers. The game can also be considered to be better equipped to deal with the heterogeneity of a classroom audience than most other games. Whereas more linear games contain fixed challenges created by the game's designers, the challenges that *Minecraft* presents are highly customisable by its players, who also have agency in choosing what types of challenges to engage with. Thus, the students themselves had some leeway in tailoring the challenges they took on, according to their own levels of proficiency. Furthermore, even though many students were seen to struggle with the game, it is fairly accessible compared to other games that have been used as educational tools (e.g., *Portal*, *SimCity*, *Civilization*, or *Europa Universalis*). One of the main issues with the game is its broad scope, making it extra important for teachers to frame gaming activities according to learning objectives, and supervising and guiding the students during the exercises to make sure that the frame was maintained. As stated many times throughout this thesis, however, the specific details of a game's design is largely subservient to surrounding factors caused by the properties of formal education. So, while the use of a broader range of games would have made it possible to compare processes of integration and use between different educational games, I argue that the challenges faced by using *Minecraft* are likely to be present in any educational game project, and in many cases they might even be more prevalent.

Finally, If I were to levy a final general critique at my own research process, it would be that its scope was perhaps slightly too large for a sole researcher to take on. While the processes of data gathering and audio transcriptions were manageable, the parts of the research that involved data processing and analysis could have been opened up for peer collaboration and scrutiny to a further extent. Both in the produced literature review (seen in chapter 11) and in the analysis of transcriptions from the game-based exercises (presented in chapter 12), additional researchers' input and perspectives could have served to reduce my own bias in the interpretation of the data. As I was present during the execution of the exercises, my own view of them were highly informed by the classroom atmosphere and how I felt that the students and teachers collaborated and behaved towards one another. Someone who had not directly participated in the exercises may read the transcribed data differently. I tried to alleviate this issue by doing member checks with the educators and asking them to reflect upon the processes as well.

PART V

CONCLUSIONS AND FUTURE WORK

CHAPTER 18
CONCLUSIONS

This research was driven by an ambition to examine how educational games, as multifaceted teaching tools, mesh with formal education environments from a practical standpoint. This examination was conducted through a series of literature and case studies, the outcomes of which were used to produce a comprehensive overview of the system that makes up educational game development, use, and play. The research is ultimately characterised by a utilitarian systems-oriented approach that describes educational games and the different components and factors that affect their development and use in formal education contexts. Challenges presented by previous research, for example in the Triadic Game Design Model (Harteveld et al., 2010) and in technology acceptance research (Venkatesh, Thong & Xu, 2012), were coupled with results from studies to more accurately describe the nature of the concerns that are specific to educational game design and use in formal education contexts (Alklind Taylor, 2014; Bourgonjon & Hanghøj, 2011; Frank, 2014; Stieler-Hunt & Jones, 2015). From the research results of this thesis, and supported by previous research, it is apparent that the problems educational games are facing often stretch far beyond what a developer alone can influence. Furthermore, primarily approaching educational games as design and development challenges is not sufficient to increase their usefulness and impact in formal education.

18.1 ANSWERING THE RESEARCH QUESTION

Using games to educate is an endeavour with a relatively long tail (as described in chapter 4). There is a large body of research describing the effects and results of using them (described in chapter 5) and how they can be better designed (described in chapter 6) to make good on the promises of motivational learning that have been made throughout the last four decades. However, the use of educational games, and how educational games can be developed to provide educators with a reliable utility, has not received nearly as much attention as their potential and virtues as finished products. This results in a glaring lack of knowledge relating to an aspect of educational games that essentially decides their actual usefulness, as the setting in which any game is used and played ultimately greatly influences the actual impact a game can have (on students, teachers, or educational institutions). Attending to the needs of an unfamiliar audience, obliging the client's will, accommodating organisational structures and processes, and keeping the educational material intact, while also creating a good gameplay experience, is a difficult craft. Therefore, created educational games can fall into disuse after completion if a good balance between these different parameters cannot be reached. The fields that educational games are deeply rooted in, that is to say the studies of games, information systems, and instructional solutions design, are fairly well understood; but there is little research that describes the ways in which they unite and create a new craft that is perhaps larger than (or at the very least different from) the sum of these separate communities of practice. In contemporary educational game development, practitioners often resort to using guidelines from traditional software- and game development, and most of the research on educational games has a strong connection to development practices described in these fields (Annetta, 2010; Harteveld et al., 2010; Tan, Neill & Johnston-Wilder, 2012; Young et al., 2012).

This is problematic, as neither field takes the unique challenges that educational game developers face into account; software development is usually very focused on achieving utilitarian objectives, whereas game development is more focused on the experiential nature of games and storytelling. Neither of these sums up the totality of what educational games need to achieve, nor cover the additional complexities that arise when utilitarian and experiential aspects need to be harmonised in one system to convey meaning.

Returning to the research question presented at the beginning of this thesis, the various case studies and literature reviews were conducted to tackle this issue by understanding *how organisational components, processes, and actors found in formal education affect the development and use of educational games*. This research question was answered by identifying the actors, situational factors, processes, and objectives involved in the development and use of educational games. Subsequently, the research described the ways in which these different components affected how an educational game can make an impact in formal education settings:

- **Objectives:** the realities of formal education settings introduce objectives that educational games need to fulfil, which extend beyond just creating an engaging and educational game experience. Educational games need to be an easily integrated and reliable utility, an accessible and interesting gameplay experience, and a good venue for meaning-making activities to be impactful in formal education settings.
- **Actors:** developers, educators, and students all contribute differently to these objectives and the educational game's ultimate impact, both through collaborations and individually. Each actor approaches educational games with a set of characteristics; developers have preferences, experiences, expertise, and constraints that influence the products that they create, educators' characteristics influence how they choose to put games to use, and the characteristics of each student in the classroom audience change the way games are played.
- **Processes:** the actors engage with educational games, their context-of-use, and each other through a series of processes. Developers analyse and interpret requirements, design and develop and 'set the stage' for the types of game-based learning that the game accommodates, educators integrate the game into the educational setting and their educational processes, and students imbue the game with meaning through their interactions and interpretations of the game content.
- **Situational factors:** The formal educational setting presents a plethora of situational factors that strongly influence the processes through which educational games are developed and used. Technological infrastructure, human factors, organisational resources and working processes, budgetary concerns, developers' working conditions, and many other factors affect every part of an educational game's lifespan.

The relationships between these different elements of the educational game system make educational game development and use both complex and significantly different from entertainment games. This relationship was summarised in a comprehensive systems-oriented description of educational games (the Utility, Gameplay, and Meaning model, shown in sub-chapter 16.1). With this description as a backdrop, recommendations could also be constructed regarding how the different steps, during educational game development and use processes, can be conducted (as shown in sub-chapter 16.3). The outcome of this thesis work is thus both a description of how the elements of formal education settings affect educational game development and use, as well as a prescription for how educational game development and use can be conducted.

18.1.1 EDUCATIONAL GAMES ARE COMPLEX SYSTEMS

From the analysis of the conducted interviews, participations, observations, and transcripts, I posit that educational games constitute a collaboration between developers, educators, and students. The educational impact or value of a game is not decided in the development studio, nor is it decided solely in the classroom. Rather, the impact an educational game has on students' learning and educational institutions', teachers', and developers' working processes is dependent on a complex interplay between these different actors and the situational factors that affected their processes of work and play (as shown in the UGM model in sub-chapter 16.1). In essence, an educational game needs to be three things at once: a reliable utility in the organisational context in which it is to be used; an interesting gameplay experience for the recipients who are meant to use and play it; and an arena in which educators and students come together to produce meaningful learning situations. An educational game's utility is primarily ensured by a game's developer and the educators who aim to put it to use. Developers can implement teacher assistive tools to facilitate assessment and exercise designs, and work towards making their game compatible with the setting it is to be used in (e.g. developing with hardware constraints, organisational structures and processes, and learning objectives and requirements in mind). The educator contributes to the educational game's utility by overseeing its integration into their educational setting, making necessary adjustments in the setting and their own working processes, in order to accommodate the game (e.g. mobilising organisational resources and support structures, installing the game and setting up maintenance processes, etc.). Gameplay is more dependent on students' reception of the educational game, and thus developers need to know how to create engaging and accessible gameplay experiences for their intended audience. Here, important factors include the students' age, their gaming proficiency and preferences, and the suitability of the game's representation of the taught subject matter. Finally, meaningful learning situations occur when the educational game is put to use during game-based exercises. Teachers facilitate students' learning by designing and conducting game-based curricula and exercises, and can couple them with contextualising activities that further help students anchor the game content they interact with to the subject matter.

Some of the conclusions and arguments made as a result of this research can be considered as re-examinations and expansions of arguments made previously by researchers and practitioners within educational games. For example, several researchers have already stated that formal education in its current form naturally produces challenges that make the use of educational games in classrooms difficult (e.g., Bogost, 2008; Egenfeldt-Nielsen, 2008, 2010; Egenfeldt-Nielsen, 2011; Ketamo et al., 2013; Young et al., 2012). Other researchers have also pointed out the importance of surrounding educational games with contextualising activities and structures when using them in formal settings (e.g., Alklind Taylor, 2014; Frank, 2014; Squire, 2007; Stieler-Hunt & Jones, 2015), and the challenges involved in conveying a subject matter while creating an engaging gameplay experience (e.g., Engström et al., 2011; Habgood & Ainsworth, 2011; Harteveld et al., 2010). However, the research presented in this thesis has shown how these, usually individually examined aspects of educational games, combine into a system in which they intertwine and mutually affect each other.

18.1.2 IMPLICATIONS FOR THE VIABILITY OF EDUCATIONAL GAMES AND GAME-BASED LEARNING

Beyond elaborating on the relationship between different actors, processes, and situational factors, the research outcomes also reveal some discrepancies and challenges that have implications for educational games and game-based learning. One of the primary implications is that the success of educational games is highly predicated on their reliability and ability to be easily integrated into formal education settings. Quality of gameplay and content becomes a relatively minor concern in comparison to the practical considerations educators face when tasked to integrate games into their working processes. The process of preparing the technological infrastructure and organisational structures of a formal education setting so that they are receptive to the integration of an educational game is long and laborious. Even with a direct channel to a school's IT department and/or with an experienced researcher assisting teachers in the integration processes, it can be difficult and unruly. And that only accounts for the process of acquiring and installing the game software and any potential hardware that might be necessary in order to start conducting a game-based curriculum. During a curriculum, assignments need to be designed and implemented, assessments of students' progress are required, and game sessions have to be started and administrated. All this effort cannot be spent on an educational tool that is unreliable – a curriculum cannot be thoroughly designed around an educational game, if there is a likelihood that a large portion of the classroom time might be spent dealing with technical difficulties. These practical challenges can make implementing educational games as a tool on a larger scale a difficult, if not unfeasible, task for educators. Achieving a positive return on investment with educational games is challenging, and until more institutionalised processes exist to accommodate them, and until educational games can adapt more to the actual circumstances of educational institutions, the wider use of educational games will probably not happen.

The critical analysis of educational games conducted in this thesis is not intended to deter efforts to use games as educational tools in formal settings. Pioneering efforts made by educators, developers, and researchers in attempting to use educational games in their intended settings are important, as they can show various ways of integrating new game-bsaed tools into educational organisations, which in the long term may lead to an overall increased understanding of the processes involved in such endeavours. It is, however, important that such efforts are done with forethought and are given ample support. Also important is that the context of use and its actors are given an opportunity to actively participate and affect the processes, rather than just being treated as passive subjects that idly await the developer-driven game-based learning revolution.

I would also like to reiterate that I do not take the stance that it is the sole responsibility of the developers to make concessions in the ways they create games and design their components to accommodate the requirements of formal education. The concerns and challenges brought up in this thesis should be read as issues that need to be taken into consideration by educators as well. Just as in the field of information systems research, organisations should not be seen as static constructs that new software solutions must be precisely adapted to (Alter, 2010); implementation of new solutions can reveal shortcomings in organisational practices and encourage change for the better (Alter, 2010; Delone & McLean, 2003; Petter, Delone & McLean, 2012). Educational games can, and perhaps should, influence the organisation of formal education in the same way, but developers still need to be aware of the details of their clients' traditions in order to start experimenting with ways to gradually change them (Bogost, 2008).

Educators' motivation and willingness to start using games for educational purposes is increasing, and the aversions that may have been more prevalent during the 1990's and early 2000's are not as prevalent today. But many challenges still remain, and it is difficult for educators to integrate and use educational game solutions without major investments and organisational restructuring. These challenges, as described in chapter 6 and examined first-hand in chapters 9, 10, and 12, may be laborious enough for educators and developers to largely negate the added values educational games may bring. However, technology expertise is slowly increasing among teachers and the quality of schools' technological infrastructures is also improving, so some of the conditions necessary for educational games to be more viable as teaching tools are constantly changing for the better. As educators and developers continue to explore the places that educational games can hold in formal education, both games and education will mutually influence and change each other. The directions of these changes, however, need to be tethered in more real-world research of game-based learning and educational games, and in a way that does not shy away from acknowledging the commercial, political, and socio-economic power-dynamics that are embedded in the concept of the digitalised game-based classroom.

18.2 FUTURE WORK

To conclude this thesis, I would like to provide some comments on several fundamental issues of educational games and educational game research that I would urge future researchers to acknowledge to a much further extent than is done currently.

In a summary, in a study on the implementation of a game in a formal education setting, Egenfeldt-Nielsen pondered: *"are games worth it? Currently, I don't think so [...]"* (Egenfeldt-Nielsen, 2008, p. 26). Although Egenfeldt-Nielsen's statement is eight years old, it still echoes in the outcomes of my own research. While the conducted studies had some positive results, the actual basis of the benefits is hard to pinpoint. The teachers and the organisation had a difficult time maintaining the necessary technological infrastructure to support educational gaming without my own direct involvement. This raises an important consideration for future research on the topic of educational games: researchers need to pursue transparency in their working processesand reflect upon the impact of their own involvement and role on the setting in which they are conducting their research. Researchers' presence undeniably has an impact on working processes and value perceptions and, as stated by educators in this research, they also often affect students' behaviours and attitudes just by being present. Assuming that research outcomes, such as 'increased engagement and motivation', are caused by an inherent quality of the games medium is thus somewhat dubious. Similarly, disregarding the processes of preparing educational settings, integrating educational games within them, and ensuring continued reliability for game-based exercises is equally nonchalant, and also still a common practice in educational games research. As an example, Chee, Mehrotra and Ong (2014) conclude a study on game-based classroom teaching by stating that "our findings suggest that the key challenges teachers face are not technology centric but practice centric" (Chee, Mehrotra & Ong, 2014, p. 313). Meanwhile, the study was heavily primed by the researchers as they a) supplied the students with Iphones, game software, and a data plan for the project and b) hosted a two-day professional development workshop for the involved teachers, and c) the researchers were also present as experts and adept consultants, as the study was conducted on a game that they themselves had developed. In essence, the authors had bootstrapped the educational setting to be specifically receptive to an educational game they had intimate experience with, and then they state that technology is not part of the 'key challenges' teachers face when engaging with game-based learning. The authors ultimately move on to ask whether "the crust of institutional and social convention [will] continue to engender resistance to change or will insight concerning challenges to teachers' professional growth surfaced in this paper contribute to foresight for social good? Only time will tell." (Chee, Mehrotra & Ong, 2014, p. 313)

Completely glossing over the practical realities of educational game technologies and educational settings and moving on to question why educators are stubbornly resistant to game-based learning has been, and continues to be, a common narrative in educational games scholarship (e.g., Becker, 2005; Becker & Jacobsen, 2005; Gee, 2005; Kroksmark, 2012; Tan, Neill & Johnston-Wilder, 2012)[13]. This narrative is arguably even more prevalent in non peer-reviewed practitioner texts and presentations (e.g., Cobb, 2013; Huynh, 2013, 2014; McGonigal, 2011; Puentedura, 2009) and news articles (e.g., Boas, 2013; Fredriksson, 2015; Loo, 2014). Again, I do not take the stance that educational structures are perfect as they are, and that educational games should always bend over backwards to accommodate the current praxis of education. But, the prevalence of the rhetoric that diminishes teachers' work while simultaneously making proclamations of how games will revolutionise education is an approach that situates teachers as passive drones rather than actuators of change. If educational games are to impact education, teachers and students need to be able to use and trust them, and they need to be invited to participate in the construction of the systems that they themselves play a crucial part in. As researchers, we can play an important role in assisting educators, developers, and students through this process. And, perhaps more importantly, we can assist them in constructing a pragmatic, feasible, diverse, and inclusive understanding of educational games that takes their working processes, situations, and ambitions into account – instead of reinforcing the evangelistic, disempowering, and technology-centric narratives constructed through TED talks and non-peer reviewed research. By focusing on the design of finished products and measuring the positive outcomes of educational game use - and doing so in artificially produced environments that do not correspond to the realities of education - power is stripped from teachers and given to the manufacturers and distributors of educational commodities. In the words of Arnseth (2006):

> "… gaming cannot or should not be conceived as something which in and by itself will make learning more meaningful, fun or pleasurable. Uncritical depictions of games as well-designed learning environments is also problematic because such arguments can easily be refurbished to suit particular economic interests prevalent in the gaming industry." (Arnseth, 2006)

It is naïve to think that games will automatically generate a positive disruption of existing structures of politics and commercialism due to some inherent purity and integrity of the medium. Games have historically been treated as pariahs in news media as well as cultural and political discourse, which may have led to an underlying sense of games being harbingers of modernisation, rebellion, and the upheaval of a suppressive and conservative status quo. This sense ultimately feeds into a broader issue of complacency when it comes to questioning who or what the digitalisation and 'gamification' of education actually serves. While games are often dressed up as vehicles of youth empowerment, they are as prone to commodification in service of pre-existing structures as any other object. Particularly in the realm of education, these processes of "annexation" are far from unprecedented or unique to digital games. As pointed out by Ito (2009), education is a concept that has cyclically been commodified into media products to be sold and marketed to parents and educators through a rhetoric that exploits performance anxieties and that ultimately reinforce socio-economic inequalities:

[13] The reference to Kroksmark (2012) needs a special disclaimer. The referenced paper was retracted from all places of publication around 2014 after it had officially been deemed to be a product of scientific misconduct (Oredlighetsnämnden vid Högskolan i Jönköping, Dnr 13/60-239). Even though the referenced paper is hard to come by now, I have decided to still include the reference as it exemplifies the discussed "genre" of educational games research.

> "Early edutainment developers hoped to put accessible technical tools in the hands of the disenfranchised, alleviating the oppressiveness of narrow notions of education. Instead, children's software became another site for addressing achievement anxiety in parents and for supporting achievement for children who seem to have been born into success" (Ito, 2009, p. 188)

Spearheaded by spurious arguments of 'digital nativity' and games' inherent virtues as learning environments, educational games are heading down the same problematic, myopic, and increasingly exclusionary road as previous educational technologies. Academia should not expedite this journey by reinforcing the hypothetical promises of educational games and by reducing their potential users to a singular monolithic entity – it should rather provide an open dialogue that has space for nuance and healthy scepticism, or at the very least more cautious optimism.

That being said, a large part of this research's outcomes has focused on revealing challenges that emerge when formal education and games merge. Further studies would be useful for providing some mapping between the revealed challenges and more thoroughly tested ways of solving them. When working towards that goal, there are still a lot of valuable models and theories to use in the fields of information system and instructional solution design research. For example, the UTAUT model (Venkatesh et al., 2003) can be applied more extensively to understand how situational factors, educators' characteristics, expectations, and student's preferences and proficiencies affect educators' and students' acceptance and intention of use when it comes to educational games. Another example that this thesis has not really dealt with is also how student perceptions of games and individual students' learning characteristics influence educational game design and outcomes. The issue of audience heterogeneity has been explored, but then primarily in regards to how it complicates both the process of game design, the design of game-based exercises, and teachers' work during classroom gaming sessions. But, students also have individual learning styles, some respond well to auditory input, some are more visual, and they also have widely differing preferences regarding the type of challenges that they enjoy tackling. Here, research in adaptive games (e.g., Kickmeier-Rust & Albert, 2008; Kickmeier-Rust & Dietrich, 2009; Kickmeier-Rust et al., 2011) is making important strides, and research that assesses learning types, player skill, and subject matter knowledge and adapt the gameplay accordingly can play an important role in both increasing educational games' gameplay and utility. There is certainly no shortage of areas to explore when it comes to educational games. However, for the field to move forward, it needs to step back and do the necessary ground-work in the trenches of formal education. The field of educational technology in general is saturated with theories about what values and pedagogical processes games (or other technology) should theoretically be able to support, if they functioned optimally and were played by an imagined 'digital native' (Ross, Morrison & Lowther, 2010; Young et al., 2012). The context in which educational games are used, and where teachers and students imbue them with meaning, is important and needs to be acknowledged. As stated by Flyvbjerg (2006), researchers and practitioners in any field that are "exclusively trained in context-independent knowledge and rules [will] remain at the beginner's level in the learning process." (Flyvbjerg, 2006, p. 5) For educational games to progress as educational tools, game development products, and a subject of research, the realities and nuances of the educational context need to be better understood.

APPENDICES

APPENDIX A

Inventory of papers included in the literature review, which was also published in Berg Marklund (2014).

K-12?	Paper Title	Author(s)	Year	Examining	Understanding	Method	Participants
	DiGRA Papers	**Filtered from a total of 692 articles and abstracts**					
	Collaboration, Creativity and Learning in a Play Community: A Study of The University of There	Pearce, Celia	2009	Informal usage	Games and Learning Principles	Experiment	Researcher, teachers, players
Yes	Learning Games as a Platform for Simulated Science Practice	Magnussen, Rikke	2005	Informal usage	Games and Learning principles	Experiment	Students
	Spontaneous Communities of Learning: Learning Ecosystems in Massively Multiplayer Online Gaming Environments	Galarneau, Lisa	2005	Informal usage	Games and Learning principles	Case study	Players
	Game, Motivation, and Effective Learning: An Integrated Model for Educational Game Design	Paras, Brad Bizzocchi, Jim	2005	Informal usage	Design tools and techniques	Literature study	Researcher
	Affordances of Elliptical Learning in Arcade Video Games	Hock-koon, Sébastien	2012	Informal usage	Games and Learning principles	Case study	Researcher
	Team Structure in the Development of Game-based Learning Environments	Kirjavainen, Antti Nousiainen, Tuula Kankaanranta, Marja	2007	Development tools and techniques	Development tools and techniques	Case study	Developers
	Why gamers don’t learn more: An ecological approach to games as learning environments	Linderoth, Jonas	2010	Design tools and techniques	Games and Learning principles	Literature study	Researcher
	Authentic Learning Experiences Through Play: Games, Simulations and the Construction of Knowledge	Galarneau, Lisa	2005	Games and Learning principles	Design tools and techniques	Case study	Researcher
Yes	Teacher roles in learning games – When games become situated in schools	Magnussen, Rikke	2007	Formal usage	Design tools and techniques	Case study	Teachers; Students
	Evaluating Interactive Entertainment using Breakdown: Understanding Embodied Learning in Video Games	Ryan, Wallace Siegel, Martin A.	2009	Informal usage	Design tools and techniques	Experiment	Players
Yes	Serious Games in language learning and teaching – a theoretical perspective	Sørensen, Holm Birgitte Meyer, Bente	2007	Informal usage	Design tools and techniques	Experiment	Students
	Subversive Game Design for Recursive Learning	Mitgutsch, Konstantin Weise, Matthew	2011	Games and Learning principles	Design tools and techniques	Experiment	Players
	Design Guidelines for Learning Games: the Living Forest Game Design Case	Pereira, Luís Lucas Roque, Licínio Gomes	2009	Design tools and techniques	Design tools and techniques	Case study	Researcher

Yes	What Videogame Making Can Teach Us About Literacy and Learning: Alternative Pathways into Participatory Culture	Peppler, Kylier A. Kafai, Yasmin B.	2007	Development tools and techniques	Games and Learning principles	Case study	Developers
	Unexpected game calculations in educational wargaming: Design flaw or beneficial to learning?	Frank, Anders	2011	Formal usage	Games and Learning principles	Experiment	Students
	From real-world data to game world experience: Social analysis methods for developing plausible & engaging learning games	Dobson, Mike Ha, Daniel Mulligan, Desmond Ciavarro, Chad	2005	Games and Learning principles	Design tools and techniques	Survey/Interviews	SME
	Player-reported Impediments to Game-based Learning	Harviainen, J. Tuomas Lainema, Timo Saarinen, Eeli	2012	Design tools and techniques	Games and Learning principles	Survey/Interviews	SME, students
	How Are Games Educational? Learning Theories Embodied in Games	Becker, Katrin	2005	Design tools and techniques	Games and Learning principles	Literature study	Researcher
	Making sense of game-play: How can we examine learning and involvement?	Iacovides, Ioanna Aczel, James Scanlon, Eileen Woods, Will	2011	Informal usage	Research methodologies	Experiment	Players
	The Order of Play: Seeing, Teaching, and Learning Meaning in Video Games	Hung, Aaron Chia-Yuan	2009	Informal usage	Games and Learning principles	Case study	Players
Yes	Games for Learning: Are Schools Ready for What's To Come?	Becker, Katrin Jacobsen, D. Michelle	2005	Attitudes towards GBL	Formal usage	Survey/Interviews	Teachers; Students
	From Simulation to Imitation: New Controllers, New Forms of Play	Jenson, Jennifer de Castell, Suzanne	2009	Informal usage	Games and Learning principles	Literature study	Researcher
	Playful Play with Games: Linking Level Editing to Learning in Art and Design	Engeli, Maia	2005	Formal usage	Games and Learning principles	Case study	Researcher
Yes	"A Totally Different World": Playing and Learning in Multi-User Virtual Environments	Kao, Linda Galas, Cathleen Kafai, Yasmin	2005	Formal usage	Design tools and techniques	Survey/Interviews	Students
	Learning and Enjoyment in Serious Gaming – Contradiction or Complement?	Wechselberger, Ulrich	2013	Attitudes towards GBL	Games and Learning principles	Experiment	Students; Employees
	Playing And Learning Without Borders: A Real-time Online Play Environment	Sauvé, L. Probst, W. Boyd, G. Kaufman, D. Sánches Arias,	2005	Design tools and techniques	Development tools and techniques	Case study	Researcher

		Power, M.					
Yes	What Happens if you Catch Whypox? Children's Learning Experiences of Infectious Disease in a Multi-user Virtual Environment	Neulight, Nina R. Kafai, Yasmin B.	2005	Formal usage	Learning outcomes	Experiment	Students
	How Serious Are Serious Games? Some Lessons From Infra-games	Bekebrede, Geertje Mayer, Igor van Houten, Stijn Pieter Chin, Roy Verbraeck, Alexander	2005	Design tools and techniques	Formal usage	Case study	Researcher
	Engaging students in OH&S hazard identification through a game	Greuter, Stefan Tepe, Susanne	2013	Formal usage	Design tools and techniques	Experiment	Students
Yes	Recognizing New Literacies: Teachers and Students Negotiating the Creation of Video Games in School	Sanford, Kathy Madill, Leanna	2007	Formal usage	Games and Learning principles	Case study	Teacher; Students
	DATAPLAY: Mapping Game Mechanics to Traditional Data Visualization	Macklin, Colleen Wargaski, Julia Edwards, Michael Li, Kan Yang	2009	Design tools and techniques	Design tools and techniques	Case study	Researcher
	Video games in context: An ethnographic study of situated meaning-making practices of Asian immigrant adolescents in New York City	Hung, Chia-Yuan	2007	Informal usage	Context of play	Case study	Players
Yes	Stealing from Grandma or Generating Cultural Knowledge? Contestations and Effects of Cheats in a Tween Virtual World	Fields, Deborah A. Kafai, Yasmin B.	2007	Informal usage	Design tools and techniques	Literature study	Players
	Her own Boss: Gender and the Pursuit of Incompetent Play	Jenson, Jennifer de Castell, Suzanne	2005	Attitudes towards GBL	Research methodologies	Survey/Interviews	Players
	Epistemic games & applied drama: Converging conventions for serious play	Cameron, David Carroll, John Wotzko, Rebecca	2011	Formal usage	Games and Learning principles	Case study	Teachers; Students
	Digital Games: A Motivational Perspective	Medina, Eliana	2005	Design tools and techniques	Games and Learning principles	Literature study	Researcher
	DESIGN(er) META Game	Staples, Cary Ward, Neil Marone, Vittorio	2013	Development tools and techniques	Design tools and techniques	Case study	Researcher; Students
	Towards a Playful Organization Ideal-type: Values of a Playful Organizational Culture	Warmelink, Harald	2011	Context of play	Design tools and techniques	Literature study	Researcher
Yes	Use of Computer and Video Games in the Classroom	Kirriemuir, John	2003	Formal usage	Formal usage	Survey/Interviews	Teachers

		McFarlane, Angela					
Yes	Participatory design and opposing interests in development of educational computer games	Magnussen, Rikke Misfeldt, Morten Buch, Tasha	2003	Development tools and techniques	Design tools and techniques	Case study	Teachers; Students
	Studying Games in School: a Framework for Media Education	Pelletier, Caroline	2005	Games and Learning principles	Research methodologies	Literature study	Researcher
	Balancing Three Different Foci in the Design of Serious Games: Engagement, Training Objective and Context	Frank, Anders	2007	Design tools and techniques	Design tools and techniques	Case study	Researcher
Yes	Peer Puppeteers: Alternate Reality Gaming in Primary School Settings	Colvert, Angela	2009	Formal usage	Games and Learning principles	Case study	Student, Teacher, Researcher
	FDG Papers	Filtered from a total of 168 Full papers					
	Evaluation of a game-based lab assignment	Michael Eagle, Tiffany Barnes	2009	Formal usage	Learning Effects/Outcomes	Experiment	Students
Yes	BeadLoom Game: using game elements to increase motivation and learning	Acey Boyce Tiffany Barnes	2010	Informal usage	Learning Effects/Outcomes	Case study	Students
	Catalyst: seeing through the eyes of a cat	Jeremy Long, Anthony Estey, David Bartle, Sven Olsen, Amy A. Gooch	2010	Informal usage	Design tools and techniques	Case study	Players
	A framework for evidence based visual style development for serious games	Tim McLaughlin, Dennie Smith, Irving A. Brown	2010	Design tools and techniques	Development Tools and Techniques	Experiment	Students
Yes	Individual differences in gameplay and learning: a narrative-centered learning perspective	Casper P. Rowe, Lucy R. Shores, Bradford W. Mott, James C. Lester	2010	Formal usage	Learning Effects/Outcomes	Experiment	Students
Yes	Weatherlings: a new approach to student learning using web-based mobile games	Josh Sheldon, Judy Perry, Eric Klopfer, Jennifer Ong, Vivian Hsueh-Hua Chen, Pei Wen Tzuo, Louisa Rosenheck	2010	Informal usage	Learning Effects/Outcomes	Experiment	Students
	A computational approach towards conflict resolution for serious games	Yun-Gyung Cheong, Rilla Khaled, Corrado Grappiolo, Joana Campos, Carlos Martinho, Gordon P. D. Ingram, Ana Paiva, Georgios Yannakakis	2011	Design tools and techniques	Design tools and techniques	Case study	Researcher
	Fun and learning: the power of narrative	Tim Marsh, Chuang Xuejin, Li	2011	Design tools and	Learning Ef-	Experiment	

		Zhiqiang Nickole, Scot Osterweil, Eric Klopfer, Jason Haas		techniques	fects/Outcomes		
Yes	BeadLoom Game: adding competitive, user generated, and social features to increase motivation	Acey Boyce, Katelyn Doran, Antoine Campbell, Shaun Pickford, Dustin Culler, Tiffany Barnes	2011	Formal usage	Design tools and techniques	Experiment	Students
	Purposeful by design?: a serious game design assessment framework	Konstantin Mitgutsch, Narda Alvarado	2012	Design tools and techniques	Design tools and techniques	Literature Study	Researcher
Yes	My Dream Theatre: Putting Conflict on Center Stage	Joana Campos, Carlos Martinho, Gordon Ingram, Asimina Vasalou, and Ana Paiva	2013	Design tools and techniques	Games and Learning principles	Case study	Researcher
	Integrating serious content into serious games	Wallace Ryan and Dennis Charsky	2013	Development tools and techniques	Design tools and techniques	Survey / Interviews	Developers
Yes	Iterative didactic design of serious games	Michael G. Wagner and Thomas Wernbacher	2013	Development tools and techniques	Development Tools and Techniques	Case study	Researcher, teacher, student
	IJGBL Papers	Filtered from a total of: 70 papers					
	An Evaluation of the Added Value of Co-Design in the Development of an Educational Game for Road Safety (pages 1-17)	All, Anissa Looy, Jan Van Castellar, Elena Patricia Nuñez	2013	Development tools and techniques	Development tools and techniques	Case studies	Developer, students
	The Value of Team-Based Mixed-Reality (TBMR) Games in Higher Education (pages 18-33)	Denholm, John A. Protopsaltis, Aristidis de Freitas, Sara	2013	Formal usage	Games and Learning Principles	Case studies	Students
	Perceived Sociability and Social Presence in a Collaborative Serious Game (pages 34-50)	Oksanen, Kimmo Hämäläinen, Raija	2013	Games and Learning Principles	Design tools and techniques	Literature studies	Researcher
	Behavioral Evaluation of Preference for Game-Based Teaching Procedures (pages 51-62)	Marques, Leonardo B. de Souza, Deisy das Gracas	2013	Learning Effects/Outcomes	Research methodologies	Experiment	Students
Yes	An Authoring Tool for Educational Adventure Games: Concept, Game Models and Authoring Processes (pages 63-79)	Mehm, Florian Göbel, Stefan Steinmetz, Ralf	2013	Development tools and techniques	Development tools and techniques	Case studies	Researcher; Teacher
	The Impact of Students' Temporal Perspectives on Time-On-Task and Learning Performance in Game Based Learning (pages 80-92)	Romero, Margarida Usart, Mireia	2013	Games and Learning Principles	Learning Effects/Outcomes	Experiment	Students
	Factors at Play in Tertiary Curriculum Gamification (pages	de Byl, Penny	2013	Formal usage	Formal usage	Case studies	Students, Re-

	1-21)						searcher
	Learning to Play, Playing to Learn: Comparing the Experiences of Adult Foreign Language Learners with Off-the-Shelf and Specialized Games for Learning German (pages 22-35)	de Grove, Frederik Looy, Jan Van Mechant, Peter	2013	Learning Effects/Outcomes	Design tools and techniques	Experiment	Players
	Strategy Instruction and Maintenance of Basic Multiplication Facts through Digital Game Play (pages 36-54)	Denham, André R.	2013	Learning Effects/Outcomes	Design tools and techniques	Experiment	Students, researcher
	Evaluating the Relationship between Cognitive Style and Pre-Service Teachers' Preconceived Notions about Adopting Console Video Games for Use in Future Classrooms (pages 55-76)	McDaniel, Ruby Kenny, Robert	2013	Attitudes towards GBL	Attitudes towards GBL	Experiment	Teachers
	The Opinions and Attitudes of the Foreign Language Learners and Teachers Related to the Traditional and Digital Games: Age and Gender Differences (pages 91-111)	Uzun, Levent Ekin, M. Tugba Yildiz Kartal, Erdogan	2013	Demographics	Attitudes towards GBL	Survey / Interviews	Students, teachers
	Integrating Serious Games in the Educational Experience of Students with Intellectual Disabilities: Towards a Playful and Integrative Model (pages 10-20)	Saridaki, Maria Mourlas, Constantinos	2013	Demographics	Formal usage	Case studies	Students
	Second-Hand Masculinity: Do Boys with Intellectual Disabilities Use Computer Games as Part of Gender Practice? (pages 43-53)	Charnock, D. Standen, P.J.	2013	Demographics	Games and Learning Principles	Experiment	Players
	Towards a New Learning: Play and Game-Based Approaches to Education (pages 1-6)	de Freitas, Sara	2013	Context of use	Design tools and techniques	Case studies	Researcher
	MACBETH: Development of a Training Game for the Mitigation of Cognitive Bias (pages 7-26)	Too many to name	2013	Development tools and techniques	Development tools and techniques	Case studies	Researcher
Yes	Are Good Games Also Good Problems?: Content Analysis of Problem Types and Learning Principles in Environmental Education Games (pages 47-61)	Lee, Yu-Hao	2013	Games and Learning Principles	Design tools and techniques	Case studies	Researcher
	How do Professionals' Attitudes Differ between what Game-Based Learning could Ideally Achieve and what is Usually Achieved (pages 1-15)	Tan, Wee Hoe Neill, Sean Johnston-Wilder, Sue	2012	Attitudes towards GBL	Development tools and techniques	Survey / Interviews	Developer, Teachers
Yes	Is there a Place for Casual Games in Teaching and Learning?: The Snakes and Ladders Case(pages 16-32)	Daloukas, Vasilis Rigou, Maria Sirmakessis, Spiros	2012	Design tools and techniques	Games and Learning Principles	Experiment	Students, teachers

Yes	Teachers' Views on the Approach of Digital Games-Based Learning within the Curriculum for Excellence (pages 33-51)	Razak, Aishah Abdul Connolly, Thomas M. Hainey, Thomas	2012	Attitudes towards GBL	Formal usage	Survey / Inter-views	Teachers
	Martian Boneyards: Scientific Inquiry in an MMO Game (pages 52-76)	Asbell-Clarke, Jodi Edwards, Teon Rowe, Elizabeth, Larsen, Jamie Sylvan, Elisabeth Hewitt, Jim	2012	Design tools and techniques	Games and Learning Principles	Case studies	Teachers, De-velopers
	PBL as a Framework for Implementing Video Games in the Classroom (pages 77-89)	Watson, Wallace R. Fang, Jun	2012	Literature review	Development tools and techniques	Literature studies	Researcher
Yes	Game-Based Learning in Teacher Education: A Strategy to Integrate Digital Games into Secondary Schools (pages 1-12)	Charlier, Nathalie De Fraine, Bieke	2012	Demographics	Attitudes towards GBL	Case studies	Teachers
Yes	Console Game-Based Pedagogy: A Study of Primary and Secondary Classroom Learning through Console Video Games (pages 35-54)	Groff, Jennifer S. Howells, Cahtrin Cranmer, Sue	2012	Games and Learn-ing Principles	Learning Ef-fects/Outcomes	Case studies	Teachers, Stu-dents
	Detecting Learning Style through Biometric Technology for Mobile GBL (pages 55-74)	Mehigan, Tracey J. Pitt, Ian	2012	Research meth-odologies	Design tools and techniques	Experiment	Players
	Player Types, Play Styles, and Play Complexity: Updating the Entertainment Grid (pages 75-89)	Rademacher, Ricardo Javier	2012	Literature review	Design tools and techniques	Literature studies	Researcher
Yes	Math Learning Environment with Game-Like Elements: An Experimental Framework (pages 90-110)	Rai, Dovan Beck, Joseph E.	2012	Design tools and techniques	Learning Ef-fects/Outcomes	Case studies	Students, re-searcher
	Concept Learning and the Limitations of Arcade-Style Games (pages 1-10)	Moore, David Richard Hsiao, E-ling	2012	Design tools and techniques	Design tools and techniques	Literature studies	Researcher
	Empirical Taxonomies of Gameplay Enjoyment: Personali-ty and Video Game Preference (pages 11-31)	Quick, John M. Robert, Atkinson K. Lin, Lijia	2012	Demographics	Design tools and techniques	Literature studies	Researcher
	An Alternate Reality for Education?: Lessons to be Learned from Online Immersive Games (pages 32-50)	Moseley, Alex	2012	Games and Learn-ing Principles	Design tools and techniques	Case studies	Players
	The Learning Games Design Model: Immersion, Collabo-ration, and Outcomes-Driven Development(pages 87-110)	Chamberlin, Barbara Trespalacios, Jesús Gallagher, Rachel	2012	Development tools and tech-niques	Development tools and techniques	Case studies	Researcher
	Playability Guidelines for Educational Video Games: A Comprehensive and Integrated Literature Review (pages	Ibrahim, Ame Vela, F.L.G Rodríguez, Patricia P.	2012	Literature review	Design tools and techniques	Literature studies	Researcher

	18-40)	Sánchez, J.L.G Zea, Natalia Padilla					
	A Theoretical Framework for Serious Game Design: Exploring Pedagogy, Play and Fidelity and their Implications for the Design Process (pages 41-60)	Rooney, Pauline	2012	Games and Learning Principles	Design tools and techniques	Literature studies	Researcher
Yes	Introducing Cool School: Where Peace Rules and Conflict Resolution can be Fun (pages 74-83)	Young, Mark Killen, Melanie Lee-Kim, Jennie Park, Yoonjung	2012	Games and Learning Principles	Learning Effects/Outcomes	Case studies	Students, Researcher
	Digital Games: Changing Education, One Raid at a Time. (pages 1-18)	Pivec Paul, Pivec Rose	2011	Games and Learning Principles	Design tools and techniques	Literature studies	Researcher
	The Magic Bullet: A Tool for Assessing and Evaluating Learning Potential in Games (pages 19-31)	Becker Katrin	2011	Games and Learning Principles	Design tools and techniques	Literature studies	Researcher
	Honing Emotional Intelligence with Game-Based Crucible Experiences (pages 32-44)	Raybourn, Elaine M.	2011	Games and Learning Principles	Design tools and techniques	Case studies	Researcher; Students
	A Psycho-Pedagogical Framework for Multi-Adaptive Educational Games (pages 45-58)	Kickmeier-Rust, Michael D. Mattheiss, Elke Steiner, Christina M. Albert, Dietrich	2011	Games and Learning Principles	Development tools and techniques	Experiment	Researcher
	Video Game Genre Affordances for Physics Education (pages 59-74)	Anagnostou, Kostas Pappa, Anastasia	2011	Games and Learning Principles	Games and Learning Principles	Literature studies	Researcher
	Encouraging Engagement in Game-Based Learning (pages 75-84)	Whitton, Nicola	2011	Informal use	Design tools and techniques	Case studies	Players, researcher
	Leveraging Mobile Games for Place-Based Language Learning (pages 1-18)	Holden, Christopher L. Sykes, Julie M.	2011	Development tools and techniques	Development tools and techniques	Case studies	Researcher
	DataPlay: Experiments in the Ludic Age (pages 19-33)	Macklin, Colleen	2011	Design tools and techniques	Design tools and techniques	Case studies	Researcher
	Affordances and Constraints of Scaffolded Learning in a Virtual World for Young Children (pages 52-64)	Black, Rebecca W. Reich, Stephanie M.	2011	Games and Learning Principles	Design tools and techniques	Case studies	Researcher
	Collaborative Strategic Board Games as a Site for Distributed Computational Thinking (pages 65-81)	Berland, Matthew Lee, Victor R.	2011	Informal use	Games and Learning Principles	Experiment	Players
	Fear of (Serious) Digital Games and Game-Based Learning?: Causes, Consequences and a Possible Countermeasure (pages 1-15)	Bösche, Wolfgang Kattner, Florian	2011	Literature review	Attitudes towards GBL	Literature studies	Researcher

	Assessment through Achievement Systems: A Framework for Educational Game Design (pages 16-29)	Evans, Monica Jennings, Erin Andreen, Michael	2011	Games and Learning Principles	Design tools and techniques	Literature studies	Researcher
	Understanding Computational Thinking before Programming: Developing Guidelines for the Design of Games to Learn Introductory Programming through Game-Play (pages 30-52)	Kazimoglu, Cagin Kiernan, Mary Bacon, Liz MacKinnon, Lachlan	2011	Games and Learning Principles	Design tools and techniques	Case studies	Researcher
	Background Music in Educational Games: Motivational Appeal and Cognitive Impact (pages 53-64)	Linek, Stephanie B. Marie, Birgit Albert, Dietrich	2011	Design tools and techniques	Learning Effects/Outcomes	Experiment	Players
	Content Design Patterns for Game-Based Learning (pages 65-82)	Maciuszek, Dennis Ladhoff, Sebastian Martens, Alke	2011	Games and Learning Principles	Design tools and techniques	Literature studies	Researcher
	Historical Perspectives on Games and Education from the Learning Sciences (pages 83-106)	Shelton, Brett E. Satwicz, Tom Caswell, Tom	2011	Literature review	Games and Learning Principles	Literature studies	Researcher
Yes	The Mobile Learning Network: Getting Serious about Games Technologies for Learning (pages 37-48)	Petley, Rbecca Parker, Guy Attewell, Jill	2011	Formal Usage	Context of use	Case studies	Teachers, Students, Researchers
	Motivational Aspects of Gaming for Students with Intellectual Disabilities (pages 49-59)	Saridaki, Maria Mourlas, Constantinos	2011	Literature review	Games and Learning Principles	Literature studies	Researcher

APPENDIX B

Interview protocols used during the interviews held with educators during the initiation of the research project and after the completion of the game-based curricula. The protocols are structured as “conversation trees”. The higher level bulletpoints constitute more open questions regarding a certain topic, and the sub-level bulletpoints are used if the conversation stalled or the topic needed some clarification. In the post-curriculum protocol, the sub-level bulletpoints could also constitute specific details identified during data processing that I wanted to examine the teachers’ opinions and experiences of.

INTERVIEW PROTOCOL USED FOR INITIAL INTERVIEWS

Q1 Summarizing my perspectives on the previous meeting: My first question ties back to what we talked about during our last meeting. We started discussing the subject matter details rather early on, and how it could be tied into game-based exercises and came up with some ideas – so I wonder: what were your thoughts on that discussion?

- What made you gravitate towards the game(s) we discussed?

Q2: Before my involvement here, were there any previous interest in using games in your classroom? (Or was it generated by my involvement with the school)

- Why do games feel appealing to you?

Q3: Did you have any experiences, thoughts, or observation of other examples of games being used in classrooms that inspired you?

Q4: What kind of outcome are would you like to see from this project?

- Is it increasing your own understanding of games and how they can be used?
- Are you hoping for a change in the classroom or test results, or to reach particular students differently?

Q5: What do you see as the biggest points of concern for our project?

- What do you see as something "essential" you/we need to do to make this work?
- What do you see as the biggest obstacles you/we might encounter?

Q6: What do you think you will need my help with the most?

Q7: What would an "optimal" game-based exercise look like to you?

Q8: You had mentioned earlier that you did not have much time to sit down and think about this project, what kinds of deliberations do we need to do to proceed?

Q9: What do you feel the next step of our collaboration should be?

- What do we need to do to preparing the classroom/technology?
- How do you want to plan the curriculum and exercises?
- What are your schedules like? When do you have class hours that would be suitable for working with game-based exercises?
- How is the information disseminated to parents?

INTERVIEW PROTOCOL USED IN POST-CURRICULUM INTERVIEWS WITH EDUCATORS

Opening question: What did going through this project feel like for you?

- What do you think of the way that the overall project plan, now that the project is concluded?
    - Would you have done something differently?
    - What worked well? What worked poorly?

Student-related questions:

- What has it been like working with your students during the game-based curriculum?
    - Were the student dynamics different from what you are used to?
        - Was it difficult to balance the different types of personalities and proficiencies – how did you feel that the different "types" of students played off of each other?
    - Did the classroom "atmosphere" change from what you are used to?

Questions regarding the teacher's role and experiences in the project:

- How did the use of a game affect your working processes as a teacher (if at all)?

- What became your role(s) during classroom activities?
    - Did game-based activities present different challenges than usual activities?
    - Did game-based activities demand different types of "interventions" than what you usually need to administer?
- How did the game-based exercises fit into the broader working processes?
    - How did the game, and the students' work inside the game, mesh with other teaching?

Questions regarding the used technology and game:

- We have usually discussed technological aspects in a very ad-hoc way (e.g. "what do we need to do to make things work for the next session") – how would you say your understanding of the technology we used is today?
    - Is it different from when we started out?
- What did you think of the game we used?
    - What were some shortcomings, what were some of its beneficial qualities?
- How do you feel about the technology you have available now?
    - Is it something you feel you can work with?
    - Is the game and the technology something you think you can work with now?

Questions regarding researcher intervention(s):

- What did you "see" me as during this project? What type of role did I fulfil, from your perspective?
- Now that you've worked with educational games and tried your hand at a game-based curriculum – what are your thoughts on doing this on your own, without my involvement?
    - Does it feel feasible for you to go at it on your own?
    - What types of resources and support would you want to make working with games in this way easier (or feasible, depending on last answer)?

Do you have anything you would like to add, or ask me?

- Did this project feel "right" and safe for you (vis-à-vis security, my work with students, my involvement, parents' opinions, other teachers' opinions)?

APPENDIX C

This appendix contains a couple of examples of observation protocols from game-based exercises with 5th and 7th grade students. The observation protocols were written during the exercises. Since there was not much time to write down elaborate notes during the exercises, the protocols usually resulted in series of brief annotations of observed classroom events. To make the protocols easier to read at later dates, some additional contextualisation and elaboration was added to the annotations after the exercise had concluded (the elaborations were usually written the same day as the exercise). As is evident in the example protocols below, grammatical correctness and prose was not highly prioritised. Approximate time-stamps were noted to make re-visiting identified points of interests in the audio recordings easier.

NOTES 24 FEB, 5TH GRADE EXERCISE (MONASTERY GROUP)

Preparation:

This time around, I left everything untouched before teacher arrival. This session is supposed to be a trial run of the teacher doing things without too much pre-assistance from me, so I'm not even getting electrical cords, computer mice, or anything of that nature.

I started all recordings at 07:45 (which is when I arrive). A student (Dan) did walk in and take a quick look at all computers as soon as I arrived, and made sure they all worked OK. I have some suspicions that we're using the wrong computers (one of them might not have Minecraft), but we'll see.

Teacher got in at 07:50. She started the server without any assistance from me, wrote down the IP numbers at 108.

I did prepare some new "earth" for the students to build on, which I had promised to do last time I was here.

Teacher and I talked about some stuff around 07:50-08:02 (first 15 minutes of recording) about what would happen during the upcoming lessons when I would be absent and stuff of that nature.

Introduction:

I was present during the introduction of the day, and today has been dubbed a "Minecraft Tuesday", teacher mentioned that I would be gone for a couple of weeks.

The students entered the computer room at 08:10 (25 minutes into recording).

Took about 5 minutes in, I had to intervene with 3 out of the six students computers

List of difficulties:

One wrong computer brought in (without Minecraft).

One wrong-start of the wrong version of MC.

One group was missing the first parts of the IP (had to insert).

One group had a previously used computer, and didn't get started at the "name enter" screen.

Teacher Interventions:

Teacher let the students go ahead and build, matched a couple of solo-students together. Talked to the newly formed group about what to build. (The 'pro' girl (Miley) was sick today)

As opposed to my introduction, teachers did not start the game out as "frozen", but it seems to work really well anyway. All students started building.

Teacher tied everything back to the broader exercise (of detective stories), around 08:19. Teacher has a lengthy discussion with the back left group from 08:19 onward (a couple of minutes).

Teacher fetched a history book, and got the front left student started on a task.

Right section, teacher talks about a blue-print task they invented.

Teacher backuped again (on own initiative, again) at 08:56 – so she's got it down well.

There's a whole bunch of blueprints being made all over the place – and the teacher is very hands-on in helping students making them.

Teacher announces ending in 10 minz, at 09:10 (about the same as I do). Simultaneously, a discussion about horse prices come up again – one student seems to think that (M) is using horses too liberally.

Teacher talks 09:17 (no freezing). Just asking if the students want to show their stuff off. Talked to the students (and me) about the use of "freezing", was nice.

09:20 freeze, unified presentation.

Researcher Interventions:

Needed to intervene and provide more "earth" around 08:23, on the request of a student. Felt wrong not to do it since it impeded the students quite a bit. I am trying to stay back from being too intervening.

Helped teacher save a bit around 08:26, she did it 90% without assistance though – she essentially just asked how often she should do it, and then the rest was fine.

I had some "teacher"-moments around 08:33.

Helped the front left group out, they were staring at their house for a good minute, looking unpleased with it. I asked what was up, and they said that "the house is lopsided, it doesn't look good". I gave them some suggestions (they could move a door a bit, and rebuild a road segment – but given their building speed I gave them an "easier" suggestion). The problem they had was that a 3-block wide road led up to the house, but the door was only 2 blocks wide, this made things look a bit weird (and as previously stated, the students are very particular about their building). I said "you can put a nice flower or something by the door, to fill the space out", and told them the alternatives available flower-wise. They said "roses would be nice", I helped them put it out, they took a step back, and agreed that things looked nicer. This all happened around 08:59, front left.

Went back to the group at 09:05, and they've now torn down an entire wall of the house because they still want to even it out.

Student Discussions:

Student discussion is very quiet and focused, seems very organized this time around. Everyone is doing work without much coaxing.

Interesting discussion about playtimes at 08:24 in the back left group.

"The guy in the poop-pit" NPC at the stables is, I guess, the most unserious instance of students messing around with game objects. So all in all, pretty well focused. He was brought up and laughed at last time, and this time around 08:32 the back left students commented on it, they're just browsing around and don't really know what to do.

The front left group are, as per usual, very quiet. They are still building, quite slowly (comparatively) on their sleeping cabin.

(Dan) had a walk around the classroom around 08:40, talked to all groups about what they were doing.

Front left group re-built their roof since it was one block un-even. Still not done (40 minutes in). Again, the less experienced players seem to have a tough time seeing things as imprecise and representative, and wants things to be more literal.

Students starts talking about other Minecraft-games they're playing around 08:48. One of the students (Dan) has paid for a dedicated server, and the students are talking about how it is playing on that one.

Students are helping each other out well with the blueprints (within the playgroups) – one is counting the blocks, and they are drawing together. I don't think is specifically structured or planned, but students tend to do it.

Technical difficulties:

Beyond the initially stated issues, power also started running out on the front right computer (they did not bring in the right amount of chargers).

SUMMARY AND POST-SESSION TEACHER DISCUSSION

The post-session discussion was pretty short, again. We went over the list of what needed to be done next week (I mentioned how I felt the groups collaborated, and what the teacher might need to keep an extra eye on when I'm away).

I asked if the teacher had anything pressing that she felt was totally out of her control at this point or whether she felt that the session had been manageable. She seemed optimistic, but said that she was a bit nervous about how things would go.

We talked about the second group's play, and that they had been a bit slower than the monastery group still. The teacher seemed very impressed and pleased with how the monastery group had been playing today (and I was too, they were very focused and collaborated super well). It's going to be interesting to see how the castle group collaborates during the next session when the teacher is more present.

All in all, today was pretty good, the first group definitely exceeded some of my expectations. They worked together really, really well and didn't need much coaxing to start working with "serious" tasks around the game. A lot of them started doing their blueprints pretty much on their own (with some exceptions of the back right and back centre groups).

The second group was different, they had trouble staying focused on the main task of building, and many of the students (all but the back left and right groups) didn't start thinking about blueprint drawing until I paused the gameplay and explicitly told them to start drawing.

It was interesting seeing the teacher introduce and prepare for the lessons, and of course there's some basic differences. The teacher started everything up about 5 minutes into each session, and walked around to try and help students as best she could – I often had to step in an explain why certain errors popped up. The effect this had is that gameplay started around 10-15 minutes into the lessons. Less backups were being made too (not too much of a problem though, one was made every 40-50 minutes or so), which could be worrisome since the teacher doesn't look at the server computer all that often (I'd say almost never, unless it's for making backups) and didn't plug a charger into it.

The teacher also doesn't use the Freezing command at all. That worked out well anyway, but one of the corner groups snuck in some play during introductions and all that stuff.

I had to get a little bit stern with the second group, they're just a bit unruly and don't focus much on anything. When telling the pro player (Felix) – one of the louder and more unfocused students now – to focus on his building instead of messing around, he simply proclaimed "but I don't want to!", he seems to be pretty clearly bored of the project.

I think today was a good setup for next week – I tried to stay back as much as my conscience would allow, and I feel that the teacher had a chance to see most of the commonly recurring issues and knows how to solve them. Also, as she has said several times herself, there are plenty of really good MC-literate students that can help her if something goes wrong.

FEBRUARY 20TH, 7TH GRADERS

Preparation:

A ten minute preparation together with the teacher, where we recapped the last sessions, and talked about how we were going to work today.

The setup for the day is similar to the one we had two weeks prior (the students have had a one week vacation in-between). We will start the session with an introductory lecture, where we project the game on the whiteboard and draw on it.

My task now is to create some cubes of different scales that we're going to scale up and down. Similar to the previous approach, but this time I'm using differently sized blocks, and different up-down scalings than before (we've previously always had the same modifier up and down, i.e. 1:3 and 3:1, today I'll go 5:1 and 1:2).

Creating the map for this preparation took about 25 minutes. The "hidden" cube I built for the students to calculate was 30x30x30, I thought I'd try for a decimal scaling for once (since a lot of students had accidentally done so earlier).

Introduction:

The introduction started around 11:29 (4 mins into actual lesson – some students were a bit messy, tough to get them not to start their computers). Teacher talked about ratios, and also about a potential radio visit.

The introduction was primarily a repetition of the types of scales we talked about last time. Length, then moving on to area, and then volume.

Some students are starting to be very keen on answering scaling questions (the area one in particular), but most are still not really getting it right. The front student (Aaron) is very good at this types of math, and calculates quietly to himself and talks to his closest classmates about the calculations – almost always gets the questions right.

Teacher Intervention:

After break, the group division happens. This is always a messy process, students often protest, and the teacher often has to calm the class down repeatedly during the process.

Additionally, which is often the case, the students request mice to play with, and play is delayed by several minutes by mice being fetched, and then distributed amongst students.

While I was assisting students early on in the exercise, the teacher prepared a spreadsheet on the whiteboard to keep track of all of the students' different buildings, so that they would be easier to calculate later on.

There was some really good Teacher Intervention going on in the middle right around 12:16, both talking about MC stuff and mathematics-related stuff (and collaboration stuff).

Researcher Intervention:

I had to help one student re-download MC entirely since he had lost it (Peter, surprisingly). I had to manually start up the game and launch a creative map for one student (front right, the same girl as last time).

Student Discussions:

After the introductory repetition, we took a short 5 minute break (around 11:50). During the break, (Aaron) stuck around to google MC cheats, and wanted to get a hold of some building tools to make things go quicker – essentially wanting the MC teacher edition/server access.

I also got some random questions if I was working with, or was going to work together with, Pewdiepie (his name comes up a lot).

During the exercise, later one, Marshall was left alone to build his blocks, since his groupmate left to work with the backmost group instead (I don't know why, but they all seemed OK with it). Marshall builds the cubes and starts filling them up entirely with glass cubes (mimicking what I've done on mine, kind of), in spite of my recommendations not to do it that thoroughly.

Around 34 minutes into the recording. A lot of the groups started killing each other and were playing around with clearly non-subject-matter-related things.

(Aaron) in the front is "alpha-gaming" out his group mate (Sarah). I asked what she was doing (around 12:10), she said "just killing pigs, I wanted to build stuff, but then (Aaron) said we should do it his way". After a while (12:12), this group started desolving entirely, (Aaron) just achievementhunting and doing whatever, while (Sarah) kept just clicking around on her map.

The finale was alright, the students who were otherwise acting a bit "too cool" for the school exercises showed off their work (on their own initiative), and was very keen to see that their classmates paid attention to it – they definitely didn't tolerate their classmates just doing other stuff or talking.

Technical Difficulties:

One computer crashed early on, I had to go in and do a ctrl+alt+del closure and re-launch the game for them (should be around 12:00, so 35 minutes into recording), back middle right group (Peter and Rose).

The back-most group couldn't get their game running at all, I had to reinstall a new launcher to get it to work, delayed their work by approximately 10-15 minutes (most interaction/intervention here is from 12:00-12:05). This group of student had 1 totally broken down computer, which is why they couldn't simply switch laptops to a working one.

SUMMARY AND POST-EXERCISE TEACHER DISCUSSION

The post-exercise discussion was alright, pretty standard fare. I commented on some things I thought worked really well (like the list the teacher wrote, and the final presentation the students gave), and said that we should repeat the exercise next time around, but starting out with student groups' buildings as part of the introductory lecture/repetition.

We both thought that the students had become better at their calculating speed, and they were more keen on providing answers than they usually were.

Otherwise, not much was said. The teacher usually comments on messiness in the class, but not this time around (and I actually thought they were unusually well-behaved).

The teacher did, however, propose that there should be a Minecraft-themed or even Minecraft-based mathematics test later on in the semester where the students get to use all they've learned and apply it in a test context. That kind of initiative is always nice to see, and hopefully we can make it happen.

APPENDIX D

This appendix includes two examples of transcribed game-based classroom activities. The transcript examples used were produced during two different types of game-based exercises: one exercise with the 5th graders on March 2nd that exemplifies what the transcripts were like when I was not present and one of the audio recorders was attached to the teacher; and one exercise with the 7th graders on February 27th where I was present and the audio recorders were placed throughout the classroom. The transcripts of the 5th graders exercise include examples of transcriptions from 'points of interest', whereas the 7th grade exercise example just presents the first 10 minutes of the game-based exercise.

The transcripts are divided into 30-second segments. While individual dialogue lines are not time-stamped, they are synchronised across the 30-second segments, so that the timings of the discussions can be tracked (i.e. if a line of dialogue in the left column is at the same height as one in the right column, they occurred simultaneously). In some cases, when a proclamation is made out to the whole classroom, it is written across all columns to indicate that it was clearly audible throughout the classroom.

In cases where several audible discussions were held simultaneously (which happened most often in the 7th grade classroom), the columns are bifurcated into two cells to make the separate discussions more legible.

As mentioned in the method description, some exercises were recorded with two recorders instead of three due to technical difficulties or limitations – and in those cases, the transcript tables would be thinner by one column (and the amount of audible discussions would be affected).

5TH GRADE GAME-BASED EXERCISE, THE FIRST TEN MINUTES OF THE ACTIVITY

During this exercise, one voice recorder was attached to the teacher, and the other two recorders were placed on either side of the classroom. The exercise is meant to wrap up the group's work due to the game-based curriculum coming to an end. Most students' 'primary' building projects have been completed, and the members of the group are trying to help each other out to finish up the projects that remain.

Time	Left Mic	Teacher Mic	Right Mic	Comments/Other
02:00	*Sighs* Ernest: Här någonstans. Ernest: Happ, det var inte så stort, men det får duga ändå. Dylan: Vänta, jag kan visa den där idén som han skulle visa dig. Ernest: Men vänta. Dylan: Ajuste grästak… *Pause* Ernest: Och så ska vi ju ha eh… nämen det här taket blev inte bra.	Teacher: Tjejer, har ni kommit in där ni ska vara? (F) Students: Aaa. Teacher: Toppen! Felicia: *whispers* we are ready. Miley: Det är [Corrects nickname pronounciation] egentligen! Men jag trodde typ att… Miley: Men det är Ernest och dom tror jag. Miley: Nämen bygg här. Felicia: Oj, jag byggde visst hålet.	George: [Ernest and Dylan's avatar nickname]. *Lots of clicking, sounds of blocks destroyed and placed in-game* *Laughs* Dan: Vem är [Ernest and Dylan's avatar nickname]. Marcus: Det är dom. *Laugh* *Rapid mouse-clicks, sounds of blocks being destroyed* George: *low energy voice* Det är ju du som är bra på det här. *More clicking* Marcus: Det är klart att jag är bra på det. George: Aaa. Med farmar ja. Marcus: Ha-ha-ha-ha-ha…	Dylan and Ernest switch playing duties at least once during this transcript – a bit hard to say how it switches back and forth, but Dylan shows Ernest an idea that someone has had regarding chickens on the farm.
02:30	*Silence, with lots of mouse clicks*	Teacher: Alla är inne nu och har kommit igång? Felicia: Mmm. Teacher: Bra. Teacher: Men det var väl en bra start va? *Laughs* Miley: Du är ju bra på det här nu! Teacher: Ja eller hur, nu känns det riktigt bra	Marcus: Ja. Marcus: Oj. Marcus: Ja bra start. Dan: För att asså eh- Marcus: Jättebra start.	

	Ernest: Aaah. Dylan: Det är bara på kanterna vi ska ha det här. Ernest: Det här blev jättefult med *Dirt*.	här. *Pause* Teacher: *In one-on-one conversation* Peter, nu får du kika efter lite vad de har gjort förra gången – men du tycker att du vet… du förstår lite vad du kan fortsätta med? Peter: Aaa. Teacher: Mmm, inredning och, så där. Teacher: Annars kan du ju fråga Felicia, för hon var ju med Adam förra gången. Peter: Okej. Teacher: Om det är nått, hur ni tänkte där.		
03:00	Dylan: Så vi ska ha hötak? Ernest: Japp. Dylan: Jajaja. *Dylan makes funny voices* Dylan: Alla pekar och vill komma uuuut.	Teacher: Å, det var ju lite halvskojiga grejer här på kyrkogården ni skulle rätta till va, nam-nen och så? Marcus: Jaha? Teacher: Får jag se hur det ser ut? Marcus: Jag är redan här. Teacher: Har du tagit bort skyltarna helt och hållet? Marcus: Ja det finns ju inga. Teacher: Vad sa du? Marcus: Det finns ju inga. Teacher: Nej. Miley: *Shouting from across the room* Mar-cus! Marcus: Kolla, såhär ser skyltarna ut. *clicks and keyboard strokes*	George: Kolla där, det är lite konstigt där. *Pause* Marcus: Lite? *Giggles* Miley: *shouts unintelligible* Miley: Men här? Ska det gå runt här? Miley: Ska det gå en gång runt här? Så, med vatten där. Miley: *Shouting from across the room* Mar-cus!	
03:30	*Silence with a lot of mouse clicks, lots of loud rhythmic finger snapping starts*	Teacher: Mmm, och då kan du ju tänka dig några namn som fanns på medeltiden, Marcus: Så. Miley: *Shouting from across the room* Mar-cus! Marcus: Ameh vänta. Teacher: … och årtal som kan fungera som… Marcus: Ja vad sa du? Miley: Vad är det för vallgrav runt?	Miley: *Shouting from across the room* Mar-cus! Miley: Vad är det för vallgrav runt? Marcus: Det är bara så jag vet vart vägen ska gå.	

		Miley: Marcus du får ta bort vattnet, försök ta bort vattnet Marcus.	Miley: Ahaa, ska du göra vägen. Marcus: Okej varför går jag bort. George: *Laughs* Miley: Marcus du får ta bort vattnet, försök ta bort vattnet Marcus. *Unintelligible* Miley: Marcus försök ta bort vattnet. Marcus: *Quitely* Okej.	
04:00	Dylan: Vem är det som gått in där? Ernest: Kanske typ… Miley? Dylan: Näe, hon heter [Miley and Felicia's group name]. Ernest: Men det är inte det att de åt *unintelligible* Student: *Silly voice, unintelligible* ingen hjälper oss Ernest: Vi bygger tak. Dylan: Vänta vem är… Ernest: Vi gör färdigt vårat… det var Peter. Dylan: *shouts* Peter! Dylan: Aha vänta, skulle han hjälpa oss? Ernest: *unintelligible* med att byta ut taket… Dylan: Taket blir ganska fult…	Teacher: Nu får ni hjälp. Säg vad ni gör nu. Dylan: Vi bygger tak. Louise and Julie: *Unintelligible* Men nääa men… Louise: Det är ju så himla tråkigt.	*Clicks and game sounds* George: Peter vad gör du? *Pause* Peter: Bygger tak. Dylan: *Shouts* Peter! Peter: Aaaa? *Clicks and game sounds* Marcus: Nu får det vara nog så. Miley: Marcus, ta massa hinkar. *Pause* George: *unintelligible* hinkar?	
04:30	Dylan: Vad skulle *unintelligible*… *Silence, mouse clicks* Dylan: Vad har han tänkt? Ernest: *quiet reply – unintelligible* Dylan: Men nu är det inte mycket kvar. *Pause* Ernest: Så sen får inte jag köra min idé… För då hade man inte kor inne.	Teacher: Vad är det som är tråkigt Louise? *Walks across classroom* Louise: Eh. Eeeh. Lite… *Unintelligible* Louise: Asså det är liksom *Unintelligible* man ska piffa upp den lite. Teacher: Okej, hur tänkte du då? Louise: Typ bokhyllor, men dom måste – dom är liksom så himla stora. Teacher: Ah. Men tror du att det var, om man	Adam: Tar man ut hinkar med vatten? *Giggles* George: Och sätter ut mer vatten? *giggles* Marcus: Nej jag tanker inte sätta ut mer vatten… *Laughs* Adam: *unintelligible* *Mouse clicks* George: Jag trodde det skulle funka. *Mouse clicks* Marcus: Det funkar. Miley: *shouting from accross the room* Funkar det Marcus?	Louise and Julie are (still) having a hard time coming to terms with the lack of precise fidelity of game objects. The game objects are a bit too 'modern'.

	Dan: Det är en ko på övervåningen.	tänker på hur det var på den här tiden i klost-ret.	George: Du sätter ju tillbaka vattnet. *giggles* Miley: Du täcker för det.	
05:00	Dylan: Jo när jag får Minecraft sen så ska jag försöka bygga hela våningen. *quiet, unintelligible whispering between Dyl-an and Ernest* Dylan: Vi behöver göra nått fusk eller nått. Jag vill ju göra pappas bidrag. (tough to make out the end) Ernest: Moahahahaha.	Louise: Alltså det var nog ganska tråkigt. Teacher: Men ni har ju rätt i att - böcker fanns det ju. Louise: Aaa. Teacher: Annars är det inte så mycket man kan… de åkte ju inte direkt till [Local home decore store] och köpte dukar och krukor lik-som. Julie: Nej. Louise: Nej. Teacher: Så jag förstår hur ni tänker, att det ser lite tråkigt ut… Men det kanske måste vara så? Louise: Aaa. Miley: Vi måste stoppa vattnet! Miley: Det får inte segra, då är vi döda!	Adam: *Laughs* Du tar ju inte ens upp vatt-net. Klicka en gång. Miley: *shouting* Eller är det i det här… Marcus: YOLO! Miley: Vad gör du? *Mouse clicks* Marcus: Nej… George: Du tar ju inte upp *laughs* Marcus: Okej det här går inte bra… George: *Laughs* Marcus: Det får va så.	Miley provides a nice contrast here to Louise and Julie – she is more wrapped up in playing around with game me-chanics.
05:30	*Someone is humming on some music* *Mouse clicks and game sounds* Student: Alltså DEN ska ju inte vara där. *Laughs* Dylan: Jag tror det var din favoritlåt där…	*The sound of an arrow being shot in-game* Teacher: Marcus, har du någon plan för det du gör nu, eller är det bara liksom lite här och var? Marcus: Nej men jag försöker bara ta bort det här vattnet jag satte ut där. Marcus: Men asså, eh, kan jag bygga det här huset med någon slags präst eller nånting? Teacher: Hur tänker du? Marcus: Men det var ju ett sånt där litet hus för någon speciell person som prästen eller nått. Teacher: Ja, lite finare gravar! Ja sånt pratade vi ju om.	Miley: Ville vad har du gjort? Marcus: Jag vet inte… Felicia and Miley: *unintelligible discussion*	Marcus and the teacher is having a good conversa-tion regarding burials of im-portant people during the medie-val ages. Not sure where the arrow sound is from. Probably middle row.
06:00	Ernest: Du borde väl kunna ändra om det? *Pause*	Marcus: Ja ett sånt där litet minihus. Teacher: Jahopp. Marcus: Kan vi bygga det? Teacher: Ja men du, du har en kamrat du ska		

	Louise and Julie are talking quietly to each other *Dylan says gibberish words*	jobba ihop och bygga med, så George måste ju också få spela och ni måste få komma över-rens, eller hur? *Teacher turns to the other group, Dan and James* Teacher: Hur är planen här? Dan: Vi har satt ner *unintelligible* *Loud game sounds, blocks being destroyed* Dan: James ska få lägga grejer här. Teacher: Vad sa du att detta var? Dan: Veteblock.	Marcus: Vet du hur jag ser ut? *Pause* Marcus: *unintelligible* Marcus: Creeper eller?	
06:30	Ernest: Okej, visa nu då. Dylan: Okej, här, här, här, härhär! *Pause* Dylan: Nu får jag visa färdigt. Dylan: Jag behöver… det där… Dylan: Men det var ganska välgjort.	Teacher: Jahajaja. Nu är James på hugget här. Vad skulle du göra James? Vet du vad du ska göra James? *Pause, sound of blocks being destroyed* *Unintelligible* *Game sounds (of rapid digging through blocks) continue*	Marcus: Kolla! Marcus: Hjälp jag brinneeer! *Pause* George: Ta bort… *unintelligible* byxorna. Och så sätter du på Creeper-huvet. *Pause* George: Ta typ… George: Har du två Creepers? *Pause* Marcus: Taket… bygger jag… i lera?	Marcus and George start equipping their characters with different types of head-pieces (… I think).
07:00	Dylan: Mmm…. Och sen… Dylan: Ajusteja, det finns ju höna. *Pause* Dylan: Eeeeh. Vart har vi hönan nu… Dylan: Oj vänta.	*Walking around the classroom* Felicia: Va? Vad är det där? Miley: Vad är det här? Miley: Oooh, jag trodde den började lagga.	Dan: Nej. Inte lera. Tegel. Marcus: Glas. Marcus: Också har vi huset här också… Marcus: Så tar vi bort det. *Pause* Marcus: Sånna. Jag vet inte vad dom heter. *Pause* Marcus: Också har vi sånnahär som heter… eeeh. George: Vänta, håll på den, jag vill veta vad den heter. *Pause* Student: *quietly* Vad är det där? Marcus: Zombies. *Unintelligible*	
07:30	Ernest: Vad i. *Pause* Dylan: Okej, nu tar vi detta.	*Pause* Miley: Den ville att vi stannade hära. Felicia: *Unintelligible* Miley: Vi måste få bort den… aja.	Student: Catapult. Marcus: Okej…*unintelligible*	Some hardware complaints – again from a very adept player.

	Ernest: Vart ska vi sätta.. Dylan: Eller jag gör bara detta.	Julie: Teacher, vad betyder "Fence"? Teacher: Fence? Julie: Aaa. Teacher: Staket. Louise: *quietly* jag visste deeet!	(M) Student: Vem är det du skrattar åt nu då. Peter: I ditt hus, där har jag bara tatt mat. Marcus: Tar du mat?! Peter: Sen lägger jag tillbaka den. Marcus: Jahaaaa. Peter: För jag behöver mat.	
08:00	Dylan: Nu ska vi se. Vi kan göra om det här till nått annat. *Pause* Ernest: Ska vi göra ett… hönshus? Dylan: Det kan vi göra. Dylan: *unintelligible* *Door opening sound* Dylan: *shouting* Neeej! Smit inte ut, din fuling! Dylan: Meeen, jag försökte va en höna…	Dan: Kan vi göra det till dag? Miley: Det, eh, är redan dag. Dan: Oj, förlåt, det var jag som såg fel. Teacher: *laughs* Jag har ju försökt träna på detta nu Dan, så jag hade kanske kunnat… *Pause* Dan: *quietly* jag hatar den här datorn…	*Pause* Marcus: Du kan ta lite o göra. Peter: Nä men jag och Dan har gjort det klart, så vi behöver inte erat lilla hus. Marcus: Lilla?! Peter: Ja, det är inte lika stort så. *unintelligible* *Mouse clicks, game sounds*	
08:30	*Pause* Dylan: Eller vänta vi kan väl ha en källare eller nått, så kan vi ha göra såhär, hönshus? *Pause – mouse clicks* Dylan: Jaa, eller… fast eh… Dylan: Jag tycker att vi ska göra under jorden? *Pause* Dylan: Då kan vi ju ta ägg när vi vill.	Miley: Men Marcus vad har du gjort med vatt-net?! Miley: Plaska inte. *Pause* Miley: Nu ska du få en gubbe… Miley: Jag slår ihjäl den här, är det okej? Felicia: Ja det får du. Miley: För det är så himla jobbigt med vattnet.	Marcus: Sluta… jag är inte stolt över det bara så att du vet… George: *giggles* (M) Student: Jag vill bygga nu jag vill bygga nu jag vill bygga nu. (M2) Student: Men du har ingen licens. (M) Student: *unintelligible* behöver ingen licens för att jaga. *Pause* (M2) Student: Aja. Man behöver *unintelligible* ha licens för att jaga. (M) Student: Men asså, jag sa vapenvila.	Ernest is playing, while Dylan comes up with ideas for a house for chickens. A minor conflict between wanting something that's totally sensible in Minecraft terms, and something that might be thematically in-appropriate.
09:00	Ernest: Men hönshus brukar ju vara på mar-ken. Dylan: Ja men ändå… *Pause* Dylan: Jag tycker… vi kör med *unintelligible*	Felicia: Så nu är det bättre. Miley: Nope. Felicia: *Laughs* Miley: Vad gullig. *Pause*	(M2) Student: Vapenvila? Vet du ens vad va-penvila betyder? (M) Student: Nej. (M2) Student: Det är när man inte får skjuta på varandra.	Not really sure what the two stu-dents to the right are talking about. I think they're

	hönshus så vi har lite rum och källare och skit. Ernest: Jag tycker vi gör det såhär… och så. *Long pause – game sounds heard*	Miley: Men nu är det bara att trycka, då är det mycket enklare. Nu behöver du inte hacka sönder nått, det var det jag tänkte. *Pause* Miley: Säg till du börjar tröttna på det, för då…	*Both laugh* (M) Student: För att spruta eld då? (M2) Student: Nej, jag sprutar aldrig eld. (M) Student: Jo, skjuter så det skvätter eld. (M2) Student: *Laughs* Marcus: *unintelligible* är… där. George: Nej. Marcus: Jaha, där.	Peter and Adam.
09:30	Dylan: *unintelligible* Ernest: Är inte det väldigt litet? Dylan: Men ändå, för hönor är ju såhär stora… *Pause* Dylan: Nej vi kommer *unintelligible* *Pause* Ernest: Tjena Peter. (M) Student: *unintelligible* Dylan: Jag skulle kontrollera han, om jag fick.	Felicia: Du får gärna göra när du vill asså… Miley: Jag, jag gör det när du har gjort. *Pause* Felicia: Va? Adam: Vänta, Aa. Jag ska bara markera ut. Jag ska bara se…	George: Okej. George: *Laughs* Dan: (separate discussion) du kan sätta den så, där. George: Jag tänkte inte säga nått. *Game sounds and mouse clicks*	
10:00	*Silence, mouse clicks* Ernest: Ganska liten… Dylan: Nä, ganska stort. *Silence, mouse clicks*	Teacher: Hur tänker du när du bygger nu Marcus? *Pause* Teacher: Gör du ett stort hus, eller berätta vad planen är nu. Marcus: Vi bygger liksom ett litet hus här för den där… George: Prästen. Marcus: Prästen. Teacher: Men får han ett helt – är det här ett gravhus, eller vad är det för någonting? Marcus: Ja, för det fanns ju liksom sånadär speciella… som ett litet hus, som viktiga personer hade det som *unintelligible*. Teacher: Ja, har vi några, hur vet vi… Marcus: De begravde dem däri liksom. Teacher: Vi pratade om att de hade speciella gravar, men vet vi om de hade ett speciellt hus? Det är det som är frågan.	*Discussion between teacher and Marcus and George are taking up most of the audio on the right-hand side*	
10:30	*Silence, mouse clicks*	Marcus: Vi pratade ju om… vi sa ju hus? Teacher: Jag tycker nästan att du skulle kunna		

	Dylan: Men kan vi inte ha såhär staket, eller galler eller nått? Ernest: Nej *unintelligible*. Jag tänkte så. Eh. *Pause*	gå in och hämta en Ipad, så kan vi gå in och söka på det. Teacher: För kommer du ihåg att förra gången så pratade vi om att kungar och sådant, de begravdes ju faktiskt i… (M) Student: Kyrkan! Teacher: Ja! Var? Marcus: Golvet. Teacher: Ja, visst vet du! Teacher: Men stormän, vet du hur deras gravar skiljer sig – hämta Ipaden du Marcus så kan vi söka på det. *Pause* Teacher: Väldigt roligt att se, du är väldigt hjälpsam mot allihopa här inne Dan.	Miley: *Shouting* Eh, vi… eller.. Vad är det här? Miley: Vad ska det här bli? Miley: Marcus, vad ska det här bli? Miley: Vad ska det här bli? (M) Student: En grav. Miley: Va? *Unintelligible* Miley: Men vänta lite här nu, jag gör ju gångar hit.	
11:00	Dylan: Jaha, det blir som isolering. Dylan: Vi kan ha en eld där inne. Som bränner upp en kalkon… Ernest: Waoooa. Ernest: Jag tänkte mig att de kan gå ut där. *Pause* Ernest: Eller ja mellan de där.	Teacher: Eller hur? Du är en klippa när vi spelar detta. Jag känner det att nu när… jag vet vem jag ska fråga när det kör ihop säg här nu. *Pause* Teacher: George! Kommer du ihåg vilket som var din utmaning? George: … Spela? Teacher: Spela. Så att du inte sitter och tittar hela lektionen nu, medan Marcus gör. *Pause* Teacher: Aaa, det är viktigt.	Miley: Det måste väl finnas krukor… Miley: Har han blont hår? Felicia: *unintelligible* Miley: Marcus, du har blont hår. Marcus: Jag vet. Miley: Men alltså, på Minecraft. Marcus: Jag vet.	The teacher is having a nice moment with Dan – who has been very helpful during all exercises. The teacher is also talking to George about playing the game more (he usually takes a passive role, while Marcus plays)
11:30	*Silence, game sounds and mouse clicks* *Sounds of chair scraping* Adam: Går det bra Peter? *Pause* *Laughing* Adam: Hur lång tid tog det eller? (M) Student: Just det Peter.	Teacher: Hur skulle du kunna söka här nu? Vad kan du söka? Marcus: Jag vet inte… George: Prästers grav? Teacher: Ja, och kanske – präster… Marcus: Speciell grav? Teacher: Ja fast du kanske ska börja med att söka på gravar från medeltiden. *Pause*	Miley: Jag tror att *unintelligible* Miley: Ska vi inte göra den hit? Felicia: Jo, det ska vi nog göra. *Unintelligible talk between Miley and Felicia* Miley: Yes, här går det in vatten!	

TRANSCRIPTS FROM POINTS OF INTERESTS IDENTIFIED IN OBSERVATION PROTOCOL:

Transcription from 00:19:30 to 21:00: Distracted teacher, and gameplay bringing students off-track.

During this excerpt, the teacher is a bit distracted by using her avatar to look around at the students' buildings. Meanwhile, the class gets distracted by chickens (and a bit of 'griefing' by a player who spawns 80 chickens into the game world). The students that the teacher still interacts with throughout this exchange (primarily Dan and Marcus) remain focused.

Time	Dialogue		Comments
19:30	Dylan: Vi odlar tusentals frön, och Peter odlar hönor. Ernest: *Laughs* (M) Student:: Kollaaa. Dylan: Odla mer hönor! Students: *Laughing* (M) Student: Väntaaa. Allihoop, sicka söta satar. Ernest: Jaaah! Dylan: Men asså *unintelligible* (M) Student: *Shouting* Neej, neej, neeeej! Ernest: Peter kolla hönan! Hönsen, de invaderar jorden. Miley: Så många kycklingar! Peter: Vad gör ni? Vad gör ni?! Vi kan inte stoppa dem!	Miley: Titta här, titta här, titta här, titta här. Miley: Ett hönshus, vad gulligt! MIley: Men får inte dom komma ut? Nej men fy. Miley: Å nej! Stackars kycklingar!	
20:00	Dylan: Varför står de upp på staketet? *Laughs* Ernest: *Laughs* Dylan: Asså Ernest, det ser ut som ett bord, vårt hönshus, om du kollar på... Ernest: Amen, döda hönsen! Peter: Jag spammar höns in i huset! Ernest: Aah vad många det är! *Laughing* Adam: Peter, kolla vad många det är! Peter: Aaah satan! *Laughing* Ernest: Men det räcker nu! Dylan: Du vet att... det kommer lagga lite. Peter: Jag vet. Ernest: Lite? Du vet att... titta det är ju tusen höns där.	Miley: Neeej, min lilla kyckling! Den började följa efter mig, läskigt! *Laughing* Miley: *Unintelligible* Miley: Jag ser inget! Felicia: Vad är det där? Vad är det där?	
20:30	Adam: Det är ju kycklingar över... Asså, vad gör [Miley and Felicia's screen name] eller? Peter: Det är på E va...? Dylan: [Miley and Felicia, screen name]! Ernest: Det är, eeh. Marcus, eller vad säger jag. Det är	Marcus: Jäklar vad kycklingar! Miley: Ja, satan! Miley: Nej!	Throughout this exchange, the teacher has been talking to Marcus and Dan. Dan has

	80 kycklingar däri. Dylan: Miley! Teacher: Sshhhhhh… Nu tycker jag det blir lite konstigt, för nu handlar diskussionerna om kycklingar här – har man fokus på det man ska ha? Dylan: Ja vi håller på, och Peter hjälper oss, men alla andra kommer och förstör! Teacher: Ja, men fokus nu på det vi liksom har i uppgift att göra.	Teacher: Sshhhhhh… Nu tycker jag det blir lite konstigt, för nu handlar diskussionerna om kycklingar här – har man fokus på det man ska ha? Teacher: Ja, men fokus nu på det vi liksom har i uppgift att göra. Miley: Vi är Alice!	helped the teacher navigate the game-world with her own avatar, and the teacher has been discussing how to decorate the monastery's cemetery with Marcus.

Transcription from 00:40:00 to 00:42:30: Over-enthusiasm, and teachers as 'wranglers'

This short excerpt shows a dialogue between an expert player – who has ran out of projects to work on – wanting to start up new projects at the tail-end of the game-base curriculum. The teacher steps in as she needs to manage expectations, and flipping it around into a learning moment.

Time	Dialogue	Comments
40:00	Miley: Men ska vi inte ha någon smedja? Teacher: Hur går det Dan, med, eh… Dan: Han högg sönder jord förut, så. Teacher: Vad sa du? Miley: Okej… men… var är smedjan? Dan: Han högg sönder jord förut, sen lyssnade han inte… Teacher: Ska vi kolla det då? Vad som är… Marcus: Vi har ingen smedja. Miley: Va?! Miley: Men vi måste ju ha smedjan! Marcus: Näää - Men varför måste vi ha smedjan? *Pause* Miley: Men vi kan bygga en smedja då, för det måste vi ju ändå ha.	The teacher and Dan has a separate discussion in the beginning, before the teacher switches her focus to Miley. Miley wants to start a new project, even though there's only about 20 minutes left of the entire game-based curriculum. A smithy is also not really in line with the theme of the group's building theme – nor are monasteries depicted as having smithies.
40:30	Marcus: Nä, vi gör ju inte direkt några vapen. Teacher: Miley, vi gör inga sådana där stora projekt nu. Miley: Men… Teacher: … För det har vi inte tagit med i planeringen här nu – så vi gör inget sånt där stort nytt. *Pause* Teacher: Hur kunde man göra om man inte har någon smedja på området, Miley? Hur gör man då? Miley: Ehm… Marcus: *quietly* man drog till storstan… Miley: Man åkta la och förhandlade? Teacher: Ja-a, då får man lösa det liksom med gårdarna runtomkring, ifall det var något man behövde.	

	Pause	
41:00	Teacher: Hur mycket har du kvar, James? Du Dan, kom lite här så får vi se nu då! Teacher: Hur mycket har du kvar James? Dan: *Unintelligible* Miley: *Shouting* Ingen vill stanna inne i sjukhuset! Teacher: Då är du snart klar? Miley: *Unintelligible* Stängde den nu? James: Mmmm. Teacher: Mm! Adam: Men Miley låt dom bara va! *Pause* Teacher: Men Miley och Felicia, om ni är färdiga. Då släpper ni det här, och så tittar ni på frågorna ni ska fylla i nu, till deckaren. För det kan vara ganska så bra, ifall det är något man behöver kolla här nu. *Unintelligible* Miley: Okej... men jag ska bara titta här nu så att vi har...	Again, Miley's discussion is disconnected from a smaller discussion between the teacher, Dan, and James.
41:30	Felicia: Sovsal! *Pause* Felicia: Här kan man sova. *Pause* Miley: Oj. Louise, Julie ni... Julie: Aa vad är det? Miley: Häftig dörr!... Felicia: *giggles* Julie: Men... Menneeeeh! Miley: Men det är bara att sätta den – stå här, och gör samma sak. Ja ni kan... Ah, det ska vara en utåtdörr.	
42:00	*Pause* Miley: Ni får inte stå... Oj. Ni får inte stå på det hållet. Inte det hållet. Louise: Men... äh! Julie: Flytta på dig då! Miley: Så, där.	Miley continues to play around in Minecraft for a long while.

Transcription from 00:44:30 to 00:45:30: Lighting fires – the blurry lines between game rules and thematic fidelity.

This is a very brief exchange, but it shows an instance where students value the aesthetic provided by a burning kiln – and are fine with creating it even through non-appropriate methods.

Time	Dialogue	Comments
44:30	Miley: *Shouting* Går inte det? Va?! Miley: Dan! Går det inte göra så att ugnen brinner? *Pause* Dan: Jo.	Miley wants to turn on some of the furnaces (for aesthetic purposes – note that none of the buildings she and Felicia

	Peter: Sätta i. Miley: Ja men vi har gjort det! Adam: Ta lava! Teacher: Nejmen eld. Det finns… det tror jag att han har stängt av. Adam: Men det ska vara tvärtom.	was responsible for had any furnaces). The teacher correctly refers to something I have mentioned to her earlier – I have disabled open fires in Minecraft, but furnace fires are not the same game object. Understandable confusion.
45:00	Miley: Justeja. Adam: Det ska också vara sånt där, vanligt trä. Miley: Jo det går. Peter och Dan: Nää. Miley: Justeja. Det måste vara… Dan: Ta typ iron eller nått. Peter: Nejnej, ta, vad heter det… Oak. Dan: Wood. *Pause* Miley: Så. *Pause* Miley: Sen när det är slut så är det bara att fylla i mer.	

7TH GRADE GAME-BASED EXERCISE, THE FIRST TEN MINUTES OF GAME ACTIVITY

During this exercise, one voice recorder was placed in the front centre of the classroom, and the other two recorders were placed on either side of the classroom. The exercise was initiated with a repetition of volumetric scales (which took approximately 20 minutes), and I had brought in some real-world objects (e.g. a Gameboy, a Rubic's cube, a Pokémon cartridge, various dice, and other miscellaneous objects with simple geometry) that the students could measure and then re-create in their *Minecraft* worlds. This is the fifth game-based geometry exercise in the students' game-based curriculum.

Time	Left side of classroom	Front centre of the classroom	Right side of classroom	Comments/Other
22:00	Teacher: Så Björn har alltså med sig föremål som ni kan använda... Björn: Yes. Teacher: ... men att det också är fritt att fundera ut något eget föremål som man vill jobba med. Björn: Ja, ni kan ju mäta era mobiltelefoner, eller laptops, eller mät en linjal. Björn: Asså, det är helt upp till er vad ni vill bygga. Rose: *Whispers* Mäta en linjal?	Teacher: Så Björn har alltså med sig föremål som ni kan använda... Björn: Yes. Teacher: ... men att det också är fritt att fundera ut något eget föremål som man vill jobba med. Björn: Ja, ni kan ju mäta era mobiltelefoner, eller laptops, eller mät en linjal. Björn: Asså, det är helt upp till er vad ni vill bygga. *Students whispering* Teacher: Ni som ska jobba tillsammans nu då, är Wallace och Esther, Casper och Johanna, eehm.	Teacher: Så Björn har alltså med sig föremål som ni kan använda... Björn: Yes. Teacher: ... men att det också är fritt att fundera ut något eget föremål som man vill jobba med. Björn: Ja, ni kan ju mäta era mobiltelefoner, eller laptops, eller mät en linjal. (M) Student: *Whispers* laptops kanske? Björn: Asså, det är helt upp till er vad ni vill bygga. *Students whisper*	There's a constant rapid mouse-clicking heard from the left side of the classroom, and quiet whispering from the right.
22:30	*Students groaning* Rose: Lenny hoppas du kan Minecraft. Lenny: Va? Rose: Hoppas du kan Minecraft. Liz: Hoppas du kan Minecraft.	Teacher: Då gör vi så, Alfred... Eller Marshall är ju inte här idag. Så då kör vi Alfred och Archer idag. James och Anne... Teacher: ... Julian och Alice, Peter och Sarah, Lenny och Rose, Teacher: ... Aaron och Beatrix, Earl och Liz, Terrance och Jonas, har jag fått med allihopa då? Teacher: Alla är med?	(M) Student: *quietly laughs* är servern full? (M2) Student: *quietly* njaeee. (M2) Student: *whispering* det är din dator. (M) Student: *whispers* min dator? Julian: Teacher, jag jobbar med Teacher: Ja?	There's a constant rapid mouse-clicking heard from the
23:00	Earl: Ja men det kan du räkna med. Lenny: *Laughs* Liz, räkna! Liz: *Laughs* Alfred: Vem, vem ska du jobba med? Casper: Egentligen ska du jobba med [nickname] tror jag. Students: Aaa.	Teacher: Har alla fått klart för sig vem de jobbar ihop med? Students: Aaa. Teacher: Lenny, du jobbar ihop med Rose.	Julian: Ja har bara ett. Kan inte jag få... jag jobbar med Elizabeth på Engelskan. Jag vill ha nån ny att jobba med som jag inte jobbat med innan. Teacher: Fast nu får det bli såhär, jag kan inte ändra om nu. Students: Aaa.	The right-middle row of the classroom is incredibly noisy throughout the lecture – making some discussions hard to catch.

<table>
<tr><td></td><td colspan="2">Teacher: Lenny, du jobbar ihop med Rose.
Lenny: Jag vet.
Liz: Du sa det.
Rose: Nähee.
Alfred: Hehe jag spelar in ljud.
Unintelligible - lots of chairs moving and shouting</td><td>(F) Student: Vad ska vi mäta av?
(M) Student: Vad som helst.

Teacher: Dåså, då sätter ni er tillsammans och så börjar ni eh…
Unintelligible - lots of chairs moving and shouting</td><td colspan="2">Teacher: Lenny, du jobbar ihop med Rose.

Unintelligible - lots of chairs moving and shouting</td><td></td></tr>
<tr><td>23:30</td><td colspan="2">*Unintelligible - lots of chairs moving and shouting*

Rose: Vi tar din…

Alfred: Ska vi köra dator?

Unintelligible - lots of chairs scraping and shouting</td><td>*Unintelligible - lots of chairs moving and shouting*

(M) Student: Äh jag har min, jag har min dator.
(M2) Student: Jag har min.
Unintelligible - lots of chairs scraping and shouting</td><td colspan="2">James: Men starta datorn först!
Alice: Den ÄR redan startad!
Pause
James: Sätt dig där Anne, jag tänker inte flytta en meter!
Unintelligible - lots of chairs scraping and shouting

Terrance: Visste att de tavlorna man kan hänga i Minecraft är bilder på från CS:GO.</td><td>The minute(s) after the game session starts is always difficult to transcribe due to the commotion of students getting into place.</td></tr>
<tr><td>24:00</td><td>Aaron: Har du en laddare?
Beatrix: Nej.

Terrance: Visste du att Minecraft *unintelligible trivia sharing*

Aaron: Esther har du en laddare?

Terrance: *unintelligible* för grafikkortet.
Jonas: Det är olika för varje texture-pack du vet.
Terrance: Amen asså *unintelligible*
(F) Student: Bra jobbat [Nickname]!</td><td>Beatrix: Vi bygger i min dator.
Aaron: Varför då?
Beatrix: Därför att… jag vill det.
Aaron: Då kan jag surfa lite.</td><td>Björn: Tror du de hängde med på uppgiften?
Teacher: Japp, det tror jag.

Teacher: Ja nu känner jag… nu är dom ju mer inne i det, så nu är det lättare att säga vad som är vad och så.
Björn: A jo, visst. Det blir lite lättare.
Unintelligible

Teacher: Nu blir det ju lite spännande att se vad de kommer på att bygga och så, nu när de kommit igång.
Unintelligible

(M) Student: Staffan, kan vi be o få ett papper?
Teacher: Absolut!
(M) Student: Och en penna tack.</td><td colspan="2">*Unintelligible - lots of chairs scraping and shouting*
Terrance: Det är sant, Jonas!

James: Du får ju vara bra på't också!
Anne: Jag är bra, bestäm nått att bygga!

James: Den här datan till exempel.

Anne: Hallå, James!
(M2) Student: Varför har du *unintelligible* för?
(M3) Student: Ja, jag vet inte.
(M2) Student: Det är najs eller?
(M3) Student: Aaa.
(M2) Student: Bajs.
(M3) Student: Men asså… *Laughs*</td><td>Students are still moving around, one of them sharing various Minecraft-trivia with his friend.</td></tr>
<tr><td>24:30</td><td colspan="2">Rose: Amen jag trodde jag skulle upp så *Laughs*. Jag bah, vafan gör du?</td><td></td><td>Anne: Bestäm nu vad vi ska göra då!</td><td></td><td></td></tr>
</table>

	Rose: Och du bah *Laughs* å jävlar. Teacher: *Yells* Behöver ni papper så hämtar ni här! Teacher: Lenny, lenny! Lenny: Jag lånar den här. Teacher, får jag låna den? Teacher: Absolut.		Teacher: *Yells* Behöver ni papper så hämtar ni här!	James: Men mät din mobil, den är stor! James: Större än min. Teacher: Behöver ni papper så hämtar ni här. Teacher: *Yells* Behöver ni papper så hämtar ni här! James: *Unintelligible* Teacher: Amen James, inga lurar på nu. James: Men vi har ingen musik på! Teacher: *Laughs* Då finns det absolut ingen anledning att ha dem. James: Jo men det är skönt! James: Jag känner mig liksom lite som laser-mannen.	Casper: Jag har avinstallerat varenda jävla spel här på den här datorn förutom Minecraft. Terrance: Varför då eller? Casper: Jag har kvar allt liksom men har kopierat.	
25:00	(M) Student: Vart ska du någonstans egentligen? Björn: Jag ska till San Francisco på en spelkonferens. (M) Student: Åååh. (M) Student: Björn, har du varit på GamesCon någon gang eller? Björn: Japp. (M) Student: Har du vart där? I USA?	Teacher. Ja du kan få en bättre. Lenny: Har du nån annan? Teacher: Jag ska se om jag har med mig något. Rosa: Varför har du den? *Silence*	James: Men MÄT nu då! Anne: Ska jag trycka på OK? James: Vad heter du då? Anne [Lastname] Eller? Anne: Det var Jonas och Mark som dödade mig. James: Nä, Anne, Single Player? James: Där. James: New World create.	Casper: Ja det var ju fortfarande mina grejer på men jag har kopierat. *Pause* Casper: Ey Archer Archer Archer here we go here we go. Casper: I make it on my own, on my own. Johanna: Asså ni får sluta med det här. *Laughs*		Moved the front right discussions to the middle for space. (Centre was silent)
25:30	Björn: Nej bara i Tyskland där faktiskt. Beatrix: Du får hjälpa		Anne: Vi måste hämta en linjal.	(M) Student: *Whispers* Archer, Björn har		The student from the previous section asking me

	mig för jag vet inte vart jag ska gå in på… där eller? Björn: Kolla med din kompis, hjälp varandra. Beatrix: Fast han har ju inte… jag har en sånhär special. Björn: Den kan han säkert också. Beatrix: Aaron, kan du den? Aaron: Aeaeeaeeeaaa. Beatrix: Den eller den? *Silence*	Rosa: Alfred du tog min datamus! Alfred: Nej, jag tog den som låg på min plats. Rosa: Ja den var min! Alfred: Näää. Rosa: Alfred får jag den! Rosa: Alfred ge dig!	James: Nu jävlar ska vi bygga *unintelligible* här! Teacher: Eh, James. Om du jobbar lite… Om du jobbar lite. Om du kollar på [website name], så är det ju sju filmer och så. James: Amen jag gjorde provet idag. Teacher: Ja! Har du gjort det, vad bra! Teacher: Hur gick det? James: Jaaoo, jag gjorde inte klart hela provet, men jag gjorde klart till 23 frågor. Teacher: Aaa. James: Men jag fick hjälp, och Jag tyckte det gick skitbra. James: Jag ska göra det nästa gång. Anne: Vart finns det linjaler? James: Läraren tyckte också att det gick jätte-bra. Teacher: Vem hade du som lärare?	vart på GamesCon. Archer: GameCom? (M) Student: GamesCon heter det. Archer: Nej GameCom. (M) Student: Nej det heter GamesCon. *Pause* (M) Student: *Unintelligible* *Lots of noise-making*	about my conferences return to his other friends with the info.
26:00	*Silence* Beatrix: Ska vi… ska jag ta en ny värld? *Directed at Björn* Björn: Ni får prata med varandra. Beatrix: Ska jag ta en ny värld? Aaron: Ja. *Pause* Aaron: Jag ska bygga nånting snyggt. Beatrix: Nu då… där. *Pause*	Alfred: Klaga inte. Rosa: Alfred, får jag den! Rosa: MEN ALFRED! Rosa: Seriöst Alfred! Alfred: *Sings* Rosa: Nej! Lenny: Nu får du fan ta o ge dig Rose. *Pause* Rose: *Unintelligible* *Whipping noises* Rose: Man får inte slå tjejer! Rose: Aj! *Pause* Rose: Lenny var med nu.	James: [other teacher's name], han är vikarie. Teacher: Ah, bra. Teacher: Där nere Anne, på min dator där. Teacher: Men du James, då skulle du väl kunna göra det på tisdag, på läxtiden. James: Aaa. Teacher: Bra, kommer du ihåg det? Och så sitter du hemma och kollar på filmerna. Och så finn ju Quizzet, så kan du öva på det. *Pause* James: Vad ska vi bygga då? James: Va? Anne: Vi bygger eh. James: Tyst! James: Jag bygger din hjärna. Anne: Men, kul! (F) Student: Hej!	*Drumming and finger-snapping* Alice: Så, vad tycker du om den här? Umm…. Alice.: Så har man målat typ skit på ögonen på… *Laughs* (M) Student: Det är djävulen.	
26:30	Beatrix: En gång till. Så. *Silence*	Rose: *Unintelligible* i början. Lenny: Jag måste installera det först innan vi kan göra	Anne: *Unintelligible* James: Jag bygger din hjärna här. *Pause* Anne: Okej… James: Vänta, vänta! Kolla på vad vi bygger.	Alice: Jesper K…. Julian: Det ser ut som en riktig kines där	

		nått. *Silence* Rose: Jaha…	Anne: Nått litet. James: Litet? Anne: Aaa… Anne: Vi kan bygga… James: Din hjärna! James: *Laughs* nä jag skämtar. Anne: Vi kan bygga… *Pause* Anne: Okej, min telefon är.	borta. Alice: Aaa. Julian: Rattar in SAABen! Alice: *Laughs* Alice: Vad ska vi mäta av då?	
27:00	Aaron: Sopa platt. Beatrix: Det finns ju typ ingen plats att bygga på den här världen. Aaron: Amen då jobbar vi så då. Så trycker vi… såhär. Beatrix: jaha. Här, var jag inne sist, tror jag… Nähe. *Unintelligible* Beatrix: Nej jag bara skojja, det var fel. Beatrix: Det var… kanske…	*Silence*	*Whipping sound is heard* James: Chilla då! Anne: Tolv, nä. *Pause* James: Ta-da! Nu är den klar! Anne: Mmm… James: Så, förstör det här nu. Anne: Ja men den är tolv centimeter uppifrån. James: Tolv. Hur högt ska man bygga då då? James: Vi kan ta…. Anne: Hmm. Vi kan bygga. *Pause* Anne: Umm. Ett… är.	Alice: *Unintelligible*` Julian: *unintelligible* *Silence* *Singing and pen being rubbed rapidly on paper* Julian: Går det bra där borta Mark? Mark: Näee det går inte så bra. Julian: Minecraft på högsta grafik har jag på gamerdatorn hemma. Bänkriggen. Utan lagg. Julian: Här laggar det på lägsta grafik.	Julian, one of the better students (who have been asking for WorldEdit and other things) – talks about his gaming rig at home.
27:30	Beatrix: Här. *Silence* Beatrix: Men vad ska vi göra nu då? Aaron: Bygg nått. Beatrix: *Unintelligible*	Rose: *Unintelligible* Lenny: Ok… ska vi… Lenny: Nej… Rose: Nej jag vet, jag vet, jag vet.	 Anne: … vi kan bygga… James: En millimeter? Anne: Eeh… (F) Student: Hallå vad ska ni bygga nu? Anne: Min telefon! James: Dynamiteeer! Anne: Ah vi kan bygga den här då. James: Nu bränner jag det. Nu sprängs det!!!	Alice: *Unintelligible* Yää! Terrance: Jag har det numret hemma. Peter: I want some hacks. Terrance: *silly voice* You want some candy? *Loud drumming on desk* Peter: Du Björn, kom lite!	Anne is trying to accomplish the assignment, James is more into blowing things up with dynamite.
28:00	*Silence* Beatrix: Ska jag hämta någonting så vi	 Rose: *Unintelligible*	Anne: Bestäm blockstorlek! Anne: Meh, mät något. James: BANG BANG BANG! *Pause* James: Titta här nu, nu kör vi.	 Julian: Vad gör du där borta James? Julian: Vad gör du James?	Peter is still attempting to download hacks to his game.

	kan bygga då? *Pause* Aaron: Gör du det. *Pause* Beatrix: Ska vi ta den? Aaron: Aaa.	Rose: Men Lenny, hämtar du en... eh... *Pause* Rosa: Enneeeh, *Laughs* nått å eeh.... *Noises*	*Pause* James: Titta. *Unintelligible* *Pause* James: I nether. James: *Humming*	Julian: *Unintelligible* Alice: Men Jesper J.... Julian: Det laggar *unintelligible* Peter: Jag håller på och skaffa hacks	
28:30	*Unintelligible* Beatrix: Och sen... Den här var femton millimeter. *Pause* Aaron: Teacher, har du en tumstock? *Pause* Beatrix: Teacher, om denna bara blev... Teacher: Vänta nu, Peter är först.	Rose: Nej jag vill ha dedär! Lenny: Jag tror vi tar en... EN LITEN tärning! *Unintelligible* Lenny: Gaming level over 9000! Lenny: Hur tar man ut dem här? *Plastic rustling*	*Silence* James: Helvete vad flötig musjäveln var eller. Anne: *Unintelligible* *Unintelligible talk* Anne: Men vi ska bygga vår telefon då. James: Jag ska göra det så jävla snyggt *unintelligible*	Peter: Länka linken till mig. *Unintelligible* Archer: Asså allvarligt. *Laughing* Mark: Har någon sett den nya Volvo V40n eller? Julian: Nää. Alice: Nej. Mark: Är den snygg?	Peter is asking his friend for help getting the URL to the mods he's looking for. Lenny fetches a die and a ruler to measure with. The rules are wrapped in plastic.
29:00	*Pause* *Long silence – mouse clicks are heard*	Rose: *Unintelligible* Alfred: Jag tappade den här... Lenny: Aaa du. *Unintelligible* Rose: Ha Ha! I rumpan! *Laughs* Lenny: Det är något fel med dig!	Anne: Teacher! Ska det här va... (M) Student: *to James* James: Nä men asså det kommer vara... det kommer vara... Anne: Vi ska ha... plasten. *Silence* (M) Student: Bra eller?! James: Fan, spelar ni med varandra? *Silence* Teacher: Ska ni göra en avbildning av en mobiltelefon? James: Ja asså dem som *unintelligible* vill.	Mark: Den är la snygg? *Unintelligible* Mark: Glastak. *Pause* Mark: Swedish Power. *Unintelligible* *Pause* Mark: Så jävla snygg. *More unintelligible talk – lots of car-fragments thrown around*	Here, a couple (at least) of the boys in the middle-right group start talking about cars, and continue to do so for a while.
29:30	*Long silence – mouse clicks are heard* Beatrix: Yes. Femton millimeter. (M) Student: Har du en penna?!	Lenny: Straight-up om du skrattar åt att du slår dig på din röv. Rose: Men jag vill ha den lite... Hmm. *Whispering* Rose: Kolla här, kolla här. Rose: Jag vill ha en	(M) Student: Den är tretton här och *unintelligible* Teacher: Aaa. (M) Student: *unintelligible* millimeter. Teacher: Ah okej. *Unintelligible* Anne: Okej. Vänta då. James: Det är den vi ska slänga ut nu vettu. Anne: Man måste ju mäta alltihop du vet. *Silence*	Julian: Så jävla fin är den asså *moaning* Alice: Asså.... Julian: *Car brands and numbers – I'm clueless* Mark: Vaa? Alice: Jag bryr mig inte... Asså, allvarligt! Julian: En sån här kanske du vill ha, vem vet? Mark: *Laughs*	

	Beatrix: Nej… här har du en penna.	sån här eeh… Vad trycker man på, om man vill ha linjalgre-jerna?	Teacher: Just det. *Unintelligible* Teacher: Då kanske ni får, tänka att ni tar tretton och sjutton, eller sex eller sju då. (F) Student: Men Earl du är inte ens i närheten! Earl: Amen James: Men vad ska jag bygga då? Anne: Jag vet inte.	Julian: Å fy fan va snygg…	
30:00	Beatrix: Aaron kan vi inte köra. Umm. Aaron: *Unintelligible* dia-mond block! Det är ju hur dyrt som helst… använd lapis lasal suli. Beatrix: En millime-ter är. Eller nej, en kub är en millimeter. Aaron: Men jag vill inte ha den. Beatrix: Den är snyg-gare. Aaron: Nej!	Lenny: Lapus Lapuli! Rose: Hur mycket är blått på det här?	Anne: Ta bara. En vit kub. *Pause* Anne: En kub är en… tretton såhär. *Three subsequent banging noises on desk* Anne: Så. Och sen gör du… så. James: En två tre fyr fem sex sju åtta nio tio elva tolv tretton. (F) Student: Men DU kan väl skriva? Earl: Men ska jag göra allt eller? James: En… nej. Två… Anne: Ja, den här är… James: Fyra Fem… Sex. *Pause* James: Två tre fyra fem sex sju åtta nio tio elva… Anne: Nej, men… Men Teacher.	Julian: EPA Traktor och C70. *Pause* Julian: EPA Traktor av C70. Det här är det nya numret, kolla här – så jävla fräck är den. Mark: *Unintelligible* Julian: *Unintelligible* Mark: Är det här den nyaste? Julian: Mmm *unintelligible*-riktningen ja. Mark: Den där är asball! Julian: Det har kommit ut en… Mark: Det är Amerikanska namn på dem. Julian: … A jag gillar Svenska namn. Det har kommit ut en som heter ”ny V40”	A lot of the stu-dents in the mid-dle-right group start browsing cars online. Beatrix and Aaron to the left are hav-ing some issues seeing eye to eye. Aaron has a ten-dency to get wrapped up in his own gaming.
30:30	Beatrix: Den är ful. *Pause – mouse clicks* Beatrix: Nej, jag vill ha den snygga! *Pause* Beatrix: Nej då tar vi rosa då. Aaron: Rosa?! Beatrix: Mmm. Aaron: Vi ska ju göra det realistiskt ju. Beatrix: Jaha, då tän-ker jag ladda upp min dator då. Aaron: Hallå… Beatrix: A ok en kub är en millimeter då. Ska vi köra det?	*Pause* Rose: *Unintelligible* Lenny: Eh, jag går och frågar. *Silence*	Anne: om vi säger att den här är tolv och tre millimeter, kan vi inte bara skriva att den… James: Ska jag upp en sen? Anne: … är tolv centimeter då?.. Mmmm. James: *Unintelligible* Anne: Ok Tolv. Är den klar där? På… Anne: Då ska vi asså förstora. James: Nej vänta! *Mouse clicks* Anne: Det är… James: Aaa räkna ut förminskningen då. Anne: Sex… Centimeter…. *Mouse clicks* James: Jag ska göra en ascool sak. *Silence, lots of mouse clicks* Anne: Men du.	*Car talk continues* Peter: Min dator funkar inte… *Silence*	The car talk be-tween 2-3 of the boys continue throughout this section.

	Aaron: Aa visst. Beatrix: Eller ska vi köra en kub är två.				
31:00	Aaron: Du får välja. För allting jag väljer blir ju bara fel. *Silence – slow clicking* Beatrix: En, två, tre… sex…. [they count along mouse-clicks] Aaron: Åtta. Nio… Tio… Det laggar… Elva… tolv. Var det tolv? Beatrix: Aa det var det. *Silence* Beatrix: En, två, tre, fyra, fem, sex, sju…	Lenny: Men tärningen är ju femton lång va? *Unintelligible* Lenny: Men… hur långt är det på tärningen? En tärning liksom. *Pause* Rose: Hallå du Björn, är tärningen femton millimeter? (F) Student: Aaa det var den. Rose: Ska ni också använda den? (F) Student: Aaa. Lenny: Bra den var rätt, femton *unintelligible*. Rose: *Unintelligible* Rose: Gör såhär.	Anne: Kan vi få hjälp? Anne: Vad menas det med ”Bestäm räknad skala”? *Pause* Teacher: Mmm. *Unintelligible* Teacher: Det har ni gjort? Anne: Aaa. Teacher: Har ni bestämt hur stora blocken ska vara? Anne: Nääå. Teacher: Då gör ni det. Anne: Vadå? Teacher: De blocken ni har nu, vad har för mått? Anne: … Vad har de för mått? Teacher: Det är det som ni ska bestämma. Vad ska de ha för mått. James: Hur stort dom ska vara? Anne: En centimeter eller? James: Alltså… hur många block det ska vara? ------ 31:30 Anne: Neeej, vi ska bestämma hur stora blocken är i centimeter. James: *Unintelligible* Anne: Ameh ååååh vad du är korkad! Anne: Vi ska bestämma hur stora de är! Typ… en centimeter!	 Alice: Allvarligt. Peter: Vadå? Julian: Den här lilla X*Unintelligible* tycker du väl om, Peter? Peter: Vänta. *Pause* Julian: Peter! *Pause* Peter: Aaa. *Pause* Peter: Asså… (M) Student: Backa *mouse click*… Ja, du måste lägga in det i “Versions” för att det ska funka. (M) Student: Du ska lägga in det i Versions. *Pause* Julian: Här är nya EXE90 [I seriously have no idea…] *Unintelligible* Julian: Terrance, Terrance!	Peter is trying really hard to get WorldEdit to work and is getting help from a friend who knows how to install it. Note that he has been alluding to this 28:30, and talking about Hacks for a while.

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BJÖRN BERG MARKLUND

Björn Berg Marklund has a background in game design (BSc) and serious games development (1 year MSc). He has been working specifically with educational games and game-based learning since 2011, when he started researching childrens' collaboration in game environments and games as spaces for collective problem-based learning. In other research projects, he has examined the relationship between academia and the games industry in Scandinavia.

In his thesis, Björn presents an in-depth examination of digital educational games and how they are developed for, and used in, formal educational settings. Drawing from case studies that include a wide range of developers, educators, and students, Björn argues that educational games manifest a unique mixture of utility, gameplay, and context-dependent meaning-making activities. Educational games and game-based learning processes cannot be understood if they are only seen as an interplay between game mechanics and learning content. Instead, they should be understood as complex systems of actors, processes, and situational factors, all of which need to be orchestrated in tandem in order for games to have an actual positive impact in educational settings. For digital game-based learning to progress as a field of practice, both educators and developers need to alter their working processes, their own perceptions of games and teaching, as well as the way they collaborate and communicate with each other and other actors within the educational game 'system'.

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