INTRODUCTION

The term gaming has radically changed in the last few years as technologies that are mobile, multi-media, interactive, and collaborative have become more advanced and sophisticated. The process of gaming holds promise for advancing learning in P-12 education if designed and developed with educational goals and standards. The premise for this book is that gaming in P-12 Education has the potential to develop advanced knowledge and skills required by the learners while providing a transformative educational experience for both learners and teachers. In order to understand the potential of games in P-12 education this book brings together experts in multiple fields to develop a new understanding of the trends of gaming in education. As a result it provides a definitive guide for educators, researchers and game designers as we take early, but substantial steps towards a future where gaming is a core process in education. The Handbook is designed in strands that will bring together experts’ and practitioners’ voices on gaming in education. The result is that the Handbook of Research on Gaming Trends in P-12 Education is a holistic guide for trends in virtual immersive learning environments, gaming, as a transformative aspect of P-12 education.

To too great an extent current educational practice relies on past concepts of learning and knowledge that Carl Bereiter called “folk theories” (2002, pg.IX) of the mind. Folk theories of the mind are that the mind is a container that is filled by education. Advances in the cognitive sciences over the last 50 years have revised concepts of learning, mind and education but have not resulted in any major advances in the practical, day-to-day aspects of P-12 education. Most educational programs are struggling to meet standards that require high-stakes testing and a dictated curriculum that is taught in didactic methods based more on economic models of education than pedagogic models. As a result, most technologies are employed in ways that sustain the old system rather than challenge it with innovative new educational forums.

In a parallel path to the advances in cognitive science have been advances in computational capacity and networking bringing about waves of progressing interactive and visual computing connected by the Internet. Around 40% of the world population has an internet connection today. In 1995, it was less than 1%. The third billion was reached by the end of 2014. This has led to a rapid increase in the total information base known as the Knowledge Doubling Curve. Buckminster Fuller identified the Knowledge Doubling Curve noting that until 1900 human knowledge doubled approximately every century. By the end of World War II knowledge was doubling every 25 years. Today, on average, human knowledge is doubling every 13 months. Additionally, the current theory is that as a result of the “internet of things”, the Internet added to multiple devices, will lead to the doubling of knowledge every 12 hours (internetworldstatscom).
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The folk theory of education as putting information into learners becomes increasingly impossible when the sum total of all knowledge, the information base, is doubling twice a day! Education must instead focus on helping learners become knowledge workers who can respond to this constant deluge of information by using information to solve problems. Learner who, when faced with failure or challenges, can explore, research, and create knowledge.

There are many definitions of these knowledge workers but there are main ideas that run through them all. Knowledge workers are able to do complex problem-solving, drill down into information to understand patterns, evaluate information for relevance and accuracy, and create functional projects. The shift is from passive to active learning, from a focus on teaching about content to enabling learning through the application and search for knowledge, from standardization to customization, from breaking information down to building knowledge. These knowledge workers must be able to navigate the exponentially increasing information base and become the builders, creators and leaders who will be the core of the knowledge economies of the future. Education must change in core ways to develop knowledge workers. This requires a major rethinking- a paradigm shift- in the educational system.

Educational games, or immersive virtual learning environments, can provide engaging, relevant, and personalized learning experiences for all learners that mirror students’ daily lives and the reality of their futures as knowledge workers. These games may be the solution making the necessary paradigm shift in education possible.

SOLUTIONS

Into this complex changing dynamic of emerging transformative technologies, changing nature of teaching and learning, increased pedagogical challenges, increased diversity in classrooms, and the necessity for alternative assessments is the concept of gaming in education. Can gaming provide productive forums that are responsive to these issues? It is the premise of this book and the many authors that have contributed to it, that they can. Gaming when considered as an immersive learning environment designed for engagement, motivation, problem-solving and meaningful interactions can develop the types and qualities of learning processes, skills and knowledge required for knowledge workers. Gaming when it is designed and implemented as a forum for immersive virtual learning environment can flip the paradigm of education.

We believe that the nature of games as experiential, interactive, leveled, engaging, and challenging is the basis for systemic reform in education. The type of reform needed to create knowledge workers requires a comprehensive redesign of the nature of education that is based on the attributes of these learning environments, the characteristics of immersive learning, the constructivist pedagogy of the teaching and learning, and the necessity for education to develop immersive virtual learning environments that are tagged to standards and outcomes.

This book is a beginning of a systemic discussion of trends in gaming with chapters by experts in evaluative research of games, academics describing conceptual principals for gaming, gaming companies designing games for education and educators who are implementing games in their classrooms. This discussion on the viability of these transformative technologies and their potential gives us a broad perspective on the future of gaming in P-12 education and a starting point for creating a future for education that matches the challenges of our times.
ORGANIZATION OF THE BOOK

The Handbook of Research on Gaming Trends in P-12 Education is divided into four sections, theoretical research on gaming, pedagogical considerations of games, content specific cases, and gaming innovations research.

Section 1 contains chapters on theoretical research on gaming and includes essays on related philosophies of immersive learning including constructivism, cultural historical activity theory, telepresence, and the evaluation of learning in immersive learning environments.

In Chapter 1, Beyond Fun: Pintrich, Motivation to Learn, and Games for Learning, the authors, Mario Martinez-Garza, Douglas Clark, Deanne Adams and Stephen Killingsworth, present a discussion of a deeper view of motivation and learning by employing Pintrich’s synthesis of research on motivation to learn as a lens for examining (a) how popular game design conventions currently scaffold motivation to learn and (b) how game design conventions might be augmented to more effectively scaffold motivation to learn in the future.

In Chapter 2, Design and Implementation of an MMO: Approaches to Support Inquiry Learning with Games, Louisa Rosenheck, Susannah Gordon-Messer, Eric Klopfer and Jody Clarke-Midura examine how key elements of an implementation of The Radix Endeavor, a multiplayer online game for inquiry-based STEM learning, impact student and teacher experiences and support problem-solving and inquiry learning.

In Chapter 3, Games and their Embodied Learning Principles in the Classroom: Connecting Learning Theory to Practice, the author, Sam von Gillern, explores how educators can use games and their embodied learning principles as a source for student learning, motivation, and engagement. Each learning principle and activity is addressed with a summary of the concept, an example of how video games exemplify the concept, and practical methods for integrating the idea into classroom instruction through games and activities.

Chapter 4, In Game Design Frameworks and Reality Guides, Jouni Smed, Tomi Suovuo and Ilmari Lahti use the concept of reality guides to analyse the characteristics as applications that aim at assisting the user in the real world and to investigate the applicability of game design frameworks in a wider context of gaming in education.

In Chapter 5, The Design of Immersive Virtual Learning Environments Utilizing Problem-Based Learning Templates, Donna Russell describes the design of templates for the design of an immersive virtual learning environment that includes collaborative learning virtual worlds as problem-solving scenarios that engage students in virtual explorations of worlds.

Erdem Demiroz in Chapter 6, Kinesthetic Gaming, Cognition and Learning: Implications for P-12 Education, provides an overview of kinesthetic gaming, which is also called full-body gaming, as a new form of advanced human-computer interaction (HCI) allowing players to interact with games in more realistic and natural ways and investigates the philosophical foundations of kinesthetic game-playing by emphasizing the role of physical action on learning under the framework of cognitive theories and goes on to discuss possible implications in P-12 education.

Patrick O’Shea and Chris Campbell in Chapter 7, The Theory and Process Involved with Educational Augmented Reality Game Design, explore the issues associated with training teachers to become effective Augmented Reality game designers in their own educational settings.
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In Section 2, Pedagogical Concepts and Related Practice, the chapters identify and explore the pedagogical aspects of learning in games such as problem-based learning, and collaborative learning environments.

In chapter 8, Information Literacy in Virtual Environments: Changing Needs of P-12 Learners, Valerie Hill provides an overview of information literacy needs of P-12 learners in virtual environments. Using standards for 21st century learning from the American Library Association, examples highlight information literacy elements embedded in immersive learning environments, such as the Anne Frank simulation (a 3D replica of Amsterdam and the annex where Anne’s family hid) and a digital citizenship game built by students in the game of Minecraft where learners in virtual environments take on digital citizenship responsibilities.

In Chapter 9, Disciplinarily-Integrated Games: Generalizing Across Domains and Model Types, the authors Douglas Clark, Pratim Sengupta and Satyugjit Virk advance the idea that disciplinarily-integrated games are a generalizable template for supporting students in interpreting, manipulating, and translating across phenomenological and formal representations in support of a Science as Practice perspective.

Chapter 10, Playful Transition: Serious Games for the Middle School Years, Anne Snyder and Victori Van Voorhis provide game designers, instructors, and other stakeholders with an overview of the typical middle school student, as well as the role of serious games in middle school education. Drawing from a case study of an actual game under development, the authors present specific design principles in order to guide stakeholders in the design and use of serious games in the middle school classroom.

Chapter 11, Designing Alien Mysteries in Chatterdale: An Instructor’s Perspective, the authors, Stella K. Hadjistassou and Judith Molka-Danielsen, describe the design of a virtual science fiction scenario that was student-instigated. Students’ quests to unravel a mystery afford opportunities for active involvement and collaborative actions, engagement in verbal exchanges, and interaction with content and context.

In Chapter 12, Designing Digital Objects to Scaffold Learning, Grant Van Eaton and Douglas B Clark discuss the importance of digital objects in learning games to provide opportunities to scaffold teacher and student learning toward deeper epistemological understanding of the concepts they represent. Their findings highlight the importance of designs that (a) explicitly model the meaning of the representations in the learning environment, (b) provide opportunities for teachers and students to interact with the full range of the properties of the representational object, and (c) incentivize players to utilize representations in the environment to their full extent, such that the learning environment repeatedly reinforces the core concepts of the representation.

In chapter 13, Flipping the Paradigm of Education, Developing a Comprehensive Educational Program Integrating Virtual Immersive Learning Environments, Donna Russell defines a prototype for a comprehensive educational program that integrates virtual immersive learning environments into traditional educational settings to develop innovative educational programs.

In Chapter 14, An Examination of Pre-Service teachers’ Attitudes Toward Game-Based Learning, Scott Fredrickson, Patricia Hoehner, and Jane Ziebarth examine pre-service teachers’ attitudes toward game-based learning. Research participants included 30 pre-service teachers at a Midwest public university. The participants valued the usefulness of integrating games into the classroom. Playing games helped them focus on the topic and review what they had learned from the lecture.

In section 3 the chapters include conceptual chapters as well as research that describe current implementation or future trends in gaming in P-12 education. These chapters focus on practical issues including lessons learned and best practices.
In Chapter 15, *Using a Live Simulation to Teach Human Anatomy and the Diagnostic Process to High School Students*, Debra C. Burkey Piecka and Manetta Calinger describe and define role-play simulations as virtual missions for students. In this simulation, students become part of an emergency medical team aboard a National Institutes of Health (NIH) mercy ship traveling up the Amazon River.

Chapter 16, *Using Video Gameplay to Measure Achievement for Students with Disabilities: A New Perspective to Grading and Achievement Reporting Video*, the authors, Benjamin Gallegos, Michelle Kepple and Caitlyn Bukaty focus on the benefits and use of educational video game-based learning for students with disabilities. The authors discuss (1) current barriers hindering widespread adoption of video games for learning and assessment, (2) characteristics of video games being used for learning and assessment, (3) how gameplay data represents academic achievement for grading, and (4) the types of assessments available and considerations for implementation.

Philip Chappell and Douglas Agar in chapter 17, *The Creation of a Rubric for the Evaluation of Language Teaching and Learning Videogames*, report on the creation and evaluation of the Language Education Videogame Evaluation Rubric (LEVER) which will be of benefit to those involved in the teaching and learning of foreign languages.

In Chapter 18, *Can Pre-service Teachers Create Digital Game-Based Activities without Coding Knowledge?*, the authors, Phu Vu and Martonia Gaskill, examine five cases of pre-service teachers’ abilities and attitudes towards creating and using digital games in their future teaching.

Chapter 19, *Exploring the Impact of Free-form and Structured Digital Games on the Player Experience of Kindergarten and Primary School Students*, the authors, Sotiris Kirginas and Dimitris Gouscos, present results of a study that tested the hypothesis that the levels of kindergarten and primary school students’ positive emotions, engagement and positive experience are significantly different when playing free-form or structured digital games.

In Chapter 20, *Mission HydroSci: Distance Learning through Game-Based 3D Virtual Learning Environments*, that authors, James Laffey, Troy Sadler, Sean Goggins, Joseph Griffin and Ryan Babiuch, envision a learning product that integrates a game-based 3D VLE with a learning progressions approach to curriculum and innovative methods for teacher support and learning analytics. MHS uses an eight level game which at each level immerses students in a simulation environment for learning about water systems and then requires the student to put that knowledge into practice in a context of developing their competencies for scientific argumentation.

Elizabeth Rowe, Erin Bardar, Jodi Asbell-Clark, Christina Shane-Simpso and Su-Jen Roberts in Chapter 21, *Building Bridges, Teachers Leveraging Game-Based Implicit Science Learning in Physics Classrooms*, examine the student and teacher demographics, science content, instructional materials and methods, and game-based pedagogies as potential explanations for differences in learning outcomes.

Section 4, *Gaming Innovations*, contains chapters which are descriptive cases of new games or gaming related technologies. These chapters focus on highly innovative new aspects that are being developed or being planned.

In chapter 22, *The Use of Smart Toys in Learning Games*, Peter A. Smith and Shelly Welch describe use of toys and videogames in learning with the advent of new games like Activision’s Skylanders and Disney Infinity. These new approaches are introducing kids to a new level of interaction between the real and virtual. The chapter explores what smart toys are, how they are being used, and future applications of the technology.
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The authors of Chapter 23, Minecraft Schooling: Digital learning for Junior Years, Leonard Busuttil, Christina Grupetta, Vanessa Camilleri outline how Minecraft is being used in junior year settings by referring to academic literature as well as communities of practice available on the internet. The authors outline a set of activities incorporating Minecraft aimed at seven year olds which were designed to introduce a series of curricular topics in a class in a Maltese school.

Chapter 24, Designing a Learning Analytic System for Assessing Immersive Virtual Learning Environments, the authors, Donna Russell and Steve Wallis describe a template for the evaluation of learning in an educational game through an integrated system that can be linked to P-12 educational programs thereby augmenting their traditional programs and providing alternative instructional procedures, alternative learning processes for students and a standards-based assessment model.

Norman Jaklin and Roland Geraerts describe in Chapter 25, Navigating through Virtual Worlds: From Single Characters to Large Crowds, the implications of approaches for the design of crowd simulations and the features that impact learner navigation for games in education.

Chapter 26, Game-Based Learning with the Leap Motion Controller, Martin Ebner and Norbert Spot describe the development process of an educational application, a game target P-12 students. The authors describe the application itself and present the outcomes of a field study.

In Chapter 27, A Future Focus of Gaming: Soft Skills, the authors, DeAnna Proctor and Lenora Justice, discuss the instruction of soft skills training, such as communication, collaboration, decision-making, problem-solving, negotiation, and leadership in games and simulations as a future direction for the use of educational gaming in P-12 education.

This comprehensive Handbook of Research provides a thorough review of research on the multifaceted topic of gaming in education. As the technologies evolve and the educational system responds, this type of systematic review of trends can provide educators, parents, and academics a core conceptual basis for new understandings of the potential of gaming in education.

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REFERENCES