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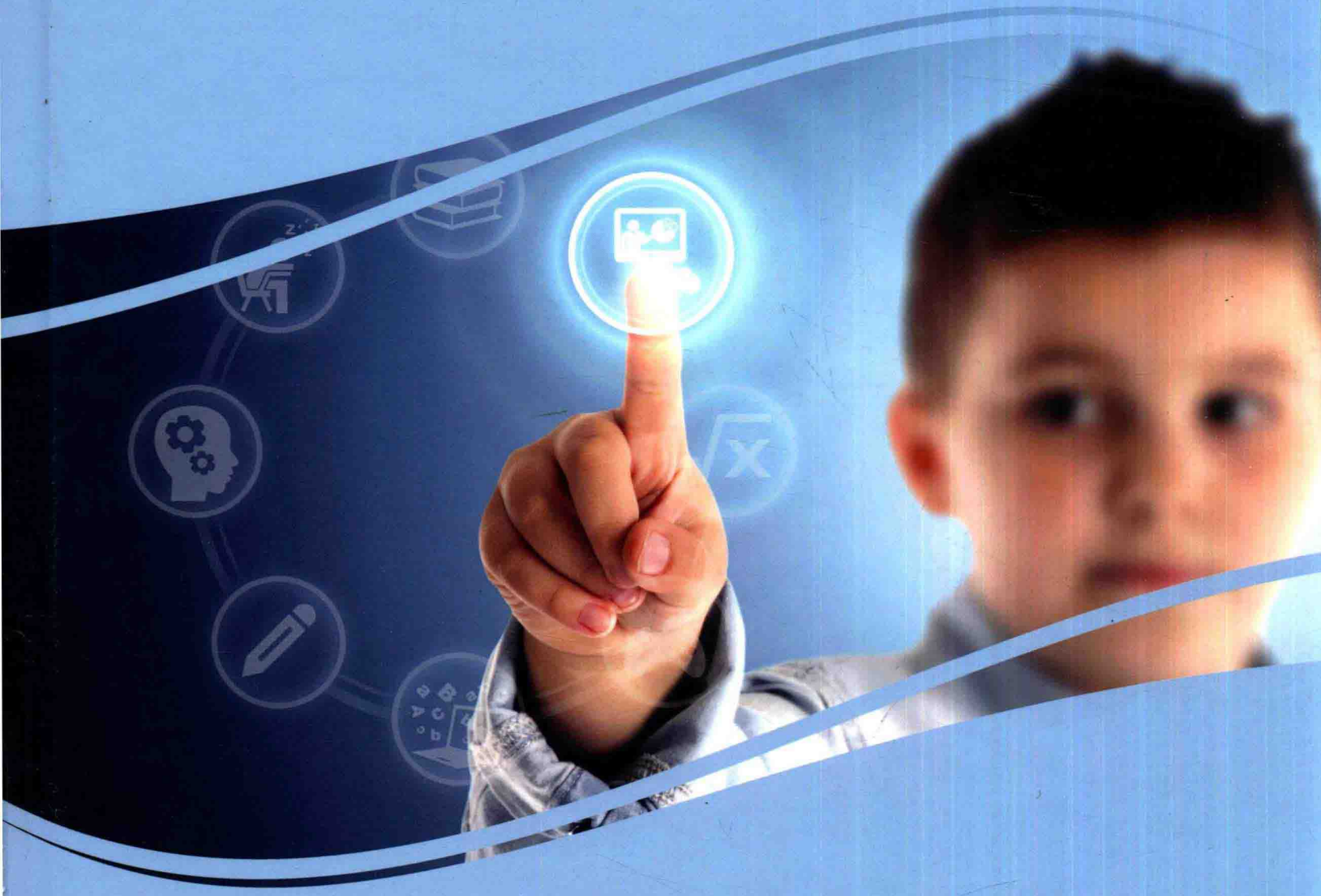
Emerging Tools and Applications of Virtual Reality in Education



Dong Hwa Choi, Amber Dailey-Hebert, and Judi Simmons Estes

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Emerging Tools and Applications of Virtual Reality in Education

Virtual reality is the next frontier of communication. As technology exponentially evolves, so do the ways in which humans interact and depend upon it. It only follows that to educate and stimulate the next generation of industry leaders, one must use the most innovative tools available. By coupling education with the most immersive technology available, teachers may inspire students in exciting new ways.

Emerging Tools and Applications of Virtual Reality in Education explores the potential and practical uses of virtual reality in classrooms with a focus on pedagogical and instructional outcomes and strategies. This title features current experiments in the use of augmented reality in teaching and highlights the effects it had on students. The authors also illustrate the use of technology in teaching the humanities, as students well-rounded in the fields of technology and communication are covetable in the workforce. This book will inspire educators, administrators, librarians, students of education, and virtual reality software developers to push the limits of their craft.

Topics Covered:

- Augmented Reality
- Ethics in Virtual Reality
- Faculty Perception of Augmented Reality
- Foreign Language Learning
- Mathematical Thinking
- Second Life® and Teacher Education
- Student Engagement
- Virtual 3-D Learning
- World of Warcraft® and Economics

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Education has undergone, and continues to undergo, immense changes in the way it is enacted and distributed to both child and adult learners. From distance education, Massive-Open-Online-Courses (MOOCs), and electronic tablets in the classroom, technology is now an integral part of the educational experience and is also affecting the way educators communicate information to students.

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This book is dedicated to educational pioneers everywhere who seek to explore opportunities to develop in meaningful and innovative ways as they learn through virtual reality—to all learners and practitioners who are becoming better equipped for the exciting future of the learning landscape that awaits us all.

In memory of my son, Jeremy Blake Estes, who got his first computer in 1983 at the age of 13 and thereafter they were inseparable. -JSE

Preface

In 1965, Ivan Sutherland posited, "There is no reason why the objects displayed by a computer have to follow the ordinary rules of physical reality with which we are familiar (Sutherland, 1965, para. 13); furthermore, "If the task of the display is to serve as a looking-glass into the mathematical wonderland constructed in computer memory, it should serve as many senses as possible (para. 9)." During the past fifty years, there has been a gradual development of what has come to be known as virtual reality, where ordinary rules of physical reality have been redefined and many senses are being experienced by users, as described in a seminal article by Mazuryk and Gervautz (1996). Today, through various visual and tactile devices, virtual reality (VR) can represent real or imaginary worlds in which the user interacts using multiple senses within a multimedia environment.

VR is being used for a variety of functions: (1) communication spaces, (2) simulation of space (spatial), and (3) experiential space ('acting' on the world), with research primary focused on three topics: participants' affective domain, learning outcomes and social interaction. (Hew & Cheung, 2012). Although the first VR systems were created for the military and aerospace industries, there has been a gradual emergence in the field of education; three-dimensional (3-D) immersive virtual worlds are being used in traditional and distance education classrooms in K-12 and higher education (Dickey, 2005). Applications include use of VR for virtual field trips (Castleberry & Evers, 2010), 3-D models to help students visualize mathematics and science concepts (Bradly & Farland-Smith, 2010; Sun, Lin, & Wan, 2010), and immersive learning environments (Becker & Schuertz, 2003; Orman, 2003).

Integration of virtual reality in educational settings has occurred more slowly than anticipated; "People don't change when you tell them they should, they change when they tell themselves they must" (Friedman, 2005, p. 462). Cuban, Kirkpatrick, and Peck (2001) found that teachers' age, experience, and gender were not significant factors in identifying why technology is not being integrated into instruction; it is a teacher's belief structure about teaching and learning that has been found to inhibit a teacher's development of the technology integration pedagogy. Teacher support was found to be critical in building teachers' confidence levels when first using technology (Redmann & Kotrlik, 2004); administrative support plays a critical role in a teacher's practice of integrating technology into classroom instruction (Shuldman, 2004).

VR holds a possibility for all, regardless of the field of application, "With the virtual reality acting in the education we can discover, explore and build knowledge about places and situations that we could never explore" (Piovesan, Passerino, & Pereira, 2012, p. 295). Perhaps, it is this possibility that has captured the curiosity and interest of the authors who have contributed to this edited collection which promotes research in the use of VR in education, with a focus on higher education. Even though, in higher education, VR has been adopted in areas such as the social sciences and medical fields, faculty

need to be more informed and educated about utilizing VR to enhance instruction. The chapters in this collection share possibilities, considerations, and evidence pertaining to the integration of VR and the unique attributes it provides to enrich the student learning process. This collection is sequenced to provide grounding in the existing and emergent research in VR, before moving on to applied models and general principles of practice across multiple disciplines in the field of education from K-12 to higher education. This collection offers a resource to benchmark and examine innovative practices and their linkage to educational settings as VR is connecting students and educators across the globe.

This collection illustrates the connected and globally networked nature of virtual reality in education, through ideas from authors working in five countries, (Australia, Italy, Turkey, United Kingdom, United States), in multiple domains of academia and industry, and across various disciplines. The characteristics and the evolving nature of VR is explored in unique settings from diverse and globalized viewpoints, providing a depth and breadth of understanding on this transformative topic. The collection also looks ahead to explore the next generation of VR in education, and unearths innovative solutions and ethical considerations for future use.

SECTION 1: UNDERSTANDING VIRTUAL REALITY

This collection appropriately begins with four chapters, collectively setting a foundational understanding of VR as a technology that has evolved in the past 26 years, with advances in applications and uses that have included a broadening of definition as well as K-12 and higher education practices unimaginable in 1989 when the term "virtual reality" was coined.

First, in Chapter 1, Nicoletta Melida Sala (Italy) reviews virtual reality-based developments in educational environments. This chapter explores examples of virtual reality in various learning contexts, from primary schools to graduate courses. The author also shares didactical applications in the fields of medical training, foreign language acquisition, chemistry, engineering, architecture and interior design from a global perspective; exploring virtual reality in the United States, Italy, Morocco, Romania, and Switzerland. Conclusively, the author stresses the appreciation for virtual reality in diverse learning environments, and establishes an expectation for potential use of virtual reality as an evolutionary teaching and learning tool.

Building upon this world view, and narrowing the focus more specifically to the context of higher education, Reza Ghanbarzadeh and Amir Hossein Ghapanchi (Australia) provide a robust review of literature on virtual worlds in Chapter 2. This literature review analyzes 164 articles from eight major databases, including both empirical and technical studies on the topic of VR in higher education. These articles were published during the 14 years from 1999-2013. The authors identify five main curricular activities for which three dimensional virtual worlds (3DVW) have been used to date, as well as categorizing 17 virtual environments identified from the literature review. Consequently, the authors provide a framework to discuss various platforms and virtual environments used for educational purposes that emerge.

In Chapter 3, Anita Cassard and Brian W. Sloboda (United States) present information on the methods and approaches used to assess student learning outcomes in virtual environments. The authors explore ADDIE (Analysis, Design, Development, Implementation, and Evaluation) enhanced learning and construct a stance to empower faculty to carefully assess student learning outcomes, which can also be used to support a rationale for the desired integration of virtual reality in learning contexts. The authors

suggest that assessment in the virtual environment needs to be enlightened on multiple levels in education, which include diversifying strategies to assess learning outcomes and to assess quality control of three-dimensional (3D) learning platforms. This stance implies that a comprehensive view of assessment issues in virtual environments is essential.

In Chapter 4, James Braman and Yvonne Pigatt (United States) share the implications and lessons learned from their interactive virtual reality project using Second Life as a means to increase student engagement in a community college course. They offer an outline of project requirements, didactical strategies, and pedagogical methodologies from their experiment, and describe the aims of their continued and future work. This chapter concludes with recommendations that are applied to the integration of virtual reality within the higher education coursework.

SECTION 2: VIRTUAL REALITY ACROSS THE DISCIPLINES

Several chapters on virtual reality, in education, across a broad range of course contexts and disciplines, are included in Section II. Each chapter shares a view of virtual reality as a pedagogical tool used to improve student engagement and learning. By providing opportunities to be immersed in natural phenomena, learners can apply knowledge through experience, which contributes to the acquisition of knowledge. These chapters include fields such as teacher preparation, economics, foreign language, mathematics and tourism marketing, each using a variety of tools, platforms, and technologies in the virtual reality landscape.

In Chapter 5, Barbara L. Ludlow and Melissa D. Hartley (United States) describe an application of virtual reality to train graduate level learners in a teacher education program leading to certification in special education (via courses offered online). The authors adopt Constructivism as a pedagogical framework and utilize Second Life to optimize situated and active learning through simulation, as they share ways to bridge the theoretical and practical issues of using virtual reality. The chapter deepens the arguments of the subject and share learners' comments on their training to suggest recommendations for practitioners.

In Chapter 6, the topic shifts from teacher preparation to the field of teaching economics and move from Second Life to the World of Warcraft, one of the most popular Massively Multi-Player On-Line Role-Playing Games (MMORPGs). In this chapter, Andras Margitay-Becht (United States) provides the history of the development of the World of Warcraft and its application in an academic setting. This chapter serves as a guide for professionals who seek to design a more immersive class experience, one which allows learners to build conceptual knowledge while applying principles directly in practice. Real world elements such as trade, production, and cooperation are applied via gamification and can lead to improved retention of student learning as a result.

In Chapter 7, Ellen Yeh and Guofang Wan (United States) provide a systemic review of existing literature on successful models to integrate virtual worlds for foreign language learning. The authors present the pedagogical advantages and technical challenges for using virtual worlds as a collaborative learning tool for foreign language instruction. The impact of integrating the virtual world results in not only improving leaners' communicative skills but the effect can also be observed on individual's competency on social-emotional and cultural levels. Lastly, implications are presented for teaching strategies, assessment tools, administrative support, and professional development programs.

Next, Azizul Hassan and Timothy Jung (United Kingdom) explore the use of augmented reality as a marketing strategy and as a means of marketing education in tourism. The authors present several exemplary cases of applying augmented reality (AR; one of the more advanced and innovative forms of VR) to meet the current trends and demand in the field of business. Interestingly, use of AR as an innovative technology has well established its position in consumers' lifestyle; however, in educational settings, it still remains at the early stage. Conclusively, the chapter proposes that AR should become easily available and accessible to students and practitioners for educational, as well as business, purposes.

Chapter 9 shifts to the discipline of mathematics, as Rebecca Lynne Patterson, D. Cooper Patterson, and Anna-Marie Roberston (United States) explore how virtual reality can revolutionize mathematical thinking. These authors describe how Second Life can be used as a creative space for prototyping, publishing and as a design studio for educational materials, with the power to immerse learners in the shape of numbers through engagement.

SECTION 3: NEXT GENERATION OF LEARNING – CATALYSTS & CONSIDERATIONS IN VIRTUAL REALITY

In this last section of the collection, readers are challenged to explore innovative uses for virtual reality, and also share critical issues to consider in the future.

In Chapter 10, Noah L. Schroeder (United States) introduces the concept of 'pedagogical agents', or virtual characters which facilitate learning in multimedia environments. In this chapter, the author shares research that describes how such agents can be used in learning, explores their effectiveness, and shares potential applications for their use in the future.

In Chapter 11, Celebi Uluyol and Sami Sahin (Turkey) continue with innovative applications for learning in virtual reality in their work on "Connecting Printed Materials with Digital Objects". The use of augmented reality in diverse professional areas are introduced and highlight the benefits of augmented reality (AR) as a means to connect ideas and digital objects through an augmented reality book in education settings. The contribution of augmented reality to learning is discussed on multiple levels.

To continue the exploration of innovative practices using emergent VR tools, in Chapter 12, Amit Goel, William Rivera, Peter J. Kincaid, Michele M. Montgomery, Waldemar Karwowski and Neil M. Finkelstein (United States) provide a critical perspective on ethics in a variety of fields using virtual world environments and present research that exists on the topic. This chapter provides the reader with provocative questions to consider and highlights the responsibility of all researchers and practitioners in this burgeoning field of VR, particularly the need to create awareness for ethical practices.

VR is one of the latest technologies to be integrated into the teaching-learning process. In Chapter 13, Judi Simmons Estes, Amber Dailey-Hebert, and Dong Hwa Choi emphasize that given teachers pivotal role in the process of technology integration, it is imperative to train teachers in computer literacy and the technological skills needed to integrate technology in instruction. The authors propose that training should also include developing a pedagogy and self-efficacy for technology integration.

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Understanding Virtual Reality in Education

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