Preface

INTRODUCTION

The International Journal of Game-Based Learning (IJGBL) was launched in 2011. This journal is devoted to the theoretical and empirical understanding of Game-Based Learning (GBL). To achieve this aim, the journal publishes theoretical manuscripts, empirical studies, and literature reviews. The journal publishes this multidisciplinary research from fields that explore the cognitive and psychological aspects that underpin successful educational games. The target audience of the journal is composed of professionals and researchers working in the fields of educational games development, e-learning, technology-enhanced education, multimedia, educational psychology, and information technology. IJGBL promotes an in-depth understanding of the multiple factors and challenges inherent to the design and integration of GBL environments.

In addition to regular issues that feature peer-reviewed articles, the journal also provides comprehensive reviews of breakthrough books recently published in the field of games and learning, as well as special issues where guest editors are invited to select and introduce the work of scholars in emergent fields. Such issues usually feature articles from conferences or workshops, capturing the atmosphere, energy, and creativity of these events.

This book, entitled Developments in Current Game-Based Learning Design and Deployment, is the first book of a series that aims to present the research and findings of prominent researchers in the area of games, learning and training. These scholars whose work was published in the first volume of IJGBL, and who are experts in instructional design, game design, psychology and educational psychology, depict their experience of designing and deploying GBL solutions, and reflect on their achievements and shortcomings. These experiences are then employed to inform the reader by providing relevant suggestions and guidelines accordingly.

All chapters in this book have been evaluated using a thorough review process. In order to recruit authors, several calls for participation were issued. All chapters were assessed through a double-blind review process by at least three reviewers. Following the double-blind reviews, accepted authors were provided with recommendations from the reviewers and the editor, and asked to submit an amended script. This amended version was then evaluated through a second round of reviews, and a final notification of acceptance was issued. As a result of this review process, this handbook includes 24 excellent chapters that provide a comprehensive explanation of the issues, solutions, and challenges related to GBL.

It is therefore with great enthusiasm that I am writing the preface of the first book of the series. This preface provides an overview of the rationale for and content of the book. It includes a description of the journal goals, objectives, and activities, and a list and summary of all chapters featured in the book. For each chapter, the summary is followed by key findings and ideas formulated by the authors.
The mission of the *International Journal of Game-Based Learning (IJGBL)* is to promote knowledge pertinent to the design of Game-Based Learning environments, and to provide relevant theoretical frameworks and the latest empirical research findings in the field of Game-Based Learning. The main goals of *IJGBL* are to identify, explain, and improve the interaction between learning outcomes and motivation in digital and non-digital games, and to promote best practices for the integration of gaming approaches and techniques in instructional settings. The journal is multidisciplinary and addresses cognitive, psychological, and emotional aspects of Game-Based Learning. It discusses innovative and cost-effective Game-Based Learning solutions. It also provides students, researchers, instructors, and policy-makers with valuable information in Game-Based Learning, and increases their understanding of the process of designing, developing, and deploying successful educational games. *IJGBL* also identifies future directions in this new educational medium.

**Topics to be discussed in this journal include (but are not limited to) the following:**

- Adaptive games design for Game-Based Learning.
- Design of educational games for people with disabilities.
- Educational video games and learning management systems.
- Game design models and design patterns for Game-Based Learning.
- Instructional design for Game-Based Learning.
- Integration and deployment of video games in the classroom.
- Intelligent tutoring systems and Game-Based Learning.
- Learning by designing and developing video games.
- Learning styles, behaviors and personalities in educational video games.
- Mobile development and augmented reality for Game-Based Learning.
- Motivation, audio and emotions in educational video games.
- Role of instructors.
- Virtual worlds and Game-Based Learning.
- Games for Change (G4C).
- Games for healthcare.

The objectives of IJGBL are to publish empirical evidence on the design and deployment of GBL, to understand the cognitive and psychological processes involved in GBL, to compare the development and use of GBL across different research fields and countries, and to provide practical recommendations to developers and instructors. All papers submitted to *IJGBL* contribute to the existing body of knowledge in this field. They describe the collection and analysis of empirical data, present theoretical models that further explain how motivation and learning occur in GBL systems, or provide practical information on the integration of GBL in educational settings. *IJGBL* is committed to publish high quality papers with innovative and informative content. Papers submitted to *IJGBL* should adhere to the journal editorial policy. Upon submission, each manuscript is sent to at least three reviewers, and evaluated through a double-blind review process, which guarantees anonymity and a fair and impartial evaluation. *IJGBL*’s review board includes 64 international experts from more than 15 countries worldwide, proficient in game design, instructional design, psychology, eLearning, and multimedia technology. The quality and relevance of the manuscripts submitted to *IJGBL* is also assessed by the Editor, the Associate Editors,
and the International Advisory Board (IAB), who have a significant experience and publication record in the area. *IJGBL* also publishes book reviews and at least one special issue per year. Papers in these special issues are selected from workshops and conferences.

The first volume of *IJGBL* includes two regular issues and two special issues. While regular issues feature papers submitted to *IJGBL* on an ongoing basis, special issues are usually based on papers and presentations featured at conferences and workshops organized by scholars who have collaborated with *IJGBL* to publish some of the outstanding work featured at these events. The first special issue was guest-edited by Professor Sean Duncan (Miami University) and included extended work presented at the 6th Games+Learning+Society Conference (GLS 6.0). GLS is an extremely popular and innovative conference organized at the University of Wisconsin-Madison, where academic researchers, interactive media (or game) developers, and government and industry leaders investigate how digital media operate, how it can be used to transform how we learn, and what this means for society. The second special issue was guest-edited by Professor David Brown (Nottingham Trent University) who organized the third Interactive Technologies and Games: Education, Health, and Games conference (ITAG 2011), a conference held in Nottingham, that brings together academics and practitioners to showcase practice and to mainstream research ideas and outcomes.

**Book Structure**

This book features very interesting and cutting-edge chapters that address a comprehensive number of opportunities, issues and challenges for all GBL stakeholders. The following section provides a summary of the ideas brought forward by the authors as well as their key findings.

**Chapter 1: Video Game Genre Affordances for Physics Education:**

- **Summary:** Chapter 1 is written by Anagnostou and Pappa, two prominent researchers from Greece, who use virtual worlds and video games to teach physics. By combining their background in both astrophysics and computer graphics, they developed highly interactive GBL environments to support the understanding of physics concepts. In their chapter, they describe the limitations of traditional school settings to teach physics. They explain how simulations and video games can provide learners with more opportunities for hands-on experiences, where they can learn by doing. Anagnostou and Pappa present guidelines that inform the choice of video games for teaching, based on game genres, featured types of interaction, and opportunities for reflection.

- **Key Findings:** According to Anagnostou and Pappa, different game genres can be employed for education, however, future advancements may focus on integrating reflective activities in action games so that students gain a deeper understanding of the qualitative processes involved in the game (or simulation), and reducing onscreen information to lower cognitive overload on the part of the students. The authors also consider that dynamic scenarios could also increase players’ motivation and learning outcomes.
Chapter 2: Encouraging Engagement in Game-Based Learning:

- **Summary**: In Chapter 2, Whitton, from Manchester Metropolitan University, describes her experience of designing, deploying, and evaluating an Alternate Reality Game (ARG). ARGs usually provide a high level of engagement, and involve users in a series of interactive and collaborative challenges that foster problem-solving skills, and stimulate curiosity and collaboration between users. Whitton explains how an ARG was used to support the student induction process in both Manchester Metropolitan University and the University of Bolton. She identifies issues preventing the increase of users’ engagement in ARGs, and proposes solutions based on her experience.

- **Key Findings**: According to Whitton, although there are many games available, educators may sometimes need bespoke games to support their teaching. However, the development of such software may be time-consuming and expensive. As a result, there is a need for cheaper alternatives. ARGs represent one of these alternatives because they use existing open-source or freely-available technologies (e.g., web pages), and are low-cost solutions. Although this format seems to yield promising results, research studies are scarce in this area. While games are usually perceived as naturally engaging for all youths and teenagers, this may not necessarily be the case for learners in higher education. These learners may need to progress quickly in the early stages of the game, avail of embedded discussion, social activities, extrinsic rewards, a variety of choice in the challenges they can undertake, and be part of an active and significant community of players; unfortunately, these features are not always included in ARGs and GBL solutions at large.

Chapter 3: Leveraging Mobile Games for Place-Based Language Learning:

- **Summary**: In Chapter 3, Holden and Sykes investigate the use of mobile technology for language learning. They describe a project entitled *Mentira*, where place-based activities, narratives, game mechanics and augmented reality were employed to teach Spanish in a community located in Southwestern United States. They explore and describe the advantages, limitations, and complexities linked to the usage of mobile devices and mobile gaming in education.

- **Key Findings**: According to Holden and Sykes, students are usually interested in being part of an active learning process. Augmented reality games are still new but present a worthwhile platform for engaging learning activities. Their work also shows the importance to organize workshops within and outside schools, and that innovative teaching opportunities are not solely linked to new technologies; instead they repose essentially on a close and fruitful collaboration between researcher and teachers to create learning activities that go beyond the confines of traditional classrooms. The authors also insist that knowledge should be contextualized using on-site gameplay, and that students should have an input and a more active role in the design and delivery format of the game.
Chapter 4: DataPlay: Experiments in the Ludic Age:

• **Summary:** In Chapter 4, Macklin examines how games and game mechanics can be employed to make it possible for end-users to represent, visualize, and experience large data sets. Macklin considers how the *data deluge*, a situation where the sheer volume of data makes it difficult for researchers to analyze it or make sense of it, can be avoided and addressed through what Macklin defines as *data-based games*.

• **Key Findings:** Although games represent a rather different medium to visual information display, they can provide meaningful experiences and stories, so that people can directly experience with data and become more information-savvy.

Chapter 5: Affordances and Constraints of Scaffolded Learning in a Virtual World for Young Children:

• **Summary:** In Chapter 5, Black and Reich evaluate how virtual worlds designed for 6-14 years old, include and leverage socio-cultural perspectives for informal learning. They consider several aspects such as ease of use, creativity, scaffoldings, safety and support, and authentic communication. They identify possible improvements and provide recommendations for future developments.

• **Key Findings:** According to Black and Reich, children are active learners who need assistance and scaffoldings during their learning activities. Such features should always be accounted for and implemented accordingly. However, educational scaffoldings, even if they might be significantly needed for beginners, may become less prevalent as children learners become more independent in their learning. Virtual environments should promote creativity, navigation, and participation. Creativity is one of the core elements of GBL, as the literature strongly suggests that players should not be passive consumers, but instead active creators of their knowledge and involved in activities where they design, create, reflect, and interact with others.

Chapter 6: Social Interactions in Online Gaming:

• **Summary:** In Chapter 6, Griffiths, Hussain, Grüsser, Thalemann, Cole, Davies, and Chappell report on five comprehensive studies that examine Massively Multiplayer Online Role Playing Games (MMORPGs). These studies investigate the motivation behind playing MMORPGs, social interactions in MMORPGs, the effect of online socializing on the “real” life of the players, addiction in online games, and how people generally feel about MMORPGs.

• **Key Findings:** MMORPGs feature significant communication mechanisms that make it possible for players to enjoy online social activities. Griffiths, Hussain, Grüsser, Thalemann, Cole, Davies, and Chappell show that, contrary to persistent stereotypes, such MMORPGs players enjoy real-life social activities, are predominantly males and young adults, single (although in the case of couples, the partner who is not initially interested in gaming, may start playing MMORPGs as a means to share a common interest with their partner). MMORPGs seem to require significant time commitment, but are played essentially for social-interaction and usually with real-life friends. The authors found that these activities may in some cases imply that less time is spent on other activities. Players seem to make good friends online, with whom they are more inclined to share and discuss sensitive topics, probability due to their anonymity and non-judgmental comments from peers. Females seem to form stronger emotional connections with their peers. Gamers usu-
ally prefer social interactions outside MMORPGs, but those who prefer social interaction inside MMORPGs feel that such environments provide a space of equality where their voice can be heard, escapism, and an opportunity to keep connected to long-distance friends and family members. Griffiths, Hussain, Grüsser, Thalemann, Cole, Davies, and Chappell also found that a significant number of MMORPG players matched some criteria for addiction, and they suggest that for some players who seem addicted, cognitive therapy may be appropriate, as addictive behaviors seem related to cognitive components. This being said, the authors recognize that there is only weak evidence that aggressive behaviour is related to excessive gaming. They also found that two thirds of the respondents experienced positive effects from gaming including friendship, collaborative activities, the discovery of new cultures, typing, reading comprehension, economics, and mathematics.

Chapter 7: The Mobile Learning Network: Getting Serious about Games Technologies for Learning:

- **Summary:** In Chapter 7, Petley, Parker, and Attewell describe a large-scale project entitled MoLeNET, involving 40000 learners and 7000 teachers, where mobile devices were employed to improve learning and teaching practices. They demonstrate how the features of portable game consoles can be leveraged and employed creatively to teach, motivate and assess learners. Petley, Parker, and Attewell provide an inspiring account of their experience, and also identify organizational and design barriers to a wide-scale implementation of this approach.

- **Key Findings:** According to Petley, Parker, and Attewell, although mobile GBL can yield significant learning and motivational benefits, some barriers still remain, including curriculum coverage, lack of flexibility in the planning and implementation of timetables, funding, and staff training. More importantly, they believe that GBL should be thought of and embedded in lesson plans at an early stage because planning and resources are key to successful GBL implementation.

Chapter 8: A Psycho-Pedagogical Framework for Multi-Adaptive Educational Games:

- **Summary:** Chapter 8 is written by Kickmeier-Rust, Mattheiss, Steiner, and Albert, who have significant experience in the design of adaptive educational video games. In Chapter 8, they address the challenge of developing non-intrusive adaptive GBL systems. Using an innovative approach that accounts for both the didactic and dramatic aspects of educational video games, they explain how micro- and macro-adaptivity can help to improve both players’ enjoyment and skills. They illustrate the effectiveness of their framework with descriptions and analyses of two case studies they conducted in France and Austria.

- **Key Findings:** According to Kickmeier-Rust, Mattheiss, Steiner, and Albert, motivation and play are intrinsic to games; however, these concepts are also based on personal preferences and internal regulations that ought to be accounted for. Games should incorporate individualized mechanisms whereby users’ specificities such as abilities, disabilities, learning styles, or preferences, because research shows that tailored interaction mechanisms can increase both learning outcomes and motivation.
Chapter 9: Content Design Patterns for Game-Based Learning:

• **Summary:** In Chapter 9, Maciuszek, Ladhoff, and Martens explore how design patterns can be applied to video games for educational purposes. They report on four studies where content design patterns and Intelligent Tutoring Systems (ITSs) were employed to generate and manage GBL environments. They present interesting templates and design patterns for character and environment design.

• **Key Findings:** Rule systems and design patterns can be helpful in the design of GBL solutions, because they are easy to communicate and replicate. Such aspects can be applied to ITSs and adaptive mechanisms, especially in Role-Playing Games (RPGs). Such structures can encompass both the entertaining and didactic aspects of GBL and present a worthy alternative for the design of educational video games.

Chapter 10: Designing Serious Games for People with Disabilities: Game, Set, and Match to the Wii™:

• **Summary:** In Chapter 10, Evett, Ridley, Keating, Merritt, Shopland, and Brown investigate how video games can accommodate people with disabilities. They remind us of the necessity to design video games inclusively; they review the current advancements in accessible games and emphasize the lack of inclusive features, even in mainstream games such as those available for the Nintendo Wii. The researchers observed how players with and without visual impairment played Nintendo Wii games, and how different cues and implicit feedback could help visually impaired users. Evett, Ridley, Keating, Merritt, Shopland, and Brown also identify features that ought to be improved in mainstream video games.

• **Key Findings:** Some video game platforms, while not specifically designed for people with disabilities, comply with fundamental Human Computer Interface (HCI) principles and offer an accessible interface that accommodates users with a sensory disability. These games, based on a “Design-for-all,” might be more enjoyable than previous specialized games, such as audio games, which were perceived as unsophisticated.

Chapter 11: Motivational Aspects of Gaming for Students with Intellectual Disabilities:

• **Summary:** In Chapter 11, Saridaki and Mourlas present a literature review of the theories and research findings pertinent to the use of GBL for people with intellectual disabilities, with a particular focus on intrinsic motivation and behavior change. They explain how GBL can enhance knowledge and social integration, and they define the scope, applications, pre-requisites, and limitations of such a medium in the context of SEN (Special Educational Needs).

• **Key Findings:** While games and game mechanics in previous GBL solutions seemed to be based on extrinsic motivation, and made it possible for students with intellectual disabilities to learn in a safe and friendly environment, researchers still need to investigate how intrinsic motivation can be solicited and harnessed to match the motivations and needs of students with intellectual disabilities more accurately.
Chapter 12: Honing Emotional Intelligence with Game-Based Crucible Experiences:

**Summary:** Chapter 12, written by Raybourn, explores how Emotional Intelligence (EI) can be accounted for in the design of GBL systems. Raybourn, an authority in the conception of personalized training systems, describes a case study where a GBL training system, that featured crucible experiences, was employed by the United States marines to improve intercultural communication, cross-cultural coordination, and decision-making skills. The system included a non-violent intercultural mission with six scenarios, each with different levels of difficulty and emotional experiences. Raybourn describes how the system made it possible for the marines to harness their emotional intelligence and to improve their decision-making skills under stress.

**Key Findings:** According to Raybourn, many instructional systems, while they provide knowledge of the topic at hand, may fail to “mirror emotional realities,” to reveal who the users are and how they may react in critical situations, and hence learn from their strength and weaknesses. Systems that account for emotions and that empower users to increase their emotional intelligence, help them to regulate their own emotions, train in a more realistic environment, understand their strength and weaknesses, and increase knowledge transfer.

Chapter 13: Possibility Spaces: Using The Sims 2 as a Sandbox to Explore Possible Selves with At-Risk Teenage Males:

**Summary:** In Chapter 13, King provides an interesting investigation on the concept of identity play; she explores how video games can be employed to engage at-risk youth and motivate them to evaluate their fears, hopes and expectations for their future. King believes that realistic virtual representations, in the form of video games, can help individuals to project themselves into the future, and consequently “move towards” desired outcomes and “move away” from undesirable outcomes.

**Key Findings:** Engaging participants in safe and realistic virtual environments with avatars can help them to project themselves into the future, experience possible scenarios, reflect on their actions, and change their behaviours, and become more confident and responsible. Current educational systems, although well intentioned, sometimes tend to stigmatize low achievers, prioritizing academic success and college as a “one-route-for-all,” and making it a prerequisite for a successful life. This perspective may discourage and lower the confidence of students who face difficulties at this stage. In this case, games can be successfully employed to increase self-esteem, help students to evaluate their options in terms of academic path, and plan for a successful and fulfilling life ahead.

Chapter 14: Forming the Guild: Star Power and Rethinking Projective Identity in Affinity Spaces:

**Summary:** In Chapter 14, grounded in cultural studies, Ellcessor and Duncan explore the concept of affinity spaces, a concept initially coined by Gee (2003), which refers to spaces where fans, from different backgrounds, identities, and expertise, meet and share knowledge. Ellcessor and Duncan nuance this concept, notably by highlighting the role of media producers and stars within
celebrity-based affinity spaces, and how they may limit or restrict occurrences of learning and literacy.

- **Key Findings:** Ellessor and Duncan show that new media are usually associated with fans and literacy practices, and that interactions from participants in affinity spaces may be shaped by the interaction of the star in these spaces.

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**Chapter 15: Fear of (Serious) Digital Games and Game-Based Learning? Causes, Consequences, and a Possible Countermeasure:**

- **Summary:** In Chapter 15, Bösche and Kattner investigate stereotypes associated with video games. They describe how video games have been depicted negatively in the media and to what extent these allegations are actually supported by research. They provide a comprehensive literature review of possible side effects caused by games; they describe the attitudes of teachers and parents towards video games and show that while there could be some risks associated with video games (e.g., addiction), they may only apply to a minority of vulnerable individuals. The authors also demonstrate that many studies, which consider the negative effects of video games on players’ behaviors, lack validity due to insufficient rigorous experimental design. Bösche and Kattner also explain that some violent video games, often depicted negatively in the media (e.g., First-Person Shooters), may be beneficial to players. Bösche and Kattner provide suggestions as to how parents and instructors can effectively gain a better understanding of the advantages and limitations of video games, and they also describe a GBL environment designed to support the understanding of violence in video games.

- **Key Findings:** There is no conclusive study on the possible effect of video games on violent behaviors. Little information present in video games can be derived for violent outbreaks, and public opinion on the alleged negative effects of video games is often exaggerated and creates “phantom public health risks.” Before making such statements, mental health professionals ought to understand games at a deeper level and become familiar with this medium. Training future mental health professionals may help to clarify these stereotypes. Engaging these students to play violent video games and assess the potential negative effects, and conducting discussions with them on both risks and benefits of games would be beneficial. The study conducted by Bösche and Kattner shows that psychology students, even those with little or no prior exposure to games, find this approach (i.e., understanding violence in video games by playing) not only beneficial but necessary to understand inherent psychological principles in video games.

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**Chapter 16: Background Music in Educational Games: Motivational Appeal and Cognitive Impact:**

- **Summary:** In Chapter 16, Linek, Marte, and Albert analyze how sound, and more particularly background music, can influence learning and motivation in educational video games. They explain the rationale for their approach and review theories and experiments related to music, cognition, and motivation. Following this literature review, they describe experiments conducted to assess how music can effectively influence motivation and learning in video games. This study provides interesting insights on how music can impact on intrinsic motivation, cognitive load, and learning.
• **Key Findings:** According to Linek, Marte, and Albert, music seems to motivate learners, and has no detrimental learning effects. They found that background music can have a significant influence on intrinsic motivation and flow; however, background music decreases the use of the cognitive activities that are considered to support deeper understanding, although no negative effects on learning success were reported. Their research also revealed that, contrary to several recent studies conducted in the field, intrinsic motivation may not always increase learning.

**Chapter 17: Formulating a Serious-Games Design Project for Adult Offenders with the Probation Service:**

• **Summary:** Chapter 17, authored by Bates, Brown, Cranton, and Lewis, investigates the effects of and challenges posed by the introduction of serious games in probation programs. In this study, video games were employed as a means to improve participants’ communication and presentation skills. Using Game Maker, a free game engine, participants were required to design and implement a serious game that helped new offenders in making suitable lifestyle choices upon completing the probation program. Bates, Brown, Cranton, and Lewis consider that learners need to be “actors” of their own learning and to take active part in shaping their knowledge. This novel approach shows how collaboration can engage learners, motivate them to research extensively on the topic, and consequently, support learning activities.

• **Key Findings:** Bates, Brown, Cranton, and Lewis show that GBL can require different approaches depending on the age group of the participants. While children are usually very motivated, they require structured activities so that goals and objectives can be met (e.g., through schedules); on the other hand, adult learners seems very keen on meeting project deadlines, although they may lack motivation to engage in learning activities, and games may be useful in this instance. Results show that the gaming approach did not manage to engage all adults in the project. Bates, Brown, Cranton, and Lewis also highlight some interesting differences between young and adult game designers: children seem more influenced by the violent characteristics of the video games they play compared to adults; adult designers are less inclined to ask for assistance during meetings or game design sessions, whereas as peer-learning seems almost spontaneous amongst children. This highlights the necessity to emphasize and accommodate differences between adult and children learners when designing GBL activities. This aspect has received little attention in the past and may deserve more consideration.

**Chapter 18: The Use of Motion Tracking Technologies in Serious Games to Enhance Rehabilitation in Stroke Patients:**

• **Summary:** In Chapter 18, Burton, Liu, Battersby, Brown, Sherkat, Standen, and Walker describe innovative experiments where motion tracking technologies were employed in a GBL environment to encourage users to perform rehabilitation exercises. They explain how serious games, and particularly gesture-based GBL, can be effective for rehabilitation, and present a comparison of the performance, features, and limitations of two systems based on both the Nintendo Wii™ technology and thermal and visual tracking.

• **Key Findings:** According to Burton, Liu, Battersby, Brown, Sherkat, Standen, and Walker, gesture-based serious games are effective media to motivate stroke survivors to perform rehabilita-
tion exercises early, intensively, and frequently, three conditions considered as primordial for effective rehabilitation.

Chapter 19: Digital Games: Changing Education, One Raid at a Time:

• **Summary:** In Chapter 19, Pivec and Pivec define and explain the requirements for successful educational video games. As prominent scholars in the field of GBL, Pivec and Pivec have contributed to an in-depth understanding of the cognitive and motivational aspects of video games. In Chapter 19, they describe the challenges faced by designers and instructors for the successful design and deployment of educational video games, and they provide relevant guidelines to address these issues.

• **Key Findings:** According to Pivec and Pivec, learning can only occur if games are designed appropriately and deployed in environments that are conducive to motivation. As such, game design and instructional environments are key to GBL success. While commercial games have great potential, their content may need to be modified or redesigned so that they can be more widely accepted and used as part of the curriculum, and open collaboration between developers and trainers should help the integration of GBL.

Chapter 20: The Magic Bullet: A Tool for Assessing and Evaluating Learning Potential in Games:

• **Summary:** Chapter 20 is written by Becker, an expert in the field of educational technology and instructional game design, whose research focuses on the design and analysis of commercial games for serious purposes. In this chapter, Becker highlights the lack of methodologies to assess digital learning resources, and emphasizes the need for a simple yet effective framework to evaluate educational video games. She presents *The Magic Bullet*, a model that classifies learning opportunities in video games, and provides a means to evaluate and compare educational video games.

• **Key Findings:** There are, to date, no definite tools to assess DGBL (Digital Game-Based Learning) solutions; such tools would be essential to evaluate the potential of DGBL, and without a thorough analysis of games as media, it is very difficult to know whether and to what extent they can be used in education. The magic bullet is an important step towards the systematic evaluation of DGBL.

Chapter 21: Collaborative Strategic Board Games as a Site for Distributed Computational Thinking:

• **Summary:** In Chapter 21, Berland and Lee explain how computational thinking can be supported in collaborative board games. They refine the distinction between digital and non-digital board games, and further clarify how this medium can spontaneously engage players in complex computational thinking, notably through a socially-distributed approach whereby players collaborate to create, understand, and apply rules. The authors also explain how computational thinking can be leveraged for instruction, and they reveal interesting research paths for board games, computational thinking, and participation in computational activities.

• **Key Findings:** Many contemporary board games could be used to develop and support computational thinking; however, more attention needs to be paid to relationships between game design features and computational thinking. In addition, board games have an appealing social and fam-
ily-oriented aspect; they bring together children, teenagers, and adults, and this unifying aspect ought to be explored to increase participation in computational thinking activities.

Chapter 22: Assessment through Achievement Systems: A Framework for Educational Game Design:

• Summary: In Chapter 22, Evans, Jennings, and Andreen propose to harness the potential of game achievement systems to measure learning and engagement in educational video games. They describe the concept of achievement from a psychological perspective, and illustrate how it applies to both traditional and game-based learning environments. They explain why assessment techniques employed in formal education, which usually focus on lower-level cognitive activities rather than higher-thinking skills, usually fail to assess students’ in-depth knowledge of the topic. Evans, Jennings, and Andreen then provide insights on how to successfully combine achievements systems and learning objectives in educational games, and they explain their theoretical framework, a framework partially based on well-received educational theories.

• Key Findings: Assessment techniques in GBL should be similar to those in place in traditional settings, and achievements systems could be valuable solutions in this case. These systems can also be useful to measure higher-thinking skills such as creativity, curiosity, or problem-solving activities, which would be difficult to measure otherwise.

Chapter 23: Understanding Computational Thinking before Programming: Developing Guidelines for the Design of Games to Learn Introductory Programming through Game-Play:

• Summary: In Chapter 23, Kazimoglu, Kiernan, Bacon, and MacKinnon propose an innovative approach to teach programming skills based on computational thinking and GBL. They explain that, despite a large body of evidence on GBL, very few educational video games are designed to teach programming skills properly. The authors have therefore designed a model that addresses some of the pitfalls found in current educational game design techniques. This model, based on constructivist theories, accounts for learning objectives, academic support, scaffolding strategies, gender and expertise neutrality, and activities based on both collaboration and competition. The implementation of these guidelines is then illustrated through the description of a video game developed by the authors, where players are encouraged to think computationally to solve puzzles.

• Key Findings: Although the study presents preliminary results, it shows that puzzle games developed to encourage computational thinking as part of a problem-based approach can help to learn programming. The literature included in Chapter 23 also provides interesting insights. It reveals that learning programming through games can be very efficient; however, designers need to pay attention to several important factors, to ensure that they obtain all the benefits offered by this medium: (1) competition can put students under pressure and disengage them from the activity; (2) games should be considered as problem solving activities so that students focus on learning from the game to solve challenges, and drill and practice activities should be avoided for deep learning unless conceptual knowledge is sought (i.e., rather than procedural or applied knowledge); (3) learning material should be part of the game play; (4) formative feedback ought to be included at the design and coding stages and not only when the application is executed; and (4) STEM (Science Technology Engineering and Mathematics) programming initiatives should focus on computational thinking rather than teaching programming code.
Chapter 24: Historical Perspectives on Games and Education from the Learning Sciences:

- **Summary:** In Chapter 24, Shelton, Satwicz, and Caswell analyze well-established educational theories from Piaget, Bruner, and Vygotsky, and assess their applicability to the design and development of GBL applications. Their chapter provides an in-depth explanation of the theoretical basis for these concepts, and identifies links between these theories, current technologies, and game activities. Shelton, Satwicz, and Caswell then analyze a video game entitled *Portal* in the light of these principles, and illustrate the intricate links that exist between game play, learning, and motivation.

- **Key Findings:** Play is a natural aspect of learning, and it takes place in many aspects of our lives, in both formal and informal environments. Learning through play is supported by several well-received and well-known educational scholars, including Bruner, Piaget, or Vygotsky. While several researchers have emphasized these links between learning and play, more empirical studies may be needed to analyze how these theories can be applied to GBL, and such efforts may be helped and supported by new and more accessible game authoring tools.

**INTENDED AUDIENCE**

This book is intended for all stakeholders closely or remotely involved in financing, designing, deploying and using Game-Based Learning solutions, including students, teachers, researchers, designers, and developers working in the fields of educational games development, e-learning, technology-enhanced education, multimedia, educational psychology, and information technology. The book includes a wide variety of chapters with both theoretical and practical information. Researchers, lecturers, and students will find detailed literature reviews, theoretical models, and the description and analysis of relevant experiments. Teachers and instructors interested in deploying GBL solutions will be able to learn from the experience of the authors, use guidelines, and appreciate the organizational, technical, and pedagogical requirements for such environments. Developers will find innovative and effective concepts to improve both the educational and motivational aspects of their games. Policy makers will be able to appreciate the changes needed to facilitate the inclusion of GBL.

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