# International Journal of Advanced Virtual Reality

# Book Review: Mixed Reality for Education

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**Abstract**

The book, "'Mixed Reality for Education"' has been published within the esteemed "Gaming Media and Social Effects" series, known for its interdisciplinary approach encompassing the technical facets of gaming, both software and hardware, and its sociological and psychological impacts. Functioning as a swift avenue for disseminating high-caliber works on burgeoning or pivotal subjects in gaming and its societal repercussions, this series caters to diverse exposition levels. It accommodates a spectrum ranging from introductory tutorials to advanced research topics, aligning with the varied objectives of the contributing authors. In the realm of educational literature, "Mixed Reality for Education" emerges as a pioneering addition to the distinguished series curated by Cai, Mangina, and Goei (Editors). The book, comprising sixteen meticulously crafted chapters, is intricately structured into four distinct sections. These sections traverse the diverse landscapes of K-12 Science, Technology, Engineering, Art, and Mathematics (STEAM) Education, Tertiary/Professional Education, Special Needs Education, and Cultural, Social & Museum Education.

## Contents

## How to Cite

## 1. K-12 STEAM Education

"Mixed Reality for Education" unfolds its scholarly commencing with Section I dedicated to K-12 STEAM Education. This section, comprising five insightful chapters, presents a rich tapestry of innovative approaches and applications.

Chapter Highlights:

1. Chapter 2: "aMazing Walk-through Mathematics" Ulbrich, Haas, Elbedewy, and Lavicza illuminate the interdisciplinary landscape in Chap. 2. Their work delves into positive stimulation and heightened participant engagement through experiments involving mazes and labyrinths. The chapter serves as a valuable resource for pre-service mathematics teachers, imparting 3D modeling, AR, and 3D printing skills.

2. Chapter 3: "Architectural Models with Mixed Reality Technologies" Elbedewy, Haas, and Lavisca contribute to a new STEAM practice in Chap. 3. Through the incorporation of Dynamic Geometry Software, AR, VR, CAD, and 3D Printing, students engage in inquiry-based principles. The chapter accentuates

the importance of principles that encourage engagement, exploration, explanation, elaboration, and evaluation.

3. Chapter 4: "Application of Meta-Modeling Knowledge in VR" Jansen, Aung, Taib, Cai, and van Joolingen delve into the application of prior meta-modeling knowledge in Chap. 4. Focused on a VR model of a biological process, the study explores students' ability to extend meta-modeling knowledge gained from 2D models. The pre-and post-tests underscore the significance of integrating meta-modeling knowledge into teaching, both in 2D and VR models.

4. Chapter 5: "Systematic Review of Pedagogy in Mixed Reality" Ramnarain and Penn conduct a meticulous systematic review in Chap. 5, shedding light on pedagogical strategies in mixed reality for K-12 education. Their findings advocate for a guiding framework to optimally exploit technology affordances, fostering content understanding, long-term memory retention, enhanced physical task performance, and increased learner motivation.

5. Chapter 6: "Transforming Learning Experiences through VR and AR" In the final chapter of this section, Choon and Cai present transformative research in Chap. 6. Their exploration revolves around the affordances of virtual and augmented reality, aiming to enhance learning experiences within the secondary school curriculum.

## 2. Tertiary/Professional Education

Diverse Insights into Tertiary and Professional Education: The second section of "Mixed Reality for Education" delves into the realm of Tertiary/Professional Education, comprising six chapters that intricately dissect the applications and impact of mixed reality in advanced educational domains.

Chapter Highlights:

1. Chapter 7: "Virtual Final Year Project Exhibition" In Chap. 7, Movania, Samad, and Raza embark on an exploration of the Mozilla®Hubs®platform, unfolding the intricacies of a virtual final year project exhibition. This chapter illuminates the utilization of virtual replicas to showcase students' posters and presentations, employing virtual avatars to enhance the immersive experience.

2. Chapter 8: "VRLE-based Teaching for Medical Students" Ryan, Murphy, McAuliffe, and Mangina unravel the potential of VRLE-based teaching in Chap. 8. The focus is on VR-Baby, a tool designed to augment the understanding of complex topics in Obstetrics and Gynaecology Education. The chapter details

the development of a 3D model of fetal circulation within a VRLE, aligning with specific pedagogical objectives.

3. Chapter 9: "Immersive and Interactive VR for Tower Crane Lifting Training" In Chap. 9, Yu, Huang, Ooi, and Cai delve into immersive and interactive VR for tower crane lifting training. The chapter outlines the development of VR technology that encompasses fidelity modeling, immersive visualization, real-time interaction, and natural user interface, with a primary focus on enhancing safety and productivity in a simulated construction environment.

4. Chapter 10: "Systematic Review of Mixed Reality in Veterinary Education" Chap. 10, authored by Xu, Kilroy, Kumar, Iqbal, Mangina, and Campbell, undertakes a systematic review of mixed reality applications in tertiary veterinary education. The chapter provides a comprehensive analysis based on an intensive search across multiple databases, contributing valuable insights into the evolving landscape of veterinary education.

5. Chapter 11: "Gestural Agency in Collaborative Simulations" Planey and Lindgren, in Chap. 11, report on the exploration of gestural agency in collaborative mixed-reality simulations. Focused on the crosscutting concept of "rates of change," the chapter delves into the theories, design, and analysis applied to these simulations, offering a nuanced understanding of collaborative embodied learning.

6. Chapter 12: "Efficacy of Wearable Devices for Aircraft Maintenance" In the final chapter of this section, Chap. 12, Ng, Azam, and Cai scrutinize the efficacy of wearable devices for virtual reality-based aircraft maintenance tasks. This chapter provides valuable insights into the intersection of wearable technology and virtual reality, particularly in the context of aircraft maintenance procedures.

## 3. Special Needs Education

Innovative Approaches in Special Needs Education: The third section of "Mixed Reality for Education" unveils a focused exploration of Special Needs Education, encapsulated within two thought-provoking chapters that delve into pioneering applications of mixed reality in addressing the unique requirements of diverse learners.

Chapter Highlights:

1. Chapter 13: "AR Digital Literacy Intervention for ADHD Students" In Chap. 13, Psyrra, Mangina, and Treacy present a compelling case study revolving around an AR digital literacy intervention tailored

for students diagnosed with ADHD. The chapter meticulously evaluates the impact of AR, digital, and conventional literacy programs on participants' literacy skills. Employing a pre-post assessment methodology, the study leverages data from the "ADHD AUGMENTED" pilot project, shedding light on the efficacy of these interventions compared to traditional learning methods.

2. Chapter 14: "AR Interactive Components for Behaviour Management" Chiazesse, Goei, Tostino, and Mangina, in Chap. 14, contribute to the discourse by discussing the development of AR interactive components for behavior management within classroom settings. Executed within the AR Interactive Educational System (ARETE) project, this study investigates the user design perspective in embedding AR into behavioral lessons. The research unfolds within the Positive Behavior Interventions & Support (PBIS) framework, a school-wide approach promoting prosocial behavior and ensuring a safe, positive, and predictable school climate.

## 4. Cultural, Social, and Museum Education

Enriching Cultural, Social, and Museum Education Through Mixed Reality: The fourth section of "Mixed Reality for Education" unfolds with an enriching exploration of Cultural, Social, and Museum Education, featuring three chapters that delve into the transformative applications of mixed reality within diverse educational landscapes.

Chapter Highlights:

1. Chapter 15: "New Framework for Learning Patterns in VR-Enhanced Learning" Eriksson and Sunnerstam, in Chap. 15, introduce a groundbreaking framework that redefines learning patterns and social presence in VR-enhanced learning environments. The chapter seamlessly amalgamates existing concepts and frameworks from virtual reality research and teaching methodology studies. This innovative approach contributes to an enhanced understanding of how virtual reality can reshape learning experiences and social interactions.

2. Chapter 16: "Security, Ethics, and Privacy Issues in Remote Extended Reality" Chap. 16, authored by Iqbal, Xu, Nallur, Scanlon, and Campbell, critically examines the Security, Ethics, and Privacy issues entailed in Remote Extended Reality for Education. The study meticulously explores the human value embedded in Extended Reality (XR) for learning in remote settings, emphasizing the need for responsible design and usage. This chapter serves as a thoughtful exploration of ethical considerations in the ever-

evolving landscape of extended reality education.

3. Chapter 17: "Immersive Learning Environment in Science Museums" Gu, Li, Ye, Wang, and Luo, in Chap. 17, present an immersive learning environment designed to enhance user experiences within science museums. The study introduces a construction framework aimed at systematically building immersive learning environments. Notably, force feedback technology is integrated into the framework to heighten haptic perception, ensuring a more immersive and engaging learning encounter.

## 5. Conclusion

Educators must stay abreast of the ongoing digital revolution in education, driven by Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), bringing about transformative changes that enhance the effectiveness and inclusivity of education. Whether you're already incorporating VR/AR/MR in teaching, this book aims to inspire with examples, exploring anticipated improvements, impacts, and critical considerations like safety, security, ethics, and privacy. For VR/AR/MR practitioners, recognizing education as a revolutionary domain is crucial. This book addresses the challenge of articulating convincing reference cases to potential clients, presenting best practices in K-12 STEAM education, tertiary/professional education, special needs education, and cultural, social, and museum education. The underlying philosophies might spark innovative ideas for applying VR/AR/MR in diverse fields.

The exploration extends to the Metaverse, a futuristic concept gaining attention. Users perceive the outside world as a universe built on digital technologies, be it a distinct universe in VR, a digital extension in AR/MR, or a digital counterpart as a "Digital Twin." The Metaverse signifies an advanced stage in digital transformation, expected to significantly impact daily life, work, and recreation across all industries. Kudos to Prof. Yiyu Cai et al. for their pioneering work in the Gaming Media and Social Effects book series, contributing to our understanding of education in the imminent Metaverse era. It is hoped that this book will aid to your learning journey in education, VR/AR/MR applications, and exploration into the Metaverse. As a great resource, the book not only enriches the academic discourse but also lays a foundation for educators and researchers seeking innovative strategies to enhance learning within cultural and social contexts.