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Immersive Learning Research Network

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Proceedings

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iLRN 2019 Preface

These are the curated works of the 5th Annual Immersive Learning Research Network, or iLRN – an international network of developers, educators, and research professionals developing and sharing the scientific, technical, and applied potential of immersive learning. iLRN seeks out, innovates, and shares the evidence for high-quality immersive learning across the disciplines. Research demonstrates that effective immersive learning experiences – those where the learner feels “situated” within an ecologically rich, digitally enhanced space requires applied fundamental knowledge in three connected bodies of expertise: computer science, game studies, and the learning sciences. This is the “fundamental DNA of every good immersive learning experience.” Of course, there are myriad techniques within a host of different media and every conceivable area for application of these immersive experiences, thus, employing a wealth of knowledge that spans virtually every discipline. The Immersive Learning Research Network vision is to create a productive dialogue and co-design opportunities for computer, gaming, and learning scientists to collaborate and meaningfully connect with teachers, industry, and everyone to create and practice the use of immersive experiences of the highest quality.

One way of doing this is by hosting annual meetings of scholar-designers from across the disciplines by immersing for a week within a unique host city. Beginning in 2015 in Prague, Czech Republic, iLRN has convened in North America and Europe in respective years. These conferences support and create opportunities for iLRN members to meet and collaborate in collaborative contexts, build professional immersive learning research and development capacity, and share experiences in various practice-based and scientific tracks in a variety of formats. More than this, iLRN has become an incubator where members collaboratively develop a comprehensive research and outreach agenda encompassing the breadth and scope of learning possibilities, emerging technology capabilities, and addressing the challenges using immersive learning environments. We have an official podcast, a growing knowledge base, and ever-new network services to assist scholars and designers at various stages of their career to create and share new knowledge in this exciting, innovative, and powerful experiential learning arena.

This year, 2019, marked the 5th Annual iLRN conference, hosted at the University of Westminster in London, UK. Appropriately, this year’s iLRN special call/theme was: “The Immersive City.” Founded by the Romans in 43 AD along the River Thames, London is among the oldest of the world’s great cities—its history spanning nearly two millennia—and one of the most cosmopolitan. By far Britain’s largest metropolis, London is also the country’s economic, transportation, and cultural center. The immersive learning landscape of London includes small, agile entrepreneurs as well as long-standing giants in a densely packed, information-rich concrete, digital, commerce, and arts playground and marketplace.

iLRN 2019 in London, UK, was a unique opportunity for the iLRN community to encompass the views of architects, urban planners, sustainability experts, and others

focused on life and learning in the city to discuss and share the use of immersive learning environments for improving cities and people's lives. Sustainable urban living, civic engagement, generative growth, city simulations and forecasts, transportation, food, water, energy, pollution, and waste systems, sensor networks, algorithmic design, and the intersection of virtually every other technological and socioeconomic trend on the planet with respect to urban environments intertwined at iLRN 2019. Imagine if cities were designed with augmented reality, virtual reality, and cross reality in mind. Consider how immersive digital environments may be used to help people better understand and create urban spaces. Attendees of iLRN 2019 helped establish the emerging community within our network focusing on urban environments for a better tomorrow.

Like all iLRN conferences, iLRN 2019 was an important forum for immersive learning research. The call for papers resulted in over 60 research submissions from around the world. Every submission underwent a rigorous review by at least three members of the Program Committee to maintain high scientific and quality standards. The editorial board decided, based on the reviewers' comments, to accept nine full and eight long papers for the Springer proceedings, which is an acceptance rate of 28.3%. The papers are arranged into two parts of the proceedings, the main track and the special tracks. The accepted papers' authors are from Brazil, Cyprus, England (Brighton, Durham, Essex [2], London, Reading), Germany, Scotland (2) and the USA (Arkansas, California [3], Florida, Missouri, Ohio).

We would like to thank all who contributed to the success of this conference, in particular the members of the iLRN committee (and the additional reviewers) for carefully reviewing the contributions and selecting a high-quality program. Our general chair, Michael Gardner, and scientific chair, Christian Gütl did a wonderful job in organizing and coordinating the conference details. Leonel Morgado and Christian Eckhardt performed admirably as program co-chairs, handling the development of a rigorous program, and Johanna Pirker and Roxane Koitz-Hristov did the same for the special tracks. Dennis Beck, Anasol Peña-Rios, and Todd Ogle prepared this volume with care and professionalism. And of course, we would like to especially thank Daphne Economou and Markos Mentzelopoulos, iLRN 2019 local co-chairs, for taking care of the local arrangements and many other aspects in the organization of the conference.

We also need to thank the following people for their excellent work as special track co-chairs:

- Johanna Pirker, Foaad Khosmood, Kai Erenli, and Roxane Koitz-Hristov – Immersive and Engaging Educational Experiences Special Track
- Nabil Zary, Fernando Bello, and Pascal Staccini – Immersive Medical Education Special Track
- Giuliana Dettori – Self-Regulated Learning in Immersive Environments
- Catherine Cassidy, Jonathon Richter, and Alan Miller – Platforms for Digital Heritage and Preservation Special Track
- Patricia Charlton and George Magoulas – Reshaping Learning for All in Immersive Learning Environments Through Creative Learning Special Track

- Vic Callaghan, Jennifer O'Connor, Michael Gardner, Tiina Kymäläinen, Simon Egerton, Anasol Peña-Rios, Angélica Reyes, Jonathon Richter, Minjuan Wang, Jen Wu, Victor Zamudio, Shumei Zhang, and Ping Zhang – The Future of Education Special Track

We hope that you enjoy reading the content of these proceedings. We encourage you to browse the papers, reflect on the interdisciplinary connections and applications, contact the authors to continue discussions, and immerse yourself in the city – the future of urban learning with immersive technologies.

Jonathon Richter
Michael Gardner
Christian Gütl
Dennis Beck
Anasol Peña-Rios
Todd Ogle

iLRN 2019 Main Conference Preface

ILRN 2019 was the fifth annual international conference of the Immersive Learning Research Network (iLRN). It followed on from the previous edition held in Missoula in June 2018. The topic is becoming increasingly relevant as the power and affordability of suitable computers, mobile devices, network connectivity, and interface technologies have made virtual and augmented reality environments more accessible than ever before. The vision of the iLRN is to develop a comprehensive research and outreach agenda that encompasses the breadth and scope of learning potentialities, affordances, and challenges of immersive learning environments. To achieve this, the iLRN mission is to invite and organize scientists, practitioners, organizations, and innovators across the disciplines to explore, describe, and apply the optimal use of immersive worlds and environments for educational purposes. Further, the conference, meetings, and virtual symposia aim to build capacity to explain and demonstrate how these immersive learning environments best work using a variety of rigorous, systematic, and meaningful research methods and outreach strategies. To achieve this, ILRN has invited scientists, practitioners, organizations, and innovators across all disciplines to report on their research in the ILRN 2019 international conference. We received 63 papers for this event and after a rigorous reviewing process 18 were selected as full papers for this Springer publication (30% acceptance rate). The authors of these papers hail from Austria, Australia, Cyprus, England, Germany, Portugal, Saudi Arabia, Scotland, and in the United States, Arkansas, California, Florida, Ohio, and Pennsylvania.

Papers in the main conference report on the use of immersive learning environments to address a variety of educational challenges.

Jambi et al. exhibit the effects of an interactive role-play learning activity, supported within a multi-user virtual environment, on the learning process. Chehimi et al. introduce a new method that is user-driven, not researcher-driven, which adapts to the varying cognitive and physical states people go through in MR, and utilize empathy maps to capture feelings, thoughts, actions and verbal expressions from a first-person perspective. On the basis of the Educational Framework for Immersive Learning, Dengel et al. developed a research model including the factors presence, immersion, cognitive abilities, motivation, and emotion. Rhodes et al. explore the development and reception of the Virtual Time Binoculars platform – a system for delivering virtual reality (VR) heritage apps suitable for use on most smartphones, and outline the historical and technical challenges of modelling Edinburgh's sixteenth-century cityscape. Cassidy et al. review a VR framework implemented into an exhibit in three cultural heritage centers. By taking advantage of existing visitor digital literacies, the exhibit provided accessible immersive exploratory experiences for inter-generational audiences. To gain a better understanding on the role of immersive learning in regard to one's intuition on the order of magnitude and scale, Brown et al. developed a semi-tangible VR application that serves as virtual learning environment (VLE). Webb et al. investigated whether the addition of haptics (virtual touch) to a 3D VR simulation

promotes understanding of key nanoscale concepts in membrane systems for students aged 12–13 by developing a virtual model of a section of the cell membrane and a haptic enabled interface that enables students to interact with the model and to manipulate objects in the model. Hadwen-Bennett et al. present an Adaptive Hypermedia Driven Serious Game based around Pask’s holist-serialist dimension of cognitive style to explore the potential value of adaptive hypermedia and game-based learning. Chu et al. developed and evaluated an interactive, real-time, and real-scale VR application used to understand the theory of special relativity by conducting a user study to find correlations between their perceived immersion during and after the simulation and their acquisition of special relativity theory. Schmidt et al. present the formative design and evaluation of Virtuoso, an immersive learning intervention for adults significantly impacted by autism, consisting of two components: a spherical, video-based VR intervention, and a headset-based VR intervention. To investigate the usability of prototypes from the perspective of the end-users and their activities, Doumanis et al. describe their experiences in using a single-perspective method for gathering user requirements in the Real and Virtual Engagement In Realistic Immersive Environment project. To enrich geoscience education, Klippel et al. developed and evaluated an immersive virtual field trip in previous small-scale studies, in order to make it accessible to larger audiences. Samaroudi et al. investigated digitally fabricated replicas and how these contribute as novel interpretative means to support visitor experiences in cultural heritage contexts by evaluate the experience that visually impaired users had with a 3D printed relief of a Victorian environmental display, or diorama, from the Booth Museum of Natural History in Brighton (UK) along with a pervasive audio mobile application. Alsaqqaf et al. aim to provide a conceptual framework to facilitate the designing of virtual field trip games, since there is a need for an alternative way to provide learners with rich field trip and fieldwork experience. Extending prior research in game-based learning, Georgiou et al. investigated children’s immersion in a high-embodied digital learning game integrated in an authentic school classroom, in comparison with a low-embodied digital version of the game. Longford et al. outline the results of a Modified System for the Multiple Level Observation of Groups analysis for group formation, structure and interactions by discussing why groups can be beneficial to student learning in education, but also how misusing groups has negative effects. Osking et al. state and evaluate the hypothesis, that dialogue control systems used in VR experiences are often adapted from older media, therefore a voice control dialogue system may preserve this illusion and thereby enhance the emotional impact of narrative experiences.

We hope you will find this collection of papers informative and engaging. We encourage you to join ILRN and participate in future events.

Leonel Morgado
Christian Eckhardt
iLRN 2019 Main Conference Programme Co-chairs

Special Tracks Preface

Immersive digital learning is a continuously growing research area that has made a considerable impact during the past few years. Yet, a grand challenge and opportunity of this complex and expanding research area lie in the topic's interdisciplinary and expansive nature. Immersive learning comprises various disciplines per se and hence fosters collaboration between specialists from different fields and areas of expertise. After our successful experiences at iLRN 2015, we have continued to organize special tracks as a way to unite experts from numerous disciplines to exchange ideas and research insights in focused areas.

This year, we again invited scientist and practitioners from various research fields to submit tracks on different areas of immersive learning. iLRN 2019 hosted two special tracks covering the following topics:

- The track “Platforms for Digital Heritage and Preservation” chaired by Catherine Cassidy from the University of St. Andrews, Jonathon Richter from Salish Kootenai College, as well as Alan Miller from Smart History aimed at technology, such as platforms or frameworks, that enables current and future opportunities in digital heritage.
- In the track “Immersive and Engaging Educational Experiences,” the track chairs, Johanna Pirker from Graz University of Technology, Foaad Khosmood from California Polytechnic State University, Kai Erenli from University of Applied Science BFI Vienna and Roxane Koitz-Hristov, Graz University of Technology, invited participants to discuss the potential of immersive and engaging learning environments as teaching and training tools.

For the special tracks, 16 submissions were received, of which six were chosen as full papers to be published in the Springer proceedings, for an overall acceptance rate of 37.5%.

We would like express our sincere thanks to all special track chairs and reviewers for their commitment; the high-quality research and presentations of the special tracks on different research topics in immersive learning are a vital part of the conference. Hence, we thank each individual who worked toward making the special tracks this integral part of the main conference.

Johanna Pirker
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