Preface

An Overview of Digital Game-Based Learning

In recent years, there has been increasing interest in the use of digital games, and in particular, computer games, for learning, among teachers, researchers, policy makers, and other educational practitioners. There are many examples of the effective use of computer games in all stages of formal education, including work in primary schools and secondary schools, as well as post-compulsory education. There are examples of their effective use in a variety of subject areas, from scientific and technical to business and humanities, arts, and languages. As well as in formal education, games have also been used successfully for training, work-based learning, and in informal contexts. Digital games have the potential to create active and engaging environments, which motivate students and support learning in creative ways.

Digital games can also be used to teach a wide variety of different things. This includes specific curriculum content in subject disciplines, but also transferrable skills such as problem-solving, critical thinking, or teamwork. Games can also be used to teach physical skills, cognitive strategies, and change behaviours or attitudes. The value of game-based learning does not stop simply with their use as vehicles for delivering learning, but they can also be used as triggers for discussion or as a design activity where learning takes place through the design process. Game-based learning is not just about teaching with games, but also about learning from games and applying gaming principles to teaching, and understanding the incidental learning that takes place while game play goes on, for example, the collaboration and mentoring that takes place in Massively Multiplayer Online Role Playing Games (MMORPGs). The case studies in this book explore game-based learning from a variety of perspectives, showing a range of different ways in which it can be applied to different teaching and learning contexts.

The application of digital games for learning is also wide ranging, from the use of game consoles and computer platforms, to mobile gaming on phones or tablets, to mixed-media games that incorporate digital and real-world elements. It encapsulates many different game types and genres, from games that take weeks to play to those

that are over in minutes, including games played individually or collaboratively. The potential for different types of digital games to be used in different learning situations is vast; and this volume hopes to show this variety through the range of case studies selected.

There are many advantages to using games for learning, both pedagogic and in terms of supporting student motivation and enhancing engagement. They provide active learning environments in which learners can explore problems and test multiple solutions, and create meaningful contexts in which to build on past knowledge and experiences in order to gain a deeper understanding of a subject. Computer games provide a way in which learners can interact with a simulated environment, where they can explore and make discoveries, and they allow players to take part in authentic and purposeful tasks that map on to real world activities. A key goal of many types of game is based around problem-solving – be it strategic planning, lateral thinking, or how to work as a team to defeat a powerful enemy – which provides a motivation and stimulus for learning. Games create mysteries and stimulate curiosity, allowing players to uncover secrets, or journey with a character through a story to discover what happens at the end.

Digital games enable players to take part in active and immersive experiences, not simply to passively receive information, but to explore, try things out, and see the effects of their actions. It is this interaction and feedback that is crucial to learning from games; when a player makes an action it has (a usually immediate) effect and the player can then take further actions based on what has happened and this link between action and immediate, relevant feedback is why games can be so powerful. Making mistakes in computer games is not only seen as an intrinsic part of the game play for many games, but also as an inevitable part of the progress from novice to expert player. In this respect, they provide an ideal forum for practice and reflection on progress. Digital games are particularly good at guiding players as they make the journey from novice to expert, so that new players can make big gains early on, increasing confidence and involvement in the early stages, before they tackle the more difficult challenges or levels later. Goals start small and gradually increase in difficulty as game play progresses, and the support decreases so that as the game becomes harder while the player becomes more independent.

Many games allow learners to work together, be it in an online real-time space, in a face-to-face environment on shared hardware, or though an online gaming community. This ability to share ideas and opinions, clarify and reach shared understandings, is very powerful for learning. It not only allows students to learn about the topic of interest, but also to learn transferable skills such as communication and negotiation. They allow students to work to their strengths while learning from others, developing critical thinking and analytical skills, creative-thinking and problem-solving, testing their ideas, and discovering different learning styles, skills, preferences, and perspectives.

Games provide access to alternative worlds, which are typically safe from the consequences of the real world. Players can experiment, explore, and try out new things without risk of negative outcomes outside of the magic circle of the game. The playful state that games often engender can spark creativity, innovation, and new ideas, as well as allowing players to engage with fictional narratives, characters, and plots. Games allow players freedom and control to create new identities and interact with both the environment and other people in novel and surprising ways. They also create a sense of fun and enjoyment, removing some of the stresses and pressures that are often associated with formal education, and allowing learners to engage with the game activities in a relaxed and light-hearted manner.

Computer games have the potential to be powerful learning tools, particularly when considered beyond the simple arguments that they are motivational when they are used as a reward for learning. Digital games can be rich and interactive, providing context, purpose, authentic activities, meaningful problems to be solved, new experiences, and playful environments to explore, and a forum for social activity. Of course, computer games are not without their disadvantages, and the use of any new technology is likely to have limitations both in terms of its acceptability and practical applications in real world learning and teaching situations. This volume contains a number of real world case studies that addresses some of the issues that occur when using digital games in practice, and considers how they might be overcome.

Digital Game-Based Learning in Context

The field of digital game-based learning is multidisciplinary in nature, drawing on areas as wide-ranging as sociology, psychology, computing, game design, education, learning technology, and interaction design. This means that the field benefits from multiple perspective and approaches, but also presents challenges of opposing philosophies and research paradigms. This volume aims to present case studies from a variety of disciplinary backgrounds, showing how the use and evaluation of games can be approached from different angles.

There are several key challenges in digital game-based learning, which provide a framework for the case studies presented here and, the Editors hope, show ways in which these challenges can be addressed and overcome. Obtaining appropriate games for learning in specific contexts can be difficult, and a primary dichotomy is whether to use games originally designed for entertainment, or those designed for educational purposes. The former option allows learners to play high-end games, designed to be engaging and enjoyable, but they can be expensive, difficult to integrate with curricula or learning situations, technically exclusive, and can focus on gaming objectives at the expense of learning outcomes. The second approach

has the advantage of using games that are designed with learning at the key objective, where the designers have considered curricula and the limitations of the educational environment – for example technical, space or teaching time – but can still be expensive to buy or create and may lack the professionalism of design seen in commercial products. Case studies showing the use of entertainment games are shown in Section 1: Teaching with Commercial Games, compared with those in Section 2: Teaching with Educational Games.

Balancing learning design and game design is another important challenge in game-based learning, so that games stand alone as fun and engaging while still meeting the intended learning outcomes of the activity. The whole issue of how to effectively develop bespoke games for learning is addressed in Section 3: Designing Games for Learning. In addition to using games as the vehicle for delivering learning, there is now a greater emphasis on the potential of game design to be used as a means in itself for learning, and examples of this are provided in Section 4: Learning through Game Design.

The way in which the media negatively portrays games, for example in terms of violence, sexualised content, or addictive behaviours, helps to shape negative attitudes towards the use of games for learning, in parents, teachers, and among the learners themselves. One way in which to address this bias and start to question some of the media assumptions is to use games within teacher education, presenting a cascade model in which attitudes towards games for learning become more informed and discussion of games in the media more critical. Examples of games in this context are given in Section 5: Games for Teacher Education. The use of digital games for learning in practice can also be problematic; in particular, many games do not typically lend themselves to supporting collaborative working, or fostering reflection on the learning process. A number of case studies are included that show how issues can be dealt with successfully in order to create effective learning experiences, and these are presented in Section 6: Game-Based Learning in Practice.

Finally, there is a need within the field to provide further evidence of the effectiveness of games for learning, in terms of student enjoyment and engagement, but also in terms of measuring what is being learned, whether it is being retained, and the degree to which learning from games can be transferred to the real world. The case studies in Section 7, Researching Games and Learning, provide excellent examples of how effective research in the field can be carried out.

This book aims to use these case studies to show the wide variety of approaches to the way in which digital games for learning are obtained or created, implemented, supported and evaluation. It is hoped that readers will gain inspiration as well as insights from these examples, and become open to new possibilities, discover ways in which to enhance their own practice, and learn from the experiences of others.

The Target Audience

The intended audience for the book is essentially anyone with an interest in teaching and learning with digital games, who would like to see concrete examples of their application in practice. The case studies in this volume aim to show many different ways in which different digital games can be used in different contexts, providing insights into the drawbacks and limitations of their use, as well as the benefits in a variety of situations.

While this book is designed to have a wide appeal as possible, it is hopes that it will appeal in particular to teachers and lecturers – involved in all phases of education from early years to lifelong learning – who are keen to use game-based learning in their own practice. It will also be of interest to researchers, educational practitioners, and policy makers who are concerned with innovation in teaching and learning, curriculum design, or enhancing learner engagement.

The case studies have purposefully been selected to give an international flavour and are drawn from the USA, Europe, Asia, and Australia, and the book is intended to appeal to an international audience.

Description of Sections and Chapters

Section 1: Teaching with Commercial Games

Within the last few years, we have witnessed growing interest in the potential use of commercial off-the-shelf games for learning. Early studies of these games helped to identify the aspects of games that make them especially engaging and appealing to players of various ages and of both genders. These commercial games have potential as they show many of the inherent strengths of games for learning, as well as their ability to promote collaboration, foster engagement and motivation, and to develop students' thinking skills. Yet, these chapters also detail the difficulties teachers face in incorporating complex, time-consuming, and technically sophisticated games into short classroom hours not intended for use with commercial games.

In the chapter *"Come Fly with us": Playing with Girlhood in the World of Pixie Hollow*, Velazquez introduces Pixie Hollow, which provides a series of useful, accessible examples for discussing gender, the mechanics of community building, and the interconnections between technological fluency and community norms. Pixie Hollow is a useful teaching tool for first and second year college students in women's studies, gender studies, and American studies classrooms because of its incorporation of gender roles into the pre-structuring of the program.

Akcaoglu describes how some existing classroom factors can substitute or modify the effects of very important game elements in the chapter *Using MMORPG's*

in Classrooms: Stories vs. Teachers as Sources of Motivation. Specifically, how virtual teachers can keep the students engaged is demonstrated, showing that this is possible even when a very important element of role-playing games, narratives, is missing from a game, and hence, makes the case for particularity when playing games in a classroom setting.

The chapter *Are Wii Having Fun Yet?* describes two years of work incorporating the Nintendo Wii gaming platform into multiple subjects in 4th through 8th grade classrooms (ages 9 to 13 years). Badman and DeNote found that not only were the students learning during the Wii enhanced classes, but they were retaining the information long after the initial lessons.

The case study, *Beyond Hidden Bodies and Lost Pigs: Student Perceptions of Foreign Language Learning with Interactive Fiction*, looks at how the retro video game genre of Interactive Fiction was used with learners of English as a foreign language in order to provide them with an alternative method of practising reading for fluency in a meaningful, motivating, and engaging manner. Pereira found Interactive Fiction to be an engaging way to practice reading, and the majority of students in the sample stated they would use it for autonomous language skills practice.

Section 2: Teaching with Educational Games

Educational games are games that are designed to teach people about certain subjects, expand concepts, reinforce development, shape behaviour or attitudes, understand an historical event or culture, or assist them in learning a skill as they play. Some games may be explicitly designed with educational purposes, while others may have incidental or of secondary educational value, although all types of games may potentially be used in an educational environment. Games can engage learners in ways other tools and approaches cannot, and their value for learning and motivation has been supported through research. We know more about how games work and how to apply them to teaching and learning than we ever have, and that understanding is increasing.

In the chapter *Civilization IV in 7th Grade Social Studies: Motivating and Enriching Student Learning with Constructivism, Content Standards, and 21st Century Skills*, Senrick explores how using the digital game Civilization IV could encourage constructivist learning, target social studies content standards, cultivate 21st century skills, and increase student engagement.

In the chapter *QRienteering: Mobilising the M-Learner with Affordable Learning Games for Campus Inductions*, Horne introduces mobile learning opportunities, via a mobile based learning game, at the outset of the learner's academic journey. Its purpose is to highlight how mobile phone technology could be utilised for educational purposes and determine if mobile learning could deliver an active and collaborative experience for learners during the induction process.

In the case study of *Enhancing Nutritional Learning Outcomes within a Simulation and Pervasive Game-Based Strategy*, McMahon demonstrates how a game can be used as a tool for raising awareness of diet and provide opportunities for meaningful decision-making among primary school-aged children. The game uses a blend of simulated and pervasive elements using ubiquitous technologies to enhance children's capacity to make informed choices with regard to their own eating habits.

"Sell Your Bargains" or Playing a Mixed-Reality Game to Spice up Teaching in Higher Education, describes a mixed-reality game that aims to provide a highly immersive learning experience to the players and opportunities to enhance their teaching in more creative ways as a result of their engagement and participation. Nerantzi shares details about this mixed-reality game and the pedagogical rationale on which it is based with other practitioners.

Section 3: Designing Games for Learning

One of the main shortcomings of using commercial or existing games is that these games are typically designed primarily as entertainment products, without taking into account educational considerations. More often than not, educational software designed to support learning often borrows from game design in an attempt to replicate the levels of engagement and exploit this to facilitate traditional learning; however, this is often done in a superficial or behaviourist way. The chapters in this section are success stories of game designs that managed to apply theories into practice in a more thoughtful and deep manner.

The chapter of *Medicina: Methods, Models, Strategies* discusses the creation of Medicina from inception through to dissemination, detailing the stages, challenges, and lessons learned in the process, in the hope of informing other educators of the level of commitment involved in a digital game-based project. Müller and Mathews indicate that this game familiarizes students with confusable and common medication names. It also aims to improve phonological awareness through a focus on word form.

In the chapter *Strategies for Effective Digital Games Development and Implementation*, Lim and colleagues consider how Serious Games (SGs) as a digital technology endeavour to support effective lifelong learning. Three fundamental characteristics of the SG ecosystem are presented: namely, game mechanics, interoperability, and assessment. They are considered here as strategic elements that impact upon how SGs are used to support learning, and how they affect the learning environment and ultimately the SG development process.

In the chapter *Learning and Teaching as Communicative Actions: Broken Window as a Model of Transmedia Game Learning*, Warren and Najmi review existing theoretical models of game learning and provide an overview of a new model entitled

Learning and Teaching as Communicative Actions. In addition, they describe the design process for Broken Window, an alternate reality transmedia game that was developed to support undergraduate learning in a computer applications course.

Section 4: Learning through Game Design

Game design is becoming a popular strategy for engaging learners' interests in and enhancing skills with computer technology. This can be for purposes ranging from deepening their understanding of scientific principles to fostering critical media literacy, learning about the processes involved in game design and development to their own end, or the transferrable skills that are developed during the creation process, such as teamwork, planning, or negotiation skills.

In the chapter of *Get Your Head in the Game: Digital Game-Based Learning with Game Maker*, Herrig discusses 7th grade students (aged 12-13 years) who are engaged in digital game-based learning as a method of introducing them to the concepts of programming. Each student is provided with an overview of basic programming terminology and is introduced to the functions of Game Maker, an icon-based, drag-and-drop video game creation software package. Students complete an introductory programming activity in which each student programs a similar game. A second activity has each student create a more advanced game of their own design. Rather than digital games being used to deliver content, in this case, the game creation becomes the content.

In the chapter *Elements of Game Design: Developing a Meaningful Game Design Curriculum for the Classroom*, Herro examines the development of a game design curriculum offered to high school students as an in-school elective course in the Oconomowoc area, a Wisconsin suburban school district. The rationale for proposing the course was based on the overlap of research, trends, and experiences studying game-design and game-based learning environments. To that end, it is important to note that one of the development team was simultaneously completing an educational technology doctoral degree focused on digital media and learning and engaged in research involving Massively Multiplayer Online Games (MMOGs) and Augmented Reality Games (ARGs).

In the chapter *Game-Making in a Fourth Grade Art Classroom Using Gamestar Mechanic*, Aubrecht discusses how his use of the free, online video game development toolkit Gamestar Mechanic in an elementary art classroom and how he supported the art teacher in learning how to use this tool. Through this professional development experience, the art teacher learned how to use Gamestar Mechanic and how game design and art can be integrated. Players, fourth-grade students (9-10 years) in a low-income, urban school, learned basic game design principles and how to design games by playing and fixing them.

In the chapter *Using Game Design as a Means to Make Computer Science Accessible to Adolescents*, Hadad discusses using game design and community-building as methods for increasing interest and knowledge of computer science for students from underrepresented populations. The game design courses engaged students, developed students' ability to collaborate and utilize critiques, and increased their knowledge of programming.

Section 5: Games for Teacher Education

One of the biggest obstacles to wide-scale acceptance of game-based learning in classrooms is the lack of proper training for our teachers. In order for game-based pedagogy to really take hold in K-12 (primary and secondary) as well as in higher education, we need teachers who are knowledgeable and skilled in teaching via gaming activities. It is important for teachers to be able to address the inevitable concerns of parents and administrators when the prospect of playing games. Teachers must also be capable of assessing these games and reviews themselves.

In the chapter *3D GameLab: Quest-Based Pre-Service Teacher Education*, Haskell explores the use of game-based pedagogy for a pre-service teacher education course, as well the development of a quest-based learning management system (3D GameLab) to support the class. The chapter is grounded in design-based research, and discusses four phases of development and theory generation.

In *Preparing Pre-Service Teachers for Game-Based Learning in Schools*, Lee describes the pre-service teachers' preparation of teaching consumption education to middle school students when using Farmville, a social network-based game. This chapter analyses the consumer education in middle school textbooks, and also describes the possibilities of a student-oriented classroom model using Farmville to teach consumption education.

In the chapter *Death in Rome: Using an Online Game for Inquiry-Based Learning in a Pre-Service Teacher Training Course*, Kennedy-Clark, Galstaun, and Anderson present a case study that used an online game in a pre-service science teacher training course in the context of computer-supported inquiry learning. In this chapter, the authors focused on developing pre-service teachers' skills in using a game to teach students through inquiry-based learning. The game used was Death in Rome, a free to access point and click game. Overall, this study showed a positive change in attitudes towards game-based learning in science education.

Section 6: Game-Based Learning in Practice

The emergence of game-based learning is offering the learning and teaching community new opportunities to reach and motivate hard-to-engage learner groups.

It supports differentiated and personalized learning, and provides new tools for teaching and learning.

In *Games, Models, and Simulations in the Classroom: Designing for Epistemic Activities*, Ahern and Dowling report on an eco-simulation of a food web in a middle school science classroom. The students were successful in coming to understand the dynamics of complex eco-systems. The authors discuss why the project was successful and describe a design model for teachers to successfully integrate games and simulations in the classroom.

In the chapter *The Role of Animations and Manipulatives in Supporting Learning and Communication in Mathematics Classrooms*, Uribe-Flórez and Trespalacios illustrate a short case in which educational animation and manipulatives were utilized to support communication and learning of mathematical concepts during an after-school program. The authors utilized a computer-based educational animation that involves the concept of length measurement, and a broken ruler as a manipulative to help students learn about measuring objects while communicating mathematically.

In *It's All in How You Play the Game: Increasing the Impact of Gameplay in Classrooms*, Reid, Jennings and Osterweil introduce Lure of the Labyrinth, a digital game for middle school pre-algebra students. The Education Arcade at MIT has worked on design principles that focus on assumptions about play and learning. Lure of the Labyrinth was developed with these principles in mind, which include requiring teachers to develop a modified perception of their role in the classroom. This chapter describes how teachers implemented the model in real-life classroom settings, and describes the impact of this implementation on students' outcomes.

In the chapter *Challenges of Introducing Serious Games and Virtual Worlds in Educational Curriculum*, Ribeiro and colleagues describe two experiments involving Virtual Worlds and Serious Games in a learning environment. These experiments allowed the readers to understand the real potential of two emerging technologies but also some of the difficulties one can come across. The experiment was to analyse learners learning styles profile, using virtual games and explore if virtual activities are as effective as manual ones to evaluate students efficiently. Some of the pitfalls that should be avoided are described as a set of lessons learnt at the end of the chapter.

Section 7: Researching Games and Learning

A common criticism of the field of games and learning is the lack of large-scale, robust, and longitudinal evidence of their value for learning and motivation. Recent research into games and learning are focused on pedagogical effects, design variables, and learning experience of participants. The chapters in this section provide a snapshot of some of the most recent research in the field.

In the chapter *Serious Games for Reflective Learning: Experiences from the MIRROR Project*, Pannese and colleagues describe some of the work carried out in the MIRROR project which focuses on reflective learning where adults' motivations to learn and reflect through games is being researched. It introduces briefly the project and the theoretical framework and then describes in detail the serious game that was created for research. The last part of this chapter focuses on users' evaluations and describes some lessons learned about the importance of guidance and of a de-briefing session, thus highlighting the potential of serious games for collaborative knowledge construction.

In *Evaluating Games in Classrooms: A Case Study with DOGeometry*, Wallner, Kriglstein, and Biba describe the evaluation of the game DOGeometry, which was carried out in a classroom environment over a four month period. The analysis of the gameplay data and the feedback from the children and teachers showed that the pre-evaluation was really important in order to ensure that the game was well-balanced. Although the evaluation went well more effort would be invested in the design of the pre- and post-test for subsequent evaluations to adapt the difficulty better to the target audience.

In *Learning with the Support of a Digital Game in the Introduction to Finance Class: Analysis of the Students' Perception of the Game's Ease of Use and Usefulness*, Romero and Usart introduce the case of the eFinance Game (eFG). They discuss the Serious Games' design, an analysis of the learning experience resulting from the use of the game, as well as its use in the context of the Introduction to Finance course in Esade Law and Business School. After an overall description of the game, the authors turn their attention to the Serious Games learning experience, considering the students' perception of both ease of use and usefulness, but also the implications for teaching and learning assessment that arise with the utilization of this game.

In the final chapter, *Racing Academy: A Case Study of a Digital Game for Supporting Students' Learning of Physics and Engineering*, Joiner and colleagues report a research study where the authors evaluated how effective Racing Academy is at supporting students' learning of science and engineering. They found that after playing Racing Academy, there is an increase in students' knowledge and understanding in all five of the courses, in which Racing Academy was used. In addition, they found evidence that students found playing Racing Academy motivating.

Epilogue

This case book presents twenty-six first-hand accounts of learning with digital games in schools, colleges, and universities. The impact of games in teaching and learning is described, analysed, and synthesized with the objective of offering successful strategies and examples, and addressing challenges and pitfalls experienced during the implementation of digital game applications for learning.

This book serves as a guide to practice for teaching with digital games, highlighting the variety of different ways in which games can be used, looking at different game forms and different contexts. This case book provides methods, models, and applications of digital games for learning in primary and secondary classrooms as well as post-compulsory education. The book provides teachers at all levels with good examples to follow, and advice and context for making decisions about adopting games into teaching. This book holds current models of learning, types of game, and emergent strategies of applications, positioning this book as a crucial reference book in this field at this time.

Digital game based learning will benefit from this case book by the accumulation of authentic cases, which have implications for practical reapplication in new settings. This book is a resource to improve teaching and learning with digital games with well-organized examples categorized by learning model, method, and strategy.

Youngkyun Baek
Boise State University, USA

Nicola Whitton
Manchester Metropolitan University, UK