Practitioner Proceedings of the 8th International Conference of the Immersive Learning Research Network (iLRN 2022)

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Date and Venue
Vienna, Austria and Online.

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Following two years of innovative fully online and in-VR conferences at the 2021 and 2020 editions, the 8th annual International Conference of the Immersive Learning Research Network (iLRN2022) was the first iLRN event to offer a hybrid experience, with two days of presentations and activities on the iLRN Virtual Campus (powered by ©Virbela), followed by three days on location at the FH University of Applied Sciences BFI in Vienna, Austria.

This year's conference offered scholars and professionals working from informal and formal education settings, as well as those representing diverse industry sectors, the opportunity to share their research findings, experiences, and insights; to network and establish partnerships to envision and shape the future of XR and immersive technologies for learning; and to contribute to the emerging scholarly knowledge base on how these technologies can be used to create experiences that educate, engage, and excite learners.

To achieve this, iLRN invited scientists, practitioners, organizations, and innovators across disciplines to report on their research at the iLRN2022 international conference. This year's theme, *DISRUPTION, INNOVATION & RESILIENCY: becoming an inclusive & robust global community for immersive learning*, fostered a flourishing global network of researchers and practitioners collaborating to develop the scientific, technical, and applied potential of immersive learning.

Our online meeting hosted the Metaverse Adventures series for the first time, inviting prominent speakers that explored different aspects of the metaverse: from representations of poverty in videogames to gamification, intelligent NFTs and human knowledge visualization. For our in-person meeting in Vienna, amongst other events, we hosted the first public meeting of the IEEE Technical Committee on Immersive Learning Environments (TC-ILE), part of the IEEE Education Society (EdSoc). The City of Vienna government presented a session on technology and innovation being currently developed and implemented, including Immersive Training, Digital GeoTwins and AR/VR for infrastructure visualization. We hosted the third edition of the Special Track on Self and Co-Regulated Learning with Immersive Learning Environments (SCILE). Finally, we presented six featured talks and four keynote talks, including contributions from representatives of the Austrian government, best-seller authors and leading researchers. The complete list is available in this book's *Keynote and Featured Speakers* section.
Four hundred thirty-seven authors from one hundred fifty different academic institutions, research centres and companies in thirty-one countries submitted publications to the Academic and Practitioner tracks. Countries included Australia, Austria, Belgium, Brazil, Canada, China, Colombia, Cyprus, Denmark, Ecuador, Germany, Greece, India, Ireland, Italy, Japan, Latvia, New Zealand, Norway, Portugal, Russia, Singapore, South Africa, South Korea, Spain, Switzerland, Thailand, Tunisia, UK, USA and Uzbekistan.

This year, we are pleased to present our inaugural Practitioner Proceedings volume, which includes twenty-nine submissions (twenty oral presentations, two posters, two workshops, two panel sessions and three special sessions) contributing insights to immersive learning research and practice across the lifespan. These submissions were peer-reviewed and presented at the 8th annual International Conference of the Immersive Learning Research Network (iLRN2022), and we very much hope you will enjoy reading them.

Authors were required to submit an abstract with well-articulated perspectives on applications of Immersive Learning. This allows practitioners to share their work with our community if they do not qualify for the rigorous requirements of an academic publication. Reviewers provided feedback on submitted papers, suggested improvements, and recommended to the Program Chairs whether to accept, reject or request changes to the papers. Reviewing is a volunteer activity and a time-intensive process, and we are grateful to all our reviewers for contributing to our community.

This Practitioner Proceedings volume is published separately by iLRN, and it is not indexed by the IEEE Xplore® Digital Library. For more information on the IEEE-indexed Academic Proceedings please visit our website.

In addition, we celebrated outstanding contributions through our Academic and Practitioner awards. The Program Chairs of each track chose final nominees from those that received the best reviews and have been nominated for awards by reviewers. The winning contributions were selected by an independent jury panel, which was asked to review the nominated papers based on contribution, methodology, and clarity. The list of winners is available in the Awards section of this volume.

We sincerely thank those involved who volunteered their time to make this such a great event and to attendees for joining us and sharing their excellent work with the iLRN community.

If you are not already involved, we invite you to read these proceedings and join us in our subsequent events and ongoing initiatives.

Anasol Peña-Rios and Daphne Economou
iLRN 2022 General Chairs
About iLRN Conference Series

iLRN’s annual conference is the premier scholarly event focusing on advances in the use of virtual reality (VR), augmented reality (AR), mixed reality (MR), and other extended reality (XR) technologies to support learners across the entire span of learning—from K-12 through higher education to work-based, informal, and lifelong learning contexts.

iLRN’s annual conference is indexed with CORE ranking C (http://portal.core.edu.au/conf-ranks/2266/), being the most relevant conference in Immersive Learning, devoting the entire conference to this topic.

iLRN has hosted entirely online and in-VR conferences in 2021 and 2020, and in-person editions in London, UK (2019), Missoula, Montana, USA (2018), Coimbra, Portugal (2017), Santa Barbara, California, USA (2016), and Prague, Czech Republic (2015).

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- Inquiries regarding the iLRN 2022 conference should be directed to the Conference Secretariat at conference@immersivelrn.org
- Inquiries regarding these proceedings should be sent to publications@immersivelrn.org
- General inquiries about iLRN may be sent to info@immersivelrn.org
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Keynote Speakers

“Adaptive Intelligence for XR Learning: Building Resilience and Creative Capacity at Global Scale” (Opening Keynote)

Caitlin Krause takes leaders and impact-makers to their next level of wellbeing and innovation with her unique approach to wonder, awe, and creative flow-hacking, called MindWise FlowCamp. Her practices helping people optimize flow performance, metaverse fluency, and tech relationships will be an ideal way for iLRN2022 to frame together our common goals and challenges.

- priming ourselves as resilient, adaptive, curiosity driven educators and learners
- meeting global needs in a personal way that involves agency and inclusion
- how to foster connection capacity
“Innovative Mindsets in a Meaningful Metaverse” (Closing Keynote)

Caitlin Krause, MindWise XR Studio

Caitlin Krause focuses on the intersection of technology, innovation, and well-being, and founded the XR design studio and consultancy MindWise in 2015 with the mission "to empower meaningful human connection." 2022 marks the launch of FlowCamp, an interactive metaverse space for creative flow practices, collaboration, team-building and reflection centered on wonder and awe.

She teaches about XR and Digital Well-being at Stanford University and is a creative producer for ScienceVR. Author of the books “Designing Wonder: Leading Transformative Experiences in VR” (2021) and “Mindful By Design” (2019), Krause has built numerous collaborative experiences in social XR, fusing presence, storytelling and emotional intelligence. She is dedicated to helping individuals and teams navigate complexity and change, prioritizing wonder, awe and imagination.

- Video available at: https://youtu.be/P1SH-N9FOsQ

“Educational VR Games: Lessons Learned“

Virtual Reality and Augmented Reality are two related technologies that are poised to become revolutionary educational platforms. This talk will address the many questions that surround this idea. Questions like…

- When will VR and AR be ready to use in education
- What form will VR and AR platforms take?
- What students and topics will VR and AR serve most effectively?
- How can educators make the best use of these technologies?

Using examples from successful VR education products, Jesse will present concrete tips about how to make XR experiences as effective as possible. Expect to come away with a clear picture of the present state and future promise of XR for Education.

Jesse Shell, CEO of Schell Games

Jesse Schell is the CEO of Schell Games, a team of more than one hundred thirty people who strive to make truly great games, both for the purposes of entertainment and education, including award-winning VR games such as “I Expect You To Die”, “HoloLAB Champions”, and “Until You Fall”.

PRACTITIONER PROCEEDINGS
Jesse serves as Distinguished Professor of the Practice of Entertainment Technology at Carnegie Mellon University and is the author of the award-winning book The Art of Game Design: A Book of Lenses.

- Video available at: https://youtu.be/xS81gmQFMVQ

“Multimodal data as a means to augment the learning experience “

Enhancing learning in a meaningful, attractive, and accessible manner is critical for the 21st century. Learners need easy-to-use but also powerful technologies, offering fine-grained control of time and progress. Contemporary learning systems need to translate learners’ data into a sequence of useful and actionable information; this allows systems to employ different information representation and intelligence augmentation techniques. Collecting learning analytics coming from multi-modal streams can power AI and ML algorithms with the goal to improve the learning experience. In this talk, I will present methods and studies, and our initial results on how multi-modal analytics can support the learning experience.

Michail Giannakos, Norwegian University of Science and Technology, Norway

Michail (Michalis) Giannakos is a professor of interaction design and learning technologies at the Department of Computer Science of NTNU, and Head of the Learner-Computer Interaction lab. His research focuses on the design and study of emerging technologies in online and hybrid education settings, and their connections to student and instructor experiences and practices. Giannakos has co-authored more than 150 manuscripts published in peer-reviewed journals and conferences (including Computers & Education, Computers in Human Behavior, IEEE TLT, Behaviour & Information Technology, BJET, ACM TOCE, CSCL, Interact, C&C, IDC to mention few) and has served as an evaluator for the EC and the US-NSF. He has served/serves in various organization committees (e.g., general chair, associate chair), program committees as well as editor and guest editor on highly recognized journals (e.g., BJET, Computers in Human Behavior, IEEE TOE, IEEE TLT, ACM TOCE). He has worked at several research projects funded by diverse sources like the EC, Microsoft Research, The Research Council of Norway (RCN), US-NSF, the German agency for international academic cooperation (DAAD) and Cheng Endowment; Giannakos is also a recipient of a Marie Curie/ERCIM fellowship, the Norwegian Young Research Talent award and he is one of the outstanding academic fellows of NTNU (2017-2021).
“Digital Basic Education and Digital Action Plan in Austria”

With a digital eight action plan Austria implements its digital strategy in education. A new subject Digital Basic Education will start in September 2022 for 1,500 lower secondary schools to force computational thinking and media literacy. A brief insight.

Stephan Waba, Federal Ministry of Education, Science and Research, Austria

Stephan Waba is Deputy Head of the Department for IT Didactics in the Federal Ministry of Education, Science and Research in Austria. His main areas of work are pedagogical concepts for the development of digital and IT skills by pupils and the qualification of pedagogues. Prior to that, he was a teacher of English and German at a general secondary school, teacher trainer and head of the Virtual PH.
“Developing disinformation resilience competence using the Provenance tool”

Disinformation and fake news have become a virulent problem in our times. Though this is not a new phenomenon, it has become particularly problematic through the emergence of digital media. One reason for the pervasiveness of online media with disinformation can be found in the sharing behaviour of people with low competence in evaluating online media. This talk presents a learning concept and study how such media literacy competence can be developed, in order to make people more resilient against disinformation. The key component of this concept is a tool that has recently been created by the EC-funded Provenance research project. The learning concept is built upon the seven indicators provided by the tool, which the identification of problematic aspects of online news. A study demonstrates the positive learning effect of the concept and the repeatedly applied tool in the context of a training course.
Alexander Nussbaumer, Sylvia Ebner, Christian Gütl, Graz University of Technology, Austria

Alexander Nussbaumer received a master's degree in Telematics (Information and Computer Engineering) and a doctoral degree in Computer Science from Graz University of Technology (TUGraz), Austria. After working in the industry as a software developer, he joined the Cognitive Science Section of the Department of Psychology at the University of Graz in 2006. Since 2009, he has been working at the Cognitive Science Section at the Knowledge Technologies Institute at Graz University of Technology. In 2019 he joined the Cognitive and Digital Science Lab (CoDiS Lab) of the Interactive Systems and Data Science (ISDS) at TUGraz. He has been participating in several EU-funded and Austrian research projects on digital learning, medical training, cultural heritage, secure societies, and smart cities. His research focus currently lies on digital literacy, disinformation, decision support, and evaluation analytics.

Sylvia Ebner graduated from the University of Graz, Austria, in psychology and educational science. Now she works in the Cognitive and Digital Science Lab (CoDiS) of the Institute of Interactive Systems and Data Science (ISDS) at the Graz University of Technology, Austria. The focus of her research interest includes the evaluation of learning and research environments, self-regulated learning, digital learning as well as development of motivation and interest in the STEM field.

Christian Gütl holds a Ph.D. in Computer Science from Graz University of Technology (TUG) and has received the “venia legendi” for applied computer science in 2009. He is at the Institute of Interactive Systems and Data Science at TUG in Graz, Austria, where he leads the Cognitive and Digital Science (CoDiS) Lab. Christian is involved in e-learning and e-assessment for more than 20 years and he has authored and coauthored in more than 220 peer-reviewed book chapters, journals, and conference proceedings publications. He is involved in numerous organizational and editorial boards as well as program committees. He is founding member of the global Immersive Learning Research Network (iLRN), chair of the technical committee of immersive learning (ILE-TC) of IEEE Education Society, managing editor of J.UCS, coeditor of the International Journal of Knowledge and Learning (IJKL). His research interests include information search and retrieval, e-education, e-assessment, adaptive media technologies, and virtual and augmented reality for learning and knowledge transfer.
“Immersive learning technologies for evidence-based practices”

The Technological Pedagogical Content Knowledge model seems to work well when immersive technologies are integrated in education research and teaching. But how are immersive technologies introduced in pedagogical reasoning and action? Technological Content knowledge guides us to choose the pertinent immersive technology to study a specific discipline. Technological Pedagogical Knowledge shows the instructional design to follow for the chosen technology and discipline. What are the features of immersive technologies that add pedagogical added value? Are there certain research designs that result in evidence base of effectiveness at cognitive, emotional, and psychomotor levels? Technological and their consequent learning affordances of immersive technologies are the core elements for the design of effective immersive learning environments. Psychophysiological measures such as electroencephalography assess learners’ cognitive and affective states and indicate how technological affordances affect the design of immersive learning environments. Rigorous research designs show how learning affordances affect interventions in immersive environments.

Anastasios Mikropoulos, University of Ioannina, Greece
Currently Professor in ICT and virtual reality in education at the Department of Primary Education, School of Education, University of Ioannina, Greece. Dr. Anastasios Tassos Mikropoulos holds a B.Sc. in Physics from the University of Ioannina and a Ph.D. in optical signal processing from the University of Athens. He is the director of the “Educational Approaches to Virtual Reality Technologies laboratory – earthlab”. Anastasios is the elected chair of the Hellenic Association of ICT in Education. His research interests are on learning technologies in general and special education, and especially on virtual and augmented reality in education, and educational neuroscience. Mikropoulos’ work has been published in numerous refereed journals, conferences, and volumes with more than 2900 citations. He is a member of the editorial board and reviewer for many international journals and foundations and chair on special tracks of international conferences. He has been project director, principal investigator, and consultant in many research and development and educational projects. He also serves as a consultant for the Greek Ministry of Education in topics such as digital school and in-service teachers’ further training.
“The Virtual Reality of the Pandemic”

The pandemic has changed not only our real lives, but also our virtual lives. The establishment of remote working, WHO’s suggestions to play video games, virtual sporting events, and digital funerals have found their way into our everyday lives. And it especially changed the way how we work and collaborate. In this talk, Johanna Pirker discusses the impact of the pandemic and especially how games have changed everything.

Johanna Pirker, Graz University of Technology, Austria

Dr. Johanna Pirker is Assistant Professor at TU Graz in Austria, leading the research group Game Lab Graz, and research games with a focus on AI, HCI, data analysis, and VR technologies. She has lengthy experience in designing, developing, and evaluating games and VR experiences and believes in them as tools to support learning, collaboration, and solving real problems.

“Virtual Reality for European Young Job Seekers”

Youth unemployment is a serious challenge in today’s European labour market, especially in a post-COVID context. XR/immersive technologies have extensive possibilities to inform about jobs, professions and career paths and provide basic workplace compared to traditional media. These technologies are being deployed by several industries and have proven effectiveness in workplace training, mostly targeting established professionals. Little has been done to prepare job seekers for entering the labor market and to help the unemployed (especially young unemployed) by using immersive technologies. In order to fill the gap in the current research and practice, we suggest establishing collaboration between academia with expertise on immersive technologies for learning and training, public sector bodies and related European industries to investigate how VR can inform and motivate young job seekers, increase their interest in and understanding of workplace processes and prepare them for future work as a part of Erasmus+ VR4VET project.

Ekaterina Prasolova-Førland, Norwegian University of Science and Technology, Norway

Ekaterina Prasolova-Førland is full Professor at the Department of Education and Lifelong Learning at the Norwegian University of Science and Technology (NTNU). Ekaterina has been working with educational virtual worlds and immersive technologies since 2002, with over 100 publications in the field. She has been involved in developing educational virtual reality simulations for a wide range
of stakeholders, from aquaculture industry to the Norwegian Labour and Welfare Administration. Ekaterina has founded and is leading Innovative Immersive Technologies for Learning (IMTEL) research group and VR lab at NTNU. She is Ambassador for Women in Immersive Tech and a member of several international expert panels. Prof. Prasolova-Førland frequently gives public speeches and interviews on immersive technologies for learning and training. She is currently working on a number of projects on applications of immersive technologies in STEM education, climate change awareness, professional training, medicine and therapy, career guidance, collaborative learning and other areas.

“Challenges in Educating Digitally Literate Doctors of Tomorrow”

Contemporary challenges of educating and training doctors and health professionals of tomorrow are undoubtedly shaped by digital technologies as well as modern pedagogical approaches. Immersive technologies, although set the excitement pace by the caused disruption, should be going hand-in-hand with (innovative) experiential learning episodes as well as evidence-based evaluation practices. The whole environment is also driven by the urgent need to create digital solutions allowing for a wider notion of a "topical resiliency" in the sense that any health workforce training should be topically allowing for "One-Health" ideas, as well as affording up-skilling. In this talk, numerous examples from running a handful of projects will be provided.

Panagiotis Bamidis, Aristotle University of Thessaloniki, Greece

Panagiotis Bamidis is a Professor of Medical Physics, Informatics and Medical Education and Director of the Lab of Medical Physics and Digital Innovation in the School of Medicine at the Aristotle University of Thessaloniki, Greece. He designs, implements, and evaluates IT and Assistive Technologies systems that improve everyday activities of elderly or other vulnerable groups and improves their health or life quality or improves the education and training of health professionals. He conducts research that attempts to understand how the brain reacts to different stimuli, technological or educational interventions, as well as, the development and evolution of human emotions and sleep transitions. He is the co-ordinator of ten large European projects, and the principal investigator for many national and international funded projects. He is the President of the Hellenic Biomedical Technology Society (ELEBIT), HL7 Hellas, the international Society of Applied Neuroscience (SAN), a member of the Administration Boards of other societies and patient associations. He is/has been the Chairman/Organiser of some 20 international conferences and several national Biomedical Technology conferences. In 2017, he became a visiting Professor of
Medical Education Technology, Innovation and Change for the Leeds Institute of Medical Education (LIME) of the University of Leeds, UK. Since 2020, he leads the Medical Education Innovation & Research Unit (MEIRU) of the Special Unit for Biomedical Research and Education (SUBRE) of the School of Medicine.

“Green Immersive Education for All”

Media is ubiquitous in education and its impact on the environment is unavoidable. The British Academy of Film and Television Arts (BAFTA) estimates that the annual emissions from UK film production totals in excess of 149,000 tonnes of CO2 (the equivalent CO2 output of a small village), while figures from Greenpeace suggest that Information and Communications Technologies (ICT) generate up to 3% of global carbon emissions (on par with air travel) (Jones 2018). It is estimated that by 2030, ICT electricity usage could contribute up to 23% of global greenhouse gas emissions (Andrae and Edler 2015). Storing pictures, uploading videos and attending online meetings all emit carbon. The presentation proposes some small steps to curve media pollution and present the EU Green Education framework where immersive media plays a central role both in green education and in immersive and accessible learning.

Pilar Orero, Universitat Autònoma de Barcelona, Spain

PhD (UMIST, UK) is a Professor at Universitat Autònoma de Barcelona (Spain) in the TransMedia Catalonia Lab. She has written and edited many books, near 100 academic papers and almost the same number of book chapters— all on Media Accessibility. Leader and participant on numerous EU funded research projects focusing on media accessibility. She works in standardisation and participates in the UN ITU IRG-AVA - Intersector Rapporteur Group Audiovisual Media Accessibility, ISO and ANEC. She has been working on Immersive Accessibility for the past 4 years first in a project called ImAc, which results are now further developed in TRACTION, MEDIAVERSE, MILE, and has just started to work on green accessibility in GREENSCENT. She leads the EU network LEADME on Media Accessibility.
“Representations of Poverty in Videogames”

This conversation concerns the new monograph Representations of Poverty in Videogames, which is forthcoming from Palgrave Macmillan in late June 2022. In that text, Crowley argues that the videogame form has become a meaningful vehicle for representing contemporary, middle-class anxieties about poverty. In this presentation, these anxieties are explored with gameplay examples relevant to select supply-chain and inflation-related concerns that manifested in the United States during the third year of the Covid-19 pandemic.

Adam Crowley, Husson University, USA

Adam Crowley is a Professor of English at Husson University in Bangor, Maine. His books include The Wealth of Virtual Nations: Videogame Currencies (2017) and Representations of Poverty in Videogames (2022). He was a featured speaker at the 2022 Popular Culture Association conference. Crowley was also invited to lead a "Meet the Experts" talk on game studies and education hosted...
by Thomas University this past spring. His commentary has appeared in Wired magazine and other publications. He can be followed on Twitter at @AdamMCrowley.

Video available at: https://youtu.be/uir6tXPO8PQk

“Gamification & the Metaverse”

The most important educational purpose of gamification is to create a fun and engaging experience that promotes task or concept mastery. Games are often talked about as if they were a relief from serious work. But in the make-believe world of games, we are in charge, making decisions, as we assess risk to master a range of challenges. Play helps create new connections between neurons and between different parts of the brain. Do we in fact have a neurological imperative to allow our learners to play? Employee disengagement and high turnover rates are real challenges that employers face as they navigate the post-pandemic landscape. Based on what we know of the highly interactive, responsive, and personalized nature of Internet of Things (IoT) products and services, gamification promises to be one of the most-effective concepts to apply to employee engagement, retention, and upskilling.

Monica Cornetti, Sententia Inc.

Monica Cornetti works with individuals and organizations who want to learn how to think playfully to achieve uncommon results.

A gamification speaker and designer, Monica was repeatedly rated #1 among the “Gamification Gurus Power 100” by RISE from 2015-2020, and in 2021 was recognized as #1 in the Most Influential Women in Gamification who have created a legitimate impact in the gamification industry. Monica is the President of Sententia, Inc. and leads the company’s education and design projects at Sententia Gamification. She is also the Gamemaster of GamiCon (annual international conferences for the gamification of learning) and Head of Faculty at the Gamification Academy.


She is a graduate of Seton Hill with a BA in psychology, and The University of Houston-Victoria where she earned a Masters Degree in Economic Development and Entrepreneurship.

Monica is hired for her skill as a gamification speaker and strategist and is considered at the top of her field in gamification design for corporate training and adult education.
“Intelligent NFTs”

Arif Khan is the CEO and co-founder of Alethea AI, a decentralised protocol to create an Intelligent Metaverse inhabited by interactive and intelligent NFTs (iNFTs). Alethea AI is a hypergrowth deep tech startup at the intersection of two exponential technologies, Artificial Intelligence and Blockchain. As its CEO and founder, Arif has been regularly invited to speak at major global events like The World Economic Forum, World Web Forum, and has guest lectured at the Singapore Management University’s MBA program. He is a top writer for Artificial Intelligence on Medium.com and his work has been featured in Fast Company, Forbes, The Wall Street Journal & The New York Times. Alethea’s protocol is backed by a roster of Tier-1 Investors like Binance, Gemini, Dapper Labs, Multicoin, Metapurse, Alameda Ventures, BITKRAFT, Galaxy Interactive, Sfermion and more.

Arif Khan, Alethea AI

How Artificial Intelligence technologies can be leveraged to encompass a learning experience, in the context of our products. From passing on oral history, to preserving cultural heritage and language, our Metaverse, "Noah's Ark," can empower users and communities to engage each other, via AI-powered characters that are trained to share intelligence and narrative.

“The power of human networks, especially in education”

With the evolution of the web, how have human networks changed the way different industries operate? This session will explore the change between web1, web2, and web3, along with the onset of the metaverse. We will explore a metaverse space called the Eduverse and how teacher networks can bring education into the future.

Vriti Saraf, Ed3 DAO

Vriti Saraf (@vritisaraf), the founder of k20 Educators (@k20educators), is building the Eduverse on web3, a free metaverse space for educators to connect, collaborate, learn, and earn. k20 has been recognized as the world's top 200 most innovative edtech companies by Global Silicon Valley. She is also the co-founder of Ed3DAO (@Ed3DAO), a web3 digital co-op (Decentralized Autonomous Organization) for educators by educators, aiming to catalyze innovation at scale. Vriti's goal is to break down silos among educators through web3. Her free newsletter, Metaverse for Education, contextualizes web3 for educators. Vriti has served as a teacher, dean, & director in public, private, & charter schools both locally & internationally across k12 & higher education.
“Visualise Human Knowledge”
Jackie Lee, Science VR

Jackie Lee, Ph.D. is a cross-disciplinary inventor in VR/AR, learning, and Affective Computing. He worked on Intel’s RealSense 3D cameras and Project Alloy (the first all-in-one VR headset). He did biosensing and behavioral research at the Affective Computing Group at MIT Media Lab. He did his master thesis focusing on Spatial User Interface and Augmented Reality. Jackie is the recipient of the Virtual World Society’s Nextant Rising Star Prize at AWE 2020. He is part of the Oculus Launch Pad 2020 program and a two-time recipient of Epic Games’ MegaGrants.
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Awards

Practitioner Awards

Eligibility: All presenters who submitted through the iLRN 2022 Practitioner Stream, including oral presentations, panels, posters, workshops, and special sessions.

Independent jury panel members

- Dr. Dongjin Kwon, Texas A&M University, USA
- Dr. Sungwoong Lee, University of West Georgia, USA
- Stephanie Wossner
- Meaghan Mood Stalnaker

We were grateful to receive award recommendations from scholars who reviewed all the Practitioner Stream proposals to make their decisions.

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**Innovation in K-12 Education**
Awarded to a Practitioner Stream presenter whose work is at the leading edge in immersive learning and likely to change the field in K-12 education.

- "Engaging Early Learners in a VUCA World"
  Nely Daher, Emma Donaldson, Georgie Ridehalgh, Penelope Dugan; Knox Grammar Preparatory School, Australia
  https://www.youtube.com/watch?v=o1WMH8emOgQ

- "Aurora Simulator: A Software Application for Exploring the Aurora in Upper Elementary Science Classrooms"
  Anisa Bora; Columbia University, USA

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**Innovation in Higher Education**
Awarded to a Practitioner Stream presenter whose work is at the leading edge in immersive learning and likely to change the field in higher education.

- "The Mystery of Lehigh Gap: Game-based VR for Informal Learning"
  Alec Bodzin, Araujo Junior Robson, Josie Koelsch, Mayra Arnaot Perez, Udita Agarwal, Marcos Escobar, Chad Schwartz, David Anastasio, Thomas Hammond, Brian Birchak, Junchen Bao, Yiting Chen, Tarah Cicero, Xiangyu Hu, E.J. Rovella, Laura Sary, Matthew Silverman & Hayley Whitney; Lehigh University, Lehigh Gap Nature Center, USA
  https://www.youtube.com/watch?v=Ox5PtL52j4M
• "Pedagogical Approaches to Graduate Education in Learning Experience Design Using Immersive Technologies Online"
  Douglas A. Wilson; George Mason University
  https://www.youtube.com/watch?v=f8cwT89safQ

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**Immersive Learning Pedagogy**
Awarded to a Practitioner Stream presenter whose work represents impactful pedagogy or innovative practice in immersive learning.

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• "Augmented Reality Affording Immersive Learning Experiences in Museum Education"
  Quincy Wang & Kristiina Kumpulainen; Simon Fraser University, Canada
  https://www.youtube.com/watch?v=vetENBpAOFo

• "ALIVE: Avatar Learning Impact assessment for Virtual Environments"
  Sarune Savickaite, Elliot Millington, Chris Freeman, Robert McMillan & Mohamed Khamis; University of Glasgow, UK, Edify.ac
  https://www.youtube.com/watch?v=Dh1spNbYzus

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**Outstanding Contribution to Research**
Awarded to a Practitioner Stream presenter whose work represents ground-breaking research or theoretical innovation in immersive learning.

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• "Designing Effective Immersive VR Learning Experiences"
  Jan Plass; New York University, USA
  https://www.youtube.com/watch?v=oM5KMWiIU9E

---

**Outstanding Contribution to Workplace & Industry Training**
Awarded to a Practitioner Stream presenter whose leadership and vision will positively impact workplace and industry training.

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• "Between Skills and Success: Developing Workers’ Dispositions for Applying Skills in an Uncertain, Disruptive World"
  Chris Dede & Ashley Etemadi; Harvard Graduate School of Education, USA
  https://www.youtube.com/watch?v=h0uVKeOOjSg
Special Awards

Outstanding Contribution to the Conference Development

Our conference runs entirely on the volunteering work of exceptional individuals committed to the iLRN’s vision.

Every conference committee member has made invaluable contributions to the event, and we are grateful to all of them. However, we would like to publicly recognise the work of colleagues who have gone above and beyond in their roles.

- Genevieve Smith-Nunes, University of Cambridge, UK
- Jule M. Krüger, University of Duisburg-Essen, Germany
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Abstract. When designing virtual reality (VR) training, it's important that VR learning experiences output the proper data to measure learning and drive evidence-based insights about learner competency levels. This presentation proposes using the Evidence-Centered Design for Assessment (ECD) framework for designing VR experiences to ensure learning activities are aligned to competency indicators that produce learner data that can be evaluated to assess mastery levels. The ECD framework can bring value to VR learning solutions by providing a method of embedding assessments directly within the learning experience without breaking immersion or disrupting flow. In the ECD framework, evidence of learning is directly tied to and measured by a learner’s actions within the VR environment, providing empirical data that practitioners and organizations can use to make inferences about a learner’s competency levels. This presentation will detail how to implement ECD into VR learning experiences and ensure that the solution’s instructional design is strategic and measurable, by leveraging three main models: Competency Model, Evidence Model, and Task Model.

Keywords: Virtual Reality, Evidence-Centered Design, Immersive Learning.

1 Introduction

Virtual reality (VR) is an increasingly popular medium for delivering learning experiences, yet there has been little defined in terms of solid frameworks and best practices for immersive learning experience design. An additional obstacle is that the perception of unlimited possibilities when designing VR learning experiences can often pose challenges for immersive learning designers: they may not know where to start or they may have so many ideas that they struggle to sift out all but the most viable ones. This can make designing VR learning solutions feel like a shot in the dark, with learning efficacy a moving target. Similarly, there is little consensus around the best practices for measuring learning in VR environments. Behavioral data such as usage, engagement, and attention are popular metrics collected by VR training software, but these metrics provide
only a glimpse of how engaged a user may have been during the immersive experience and cannot truly paint a whole picture of a learner’s knowledge and proficiency levels. This problem is two-fold. Immersive learning designers need a strategic method of achieving sound instructional design that manifests as learners interact in VR, and a valid and reliable method of measuring learning that occurs in the VR environment. Such a framework can provide an introductory approach for new or aspiring immersive instructional designers to enter the field and confidently begin designing and developing evidence-based VR training, as well as provide a valuable approach for experienced designers to add to their repertoire.

1.1 Evidence-Centered Design

This presentation proposes adapting Evidence-Centered Design for Assessment Framework (ECD), initially developed for adaptive testing, and extended to game-based learning, to the design and evaluation of VR learning experiences [1],[2]. By applying ECD to the design of VR experiences, designers can ensure that the learning activities they produce elicit key behaviors that fulfill the intended learning goals defined for the learning solution [3]. This same framework also enables the capture of data to measure learning which in turn enables evidence-based insights about learners’ competency levels [1].

For VR, inducing the perception that a learner is physically present in the virtual space, and maintaining this immersion throughout an entire learning experience is critical for efficacy and engagement. The beauty of applying ECD to VR is that it provides a method of assessing learning by harnessing interactivity, one of the three pillars of VR, to trigger measurement and it does this without disrupting the other pillars, immersion, and presence, and ultimately flow [4].

This presentation aims to demonstrate how developing a Competency Model (CM) enables designers to make claims about a learner using evidence collected within a VR solution. This presentation will discuss CM examples and demonstrate how to operationalize unobservable facets to observable indicators and provide a tangible way to identify the key behavioral evidence to solicit from a learner in order to infer their proficiency with the competency [1],[2]. Mechanisms for developing an Evidence Model (EM) will be discussed using immersive use cases, and how to use the EM to inform the design of immersive VR experiences such as scenarios, tasks, or activities within the Task Model (TM) to elicit evidence of learning [3].

2 Conclusion

Participants will learn how they can adapt the ECD framework to fit their VR training needs and come away knowing how to design evidence-based VR experiences that have a
lasting positive impact on the success of both the learners and your company.

References

Early Childhood Development & Learning
Engaging Early Learners in a VUCA World.

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Abstract. The Kindergarten cohort at Knox Grammar Preparatory School have been discovering and inquiring about the world around them through purposeful play and research. After consolidating new knowledge through a hands-on approach to learning, they have transitioned their inquiry learning process into an interactive virtual environment through the use of several platforms including CoSpaces, Minecraft and FrameVR. Through a differentiated approach to learning, we have been able to explicitly model critical and creative thinking, by providing new and exciting means to enhance student reasoning and communication skills. Increasing the level of positive ICT engagement through an immersive virtual learning experience, has engaged Knox community members from around the world and allowed families to reflect on the learning process each student undertakes. Kindergarten students have taken a step into the metaverse through the uploading of inquiry research tasks consisting of hand drawn posters, oral presentations, video recordings, artworks, construction projects and coding to a collaborative FrameVR environment thus providing them with the opportunity to demonstrate their multifaceted learning process on one platform. Virtual learning environments are shared with the parent community to demonstrate the process of learning throughout each unit of inquiry.

Keywords: immersive learning, inclusivity, student agency, technological literacy

1 Introduction

In this day and age, it is imperative that students are exposed to, and become familiar with the changes in technologies that are moulding their future. Through the development of students' technological, problem solving and collaboration skills, they will graduate as well-rounded, technologically literate citizens who will go on to positively contribute to the ever-changing global community. The constraints that paper and pencil place on the next generation, hinders the experience of enhanced, engaging and inclusive study which can be achieved through the use of technology. Our aim must be to nurture adaptable learners that are prepared for a volatile, uncertain, complex and ambiguous world (VUCA). Digital literacy is not just knowing how to use a computer or device, but rather
it is the skill set needed to access different technologies, providing the opportunity to create content through different platforms and developing the competence of a digital citizen through inquiry, creativity, and collaboration.

2 Making connections to the world through Coding and Robotics

When introducing Kindergarten to coding at the start of the year, students built a range of transdisciplinary skills that allowed them to make connections to the world around them. At this point in their journey, it is essential that students enjoy purposeful play through digital learning experiences that expose them to coding and robotics. Explicit language introduction and structured tasks leads to development of computational thinking skills and consequently, higher student engagement in classrooms and increased rates of participation.

Throughout a study that explored how people work together in communities, students used Blue Bot Mats to develop their own community and created codes to move around this community. During this time, students were introduced to empathy as they identified how different people used different codes each day to meet their needs. Having a deep understanding of coding and the necessary language is an essential part of this process.

This hands-on approach increased retention of information levels and allowed students to make meaningful connections. Many of the skills required when using CoSpaces and Minecraft Edu were developed during this time. In 2022, we aim to connect students' learning experiences through the use of FrameVR. This will allow our family communities across the world to be a part of each child’s learning continuum from the time they begin at Knox Grammar School. Creating a virtual environment where students upload and share their knowledge will in turn broaden the school community and enhance collaboration of all school stakeholders.

3 The integration of CoSpaces in the Classroom to Demonstrate Understanding

Integrating CoSpaces in the classroom provided students with the opportunity to demonstrate their knowledge by building virtual interactive worlds. Throughout various units of work, students are explicitly taught the coding skills that allow them to apply their knowledge into the virtual world.

When exploring how forces impact the world around them through purposeful play, students develop a deep understanding of these concepts. As they move through the inquiry cycle, they are then able to explore open-ended questions and visualise, explain and justify their understanding through the use of CoSpaces. A study on Forces saw students exploring the process of falling and floating. This platform allowed educators to
create personalised learning opportunities and offer new ways to connect with the learning material through “embodied learning” and multi-sensory experiences. In line with the Universal Design for Learning Guidelines, these experiences enabled students to exercise critical thinking to observe, analyse and find solutions to problems. Students were then able to apply multiple means of action and expression by creating scenarios demonstrating forces in action using coding on CoSpaces.

4 **Incorporating Minecraft Edu to Promote Creativity and Collaboration**

Minecraft is a platform that is easily accessible to students. It inspires confidence through exploration and increases creativity skills while encouraging problem solving through teamwork and collaboration. It is an added level of fun in the classroom, encouraging students to think outside the box and explore ideas of the future.

Chandra encourages the incorporation of structured approaches for developing solutions for real world problems, into everyday learning. During the course of the year, students delved into a study on Earth’s oceans. After researching how people use and impact oceans, students were able to demonstrate their problem-solving skills through construction within the Minecraft Edu world. Prior to using Minecraft Edu, students asked questions, used books, the internet and various documentaries to research facts to consolidate their understanding. Google Slides was used to explain how Earth’s oceans can be protected and then applied these solutions to their virtual ocean environment.

Minecraft allowed students to view and experience something otherwise inaccessible and encouraged the development of 21st century skills necessary for their impending futures.

5 **Recommendations**

In order to equip early learners with a skill set that is needed in a volatile, uncertain, complex and ambiguous world, we must provide structured approaches and opportunities for students to explore and engage in a variety of platforms. The disruptions that teachers and learners alike have, and are continuing to face, can be mitigated with the introduction of students into the metaverse from such an early age. These practices will facilitate collaboration and encourage creativity and critical thinking, allowing an opportunity and nurturing diversity in innovative thinking. The inclusion of immersive learning in the inquiry cycle is vital. The reflection of in class student learning onto a virtual environment opens a highly inclusive manner where learning can be represented multimodally.

Age plays a big part in mastery of technological literacy, however, with explicit teaching, scaffolding and a bit of patience, students slowly but surely gain proficiency. The implementation of a buddy or peer teaching program is highly effective in achieving
Weekly visits from Year 6 classes to the Kindergarteners afforded a friendly informal time where older students could demonstrate and instruct the younger ones in how to manipulate and effectively use each platform. The promotion of platforms such as these, afford students agency over their learning, in turn developing a resiliency to keep moving forwards at all costs. It is these steps that aid educators to guide students in becoming a part of an inclusive and robust global community.

References

Galleries, Libraries, Archives, & Museums (GLAM)
Augmented Reality Affording Immersive Learning Experiences in Museum Education

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Abstract. The educational possibilities of augmented reality (AR) are attracting increased attention among museum educators and curators as novel, yet largely unexplored, technologies to enrich museum experiences and learning. AR is an emerging technology that has potential to create immersive learning experiences by pairing digital and physical content. Drawing on Gibson’s concept of affordances—actions [5], see also [6], in this presentation, we consider how AR can be used in museum education to enrich visitors’ immersive learning experiences. We share what we have learned from our design-based AR research project in a Canadian science museum to further discuss the theoretical and practical insights for designing AR-mediated museum exhibits for immersive science, technology, engineering, and mathematics (STEM) learning. Participants will also be given hands-on opportunities to test and play with the designed AR app during the presentation. In addition to identifying potential affordances of AR for immersive museum learning, the presentation will illustrate design strategies for integrating AR-enriched museum exhibits and app development. Importantly, this presentation will invite participants to re-envision museum education and museum exhibits through the potentials of AR. The presentation will offer museum educators and curators, researchers, and immersive technology designers and developers’ insights into AR in museum education with consideration to its potentials and challenges.

Keywords: Augmented Reality, Museum Education, Immersive Learning, Design-Based Research, Affordance Theory.

1 Short Description

The educational possibilities of augmented reality (AR) are attracting increased attention among museum educators and curators as novel, yet largely unexplored, technologies to enrich museum experiences and learning. AR is an emerging technology that has potential to create immersive learning experiences by pairing digital and physical content. Drawing on Gibson’s concept of affordances—actions [5], see also [6], in this presentation, we consider how AR can be used in museum education to enrich visitors’ immersive learning
experiences. We share what we have learned from our design-based AR-research project in a Canadian science museum to further discuss the theoretical and practical insights for designing AR-mediated museum exhibits for immersive science, technology, engineering, and mathematics (STEM) learning. Participants will also be given hands-on opportunities to test and play with the designed AR app during the presentation. In addition to identifying potential affordances of AR for immersive museum learning, the presentation will illustrate design strategies for integrating AR-enriched museum exhibits and app development. Importantly, this presentation will invite participants to re-envision museum education and museum exhibits through the potentials of AR. The presentation will offer museum educators and curators, researchers, and immersive technology designers and developers’ insights into AR in museum education with consideration to its potentials and challenges.

2 Purpose

The purpose of this presentation is to explore how an AR-integrated museum exhibit can foster visitors’ immersive learning experience by combining virtual objects, museum displays, and physical spaces. AR refers to an emerging technology that provides real-time immersive digital information to augment and pair with the existing surrounding physical environment [1], [2], [4]. To enhance immersive STEM engagement and learning, we designed and developed an AR application for a beehive exhibit in a Canadian science museum. The exhibit allows visitors to explore a beehive and to touch 3D digital bees.

Our AR project draws on design-based research (DBR) methodology. A DBR approach allowed us to iteratively inquire, test and reflect; thereby working closely with museum curators, instructional designers, and AR application developers to design an authentic AR-enhanced exhibit for a science museum. On completion of the phase one prototype, we conducted one-on-one in-person short surveys with visitors immediately after they explored the AR-enhanced exhibit. The survey questions focused on user accessibility, user interface and user experiences during their immersive learning activities. The results suggested that AR technology can enhance learners’ engagement, foster their curiosity towards science, and help them become more self-motivated, seamlessly and synergistically, to connect individual, social, and physical components. Furthermore, AR has the potential [3], [7], [8], [9]:

- To afford accessibility to museum artifacts without time and spatial restrictions
- To energize immersive learning activities while providing novel learning experiences to visitors
- To allow hands-on experimentation
- To develop curiosity through visualizing invisible concepts
- To foster active engagement
By sharing our design-based research project for a museum exhibit, in our presentation we will consider the affordances of AR for immersive museum education and learning and suggest a set of design principles that contribute to a pedagogical approach for AR-informed museum education to foster immersive STEM learning.

3 Target Audiences

The target audiences for our presentation are K-12 educators, instructional designers, AR application developers, and museum educators and curators. Interests of participants that may be met include:

- Improving their understanding of ways that AR can enrich museum education
- Developing approaches to curriculum development of AR exhibits for museum display.
- Acquiring insights into ways educators could use AR as an approach to teaching,
- Gaining knowledge about how immersive technology may improve learning outcomes that result from learning in engaging and playful activities for STEM education, and
- Becoming informed about possibilities and limitations of the use of AR technology by museum curators and instructional designers in the development of museum exhibits.

4 Audience Engagement

During our presentation, the audience will have opportunities to engage in hands-on activities with the AR application that we developed for a science museum as part of our design research. The participants will need their own digital handheld devices to test and play with the AR app. First-hand, immersive experiences will allow participants to access and explore digitally simulated museum objects. After the AR experience, we will invite participants to share and reflect on their experiences and to consider how they see the value and applications of AR technology in and for museum education.

5 Outcomes

The presentation will help the audience to develop their professional knowledge about how AR can enrich museum education. The target audiences for this presentation are K-12 educators, instructional designers, AR application developers, and museum educators and curators. The presentation will help participants to better understand how AR can enrich museum education. The presentation will also introduce practical insights for educators to
use AR as part of their pedagogical approaches. AR application developers will gain ideas about how immersive technology can leverage learning content by creating an engaging and playful learning environment for STEM education. Museum curators and instructional designers will be informed about the potentials and limitations of the use of AR technology in museum education and exhibit design. Finally, participants will develop new insights about uses of AR technology, and be open to sharing newfound discoveries, resources, and creative pedagogical strategies for immersive teaching and learning experiences in museum education.

Fig. 1. Example of AR application in museums.

References


Engaging Humanities & Humanistic Social Sciences Faculty, Staff, and Students Through XR

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Abstract. As a Karp Library Fellow for the University of Rochester’s hub for extended reality technology, Studio X, I conducted research on the applications and potential that XR (extended reality) technology offers to the humanities and humanistic social sciences during the spring 2021 semester. My research involved three phases: finding pre-existing use cases, holding a focus group with Learning Initiatives Librarians, and conducting a student survey. From these three phases of research, I curated a range of XR use cases across humanities and humanistic social science fields and developed targeted engagement strategies for these users, which I implemented in the fall of 2021. From this, I began to plan an Intro to XR workshop that could be tailored for any group who wanted to learn about these amazing technologies.

Keywords: Extended Reality, Humanities and Humanistic Social Sciences, Education, Higher Education.

1 Introduction

As the hub for extended reality at the University of Rochester, Studio X [1] fosters a community of cross-disciplinary collaboration, exploration, and peer-to-peer learning that lowers barriers to entry, inspires experimentation, and drives innovative research and teaching in immersive technologies. My position as a Karp Library Fellow for Studio X has allowed me to participate in research that betters my university’s library community. Established in the summer of 2020, the Karp Library Fellows Program at the University of Rochester River Campus Libraries aims to prepare students for their future careers through their work in and contributions to specialized library spaces. While collaborating with library staff, Karp Library Fellows share their expertise, provide training to their peers, and enhance the libraries.
2 Research

My research from the spring 2021 semester [2] encompassed the many fields of the humanities and humanistic social sciences to showcase to those disciplines the endless potential that XR technologies offer. From conducting research, student surveys, and meetings with learning initiatives librarians, I collected information to fuel my project and showcase how easy it is for any discipline to get involved with XR technologies.

2.1 Pre-Existing Use Cases

As a humanities research fellow, I identified preexisting use cases in which the humanities and humanistic social sciences are already leveraging XR technologies. The goal with this task was to better understand what XR looks like in these disciplines and to curate examples and use cases for faculty, staff, and students in these disciplines. These examples demonstrate the possibilities for XR and the humanities and help humanities folks better relate to these technologies, so they may consider XR for classes, studying, and research opportunities. [3]

2.2 Learning Initiatives Librarian Focus Group

In order to get a better idea of ways that Studio X could benefit humanities faculty and students, I organized a focus group with some of the Learning Initiatives Librarians here at the University of Rochester River Campus Libraries. They are liaisons to the humanities and humanistic social sciences departments. I asked them a series of questions about their experiences working with faculty and how we might better engage their faculty with these technologies. I then established how Studio X could help with their goals and explained how we could help them overcome any challenges they may face.

2.3 Humanities Student Survey

In order to gauge humanities and humanistic social sciences students' exposure to XR technologies, I ran a short survey for about a week. The survey was open to both graduate and undergraduate students. I asked a range of questions about prior exposure to XR, how they could imagine using XR, and what might motivate them to do so. From the results, I was able to begin creating programming to get students engaged with Studio X.

3 Conclusions

Although many humanists have embraced technologies in their research, immersive technologies are largely new territory for humanities and humanistic social sciences
faculty and students at the University of Rochester. The technology is expensive, has a steep learning curve, and often comes off as a novelty rather than a viable research tool. However, as we progress into the future, it is important to recognize the benefits that immersive technologies could offer these disciplines. It is clear to me that with enough guidance and support from Studio X, people will be much more likely to expand their research potential by working with XR technologies.

3.1 Moving Forward

Using the results from the focus group and the student survey, I was able to produce a plan to help Studio X move forward with the Humanities and Humanistic Social Sciences in mind. I created an Intro to XR workshop, which I have run several times with different variations depending on the group attending. In addition to this, I ran a Beat Saber Competition, a VR game that involves music and rhythm, as games were one of the most commonly used applications of XR technology mentioned in the survey results. I also wrote several informative blog posts to help people get a quick and easy introduction to XR. [4]-[6].

3.2 Final Thoughts

My personal experience with XR has been quite interesting, as I have been learning and immersing myself through the process of doing research for this project. I got my first VR headset, an Oculus Quest 2, just several months before starting this project. The sudden explosion from no exposure to so much through my own experimentation and research has been quite illuminating. As Creative Writing Major, I see the great potential that VR has for the Humanities and Humanistic Social Sciences disciplines. This project only fueled my passion for XR technology, which has led me down a path of pursuing more detailed research into VR and the future potentials it holds for us.

Acknowledgements

Thank you to Meaghan Moody, Emily Sherwood, and the Karp Family for making this possible and helping me on my journey to becoming a librarian. Thank you to all the students and Learning Initiatives Librarians who assisted me in this research journey.

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Light & Shadow App: A photo lighting workshop in Augmented Reality

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Abstract. The App Light and Shadow is a Portrait Lighting Workshop in Augmented Reality. The App allows students to virtually step into a full-size photo lighting studio and study the placement of studio lights for portrait photography in three dimensions. The App was developed during the covid-19 restrictions of 2020 and 2021 when in-person learning was not possible. The goal of the app is to recreate the photo studio learning environment and allow students to study the placement of lights in an interactive and immersive format. Students can use the App with a smartphone or tablet to view lighting setups from different points of view and visualize in three dimensions the effect of lighting on the portrait.

Keywords: virtual learning, augmented reality, photography

Introduction

During the pivot to remote learning brought on by Covid-19 restrictions and lockdowns students at all levels faced challenges such as isolation, disruption of access to learning spaces, and the need to learn courses at home. Traditionally, the photography classes I teach at university level include a section on studio lighting for portrait photography taught in person in a photo studio. I developed the Augmented Reality App Light & Shadow to give my students the option to use their iPhone or iPad to visualize the entire portrait studio environment as a life-size space where they can study virtually the interaction of light placement in relation to the portrait subject.

1.1 The In-person Learning Environment and Visualization in Augmented Reality

The in-person learning environment of the photo studio provides a space where students can see the placement of lights and see the effect of different light setups on the portrait subject directly. The photo studio allows students to see the entire portrait lighting setup and move around it to study it from different angles. The photo studio also lets students...
interact with the lights directly and try the setups themselves. The ability to see the entire scene and the relationship between the lighting and the person being photographed is useful to judge distances and the appropriate light intensity needed to recreate the same effect in their own photography. The in-person learning environment provides a descriptive, immersive, and interactive learning space, and Augmented Reality offered a way of introducing some of the immersive and interactive aspects in the home learning environment.

1.2 The Problem

Starting in March 2020 the pivot to remote learning brought on by Covid-19 restrictions and lockdowns meant that students in Canada, like most around the world, faced exceptional circumstances with a sudden shift to learning from home. The introduction photography classes I teach at university level include a section on studio lighting for portrait photography taught in person in a photo studio setting. With the turn to study at home, students relied on video lessons and written online tutorials. Based on the results students achieved, these online tools were mostly successful in conveying and describing photo techniques and principles for home learning.

For certain topics, such as studio lighting for portrait, the types of questions students asked suggested that being able to see the lighting setups in the round (like it would be possible in the classroom) would prove useful to clarify the lessons and aid in understanding the techniques.

1.3 Learning with a virtual photo studio.

Making use of Augmented reality and smartphones and iPads as teaching tools, the Light and Shadow App provides a learning option that aims to recreate some of the immersive and interactive aspects of in-person learning for students learning at home. The App uses 3D objects, a 3D scanned portrait model, in an Augmented Reality virtual space. Using the App with a smartphone or tablet, students can step into a full-size portrait lighting studio workshop anywhere they are. Users can learn about light placement for portrait photography by physically moving around the virtual portrait studio including the subject, the lights, the reflectors, and the backdrop. There are nine lighting setups for study and each scene includes a text panel describing the light set up and the typical use of it in portrait photography. The app is meant as a complement to the studio lighting lessons at introductory and intermediate level photo classes.

Originally developed for university photography students at Kwantlen Polytechnic University in Surrey, BC. Canada, the Light and Shadow App is now available in the Apple App Store for free to everyone with an interest in photography and portrait lighting.
Fig. 1. Light & Shadow Augmented Reality App. Black and White mode. Screencapture – iPad view.

Fig. 2. Light & Shadow Augmented Reality App. Color scene mode. Screencapture - iPad view in a home location.
References

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Collaborative Art Workshop in Virtual Environment

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Abstract. The proposed workshop will bring together VR artists in a collaborative workshop in visual arts, taking place exclusively in virtual environments. It will investigate the potential of the virtual tools in collaboration in a creative exercise with a non-firmly structured goal and the prospects of such platforms employing art in learning processes in public set-ups.

Keywords: Virtual Reality, Virtual Environment, Artmaking, Creativity, Visual Arts, Network.

1 Introduction

The past two years have acted as a catalyst for the usage of digital and VR platforms, thus showing the way towards an everyday life where we work, collaborate, communicate, and create independently if we all are in the same room or not. Although we have used such tools for years, we are at a stage where we use them unprecedentedly [1]. Simultaneously, as a virtual parallel world, Metaverse old has already been offering “space” for the development of art, exhibitions, education, collaboration, and the creation of whole worlds [2].

In such a time when our life has become more virtual-only recently, Meta was announced, introducing Metaverse to a broader audience, hoping to become as popular as Facebook – Art will keep up by maintaining its role of putting questions and challenging our culture and society. However, when we mean Art, we mean the finished outcome, which we will experience in some form of an exhibition. We tend to leave out the research behind it, one which expands in time, effort and experience and includes purposeful and purposeless creativity.

As the usage of digital tools increases, the artmaking process is inevitably incorporating faster, more “non-traditional” media. Therefore, it becomes imperative for the artists to come out of their lonely art studios and collaborate closely with technicians or other artists who may have higher expertise. Of course, the collaborative process could and can take place in physical space; however, since 2020 and the explosion of the
usage of online platforms, the collaboration has expanded more and more in the digital realm.

Therefore, one question arises: how does creative collaboration work in a virtual environment. How efficient could this environment be for the process, the offered tools, and the final outcome? In physical space, the directness between parties facilitates the process. However, although the virtual platforms are being updated, it seems that there is still a slight learning curve for their users, one which may detain the communication, at least at the beginning of the procedure.

2 Purpose and Objectives

The proposed workshop is part of a PhD research on the process of artmaking in VR regarding the usage of existing platforms and their effectiveness for the creative process in visual arts.

2.1 Objectives

1. Offer a definition of creativity in relation to the artmaking process in VR in comparison to analogue media

2. Initiate the creation of an interest group bringing together artists and computer scientists to discuss the gaps that need to be bridged to provide VR platforms with the required support port for the creative process

3. Investigate the procedure of collaboration in a VR environment when the purpose is a creative exercise without a structured goal

4. Give the opportunity to the artists to present their work to a broad audience with expertise in XR media and thus open a discussion on Art and XR

5. Trial the potentials of collaboration and exchange of ideas in the art process in a virtual environment, and research the further potential for learning through art, either in a general context or specifically in art.

2.2 Process

It will bring together VR artists from the Zabludowicz Collection and the Pangaea Sculptors’ Centre, based in London, UK and the researchers at the XRLab of the University of Westminster.

The proposed workshop for the iLRN will be the last stage of a three-staged empirical study.

- Stage 1 – it will investigate the platforms used by the artists in their creative process, as well as their preferred procedure or combination of
platforms and other media. It will initiate the first group discussion on creativity and artmaking in VR

- Stage 2 – it will explore creativity in VR through individual exercises in two aspects:
  
  (a) creating in a desktop platform where there is a margin of familiarisation with the tool (Unity & ProBuilder)
  
  (b) creating in a VR platform which offers an embodiment closer to the movement of the natural body (Open Brush)

- Stage 3 – this is the proposed workshop for the iLRN. It will inspect the aspects of collaboration within a creative exercise in a virtual environment. In particular:
  
  - All participating artists will be logged in the iLRN virtual campus
  - All collaborative processes will take place in the iLRN virtual campus
  - The Workshop will take place in the Innovation Gardens, where the presentation of the exercise will be presented in the main room, as well as the outcomes from Stage 1 and Stage 2.
  - The participating artists will be divided into groups of 3-to 4 and will be invited to work together to create a narrative of virtual environments, as they will be imported into FrameVR.io. They will have a room to themselves in the Innovation Gardens, as well as a Mural workspace created for the purpose
  - Each artist will have a scene loaded in FrameVR.io, which will have a built-in Stage 2 Workshop. Each group will aim to create a narrative between their scenes and add more elements, such as videos, images etc.,
  - Each constructed narrative of scenes of environments will be accessible to the public of the virtual campus.

3 Context and Theoretical Framework

As mentioned in the previous section, the proposed activities are a part of a more comprehensive study regarding the creative process of visual arts as it would occur in a virtual environment. The workshop output will support and evaluate the methodology and the long-term aims of the research. Having the chance to expand the workshop on the
iLRN campus, the aimed production of the study will fall at the core of the conference’s mission on the expansion of the learning and immersive technologies. In particular:

- It offers the opportunity for interdisciplinary collaboration between the audience of the iLRN and the participating artists for future creative and educative projects.
- It aims to collect initial data for creativity in virtual environments, thus, supporting the research on the assemblage of the artmaking VR toolkit. This toolkit could allow artists who work remotely or in groups not easily accessed to create art, collaborate, and communicate their work to a broader audience.
- It aims to create an Art and VR network, enforcing the presence of the values of the artistic method overall and in particular in education or educative public set-ups, thus contributing to the aims of Track 3 of iLRN.
- The workshop’s outcomes could support the further broadening of the VR collaboration, communication and learning opportunities within more disciplines in the STEAM community.

Acknowledgements

We would like to thank the XRLab at the University of Westminster, the Zabludowicz Collection, the Pangaea Sculptors’ Centre and the University of Westminster Research and Knowledge Exchange Office for supporting this workshop.

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Inclusion, Diversity, Equity, Access, & Social Justice (IDEAS)
Diverse Designs Create Liveable Cities: An Inquiry Learning Unit
Utilizing VR/XR Platforms to Explore and Create

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Abstract. In their first inquiry unit of 2022, Year 5 students at Knox Prep investigated the big idea Diverse designs create livable cities. A study into how cities are creatively designed to enhance livability and support diverse communities. The students explored the immersive use of virtual reality and augmented reality platforms to help initially explore and then ultimately demonstrate the depth of their understanding of the topic. In the finding out phase of their learning, the students learn the skills of assessing the livability of a city and then research how they might go about improving sustainable and inclusive practices within a city. Case study of Singapore Students explored existing architectural designs and city planning considerations to ensure they develop the concepts of empathy and inclusivity when thinking of the world's diverse communities. Students looked at specific examples of designs that were diverse. The students explored virtual space with the guiding questions - what designs did you notice? What is the impact of these designs on the city? What makes this city appealing to the population? The big idea of this unit is Diverse designs create livable cities and that the concepts are design, creativity, and inclusion. By encouraging the students to use virtual environments we are further aligning the learning experience with one of the unit’s concepts of inclusivity. The virtual environment of Frame VR enables students to demonstrate their understanding on a platform that all can access without the need for high-end VR headsets.

Keywords: Virtual, Augmented, Extended, Blended, Reality, Technologies, Virtual Reality, Mixed /Augmented Reality, 360-degree photo or video, Robotics, Pedagogical / Learning-focused, Interdisciplinary, K-12 (primary).

1 Introduction

As a primary school learning community of 770 students, we value becoming an inclusive and robust global community for immersive learning. Many of our students are from diverse backgrounds, have family dispersed around the world, and many family environments are
made up of non-English speaking parents or grandparents. The 24/7 nature of WebXR spaces mean that visitors can engage with synchronous and asynchronous experiences. The use of WebXR platforms such as FrameVR has such a strong application in the education sector, especially in the response to the current COVID19 Pandemic. Students are able to access the platform easily during remote learning or whilst at school and this provides a consistent, low barrier entry platform that reduces the disruption brought about by periods of isolation. Innovation. As a school we promote the mantra of Innovation Wrapped in Tradition. This means we consistently look to review and refine the learning experiences of our students whilst still maintaining a strong vision and culture based on shared beliefs and values. We provide our students with inquiry-based learning units which purposefully use technology to deepened student understanding. We promote a growth mindset amongst the students and social learning theory to allow students to explore and apply themselves at a level appropriate to their stage of development.

2 Audience and Outcomes

1.1 Audience

K-12 educators who seek to design and implement a unit of work that aims to develop empathy in their students, enhance understanding of inclusivity and diverse perspectives share student learning through VR platforms, and enable student creativity using VR platforms.

1.2 Outcomes

The audience, students, and employers will have the opportunity to engage with authentic student learning via immersive platforms and gain professional development in use of VR platform for showcasing student learning. It will enable students to develop skills and experience with VR platform support students to share learning with a wider audience due to VR platform.

3 Educational Significance and Impact on Advances in the Field

The learning framework at Knox Prep has a future focus providing educational experiences relevant to our students' diverse lifestyles through engaging and personally relevant inquiry topics. We focus on developing a deep understanding of connected concepts rather than rote memorization of facts. As a school community we can use virtual environments to connect with our communities both local and globally. The school in recent years has a large community further abroad. This platform enables our boys to make connections with those they are unable to see on a regular basis and foster positive relationships with them. We
have also had student teams running workshops in extended reality spaces at global conferences throughout the last two years and the boys always provide such a rich and engaging range of perspectives, skills, and competencies beyond their years.

4 Additional Information

To prepare for this presentation ahead of the hands-on workshop, please:

1. Check you have the latest version of the Chrome browser
2. Access the following site to familiarize yourself with how to move around https://framevr.io/
3. Check the top right corner menu (3 lines) containing all of the links and resources you need
4. Sign-in to FRAME with the Single Sign-in option of your choice (Google/Microsoft)
5. Complete the ‘Your Info’ section of Frame so students and other participants can identify to whom they are speaking
Abstract. This poster describes the process of creating a virtual reality (VR) training tool with the goal to reduce bias in law enforcement responses to domestic violence and sexual assault. VR training experiences have proven effective in improving decision-making skills, eliciting empathy, and creating an emotional connection between the trainee and the materials in many domains. However, law enforcement VR training solutions are currently concentrated in tactical topics, such as firearms training, or in first response scenarios, for example officer safety and de-escalation protocols for domestic abuse calls. Our prototype aims to fill a gap in training opportunities by providing an interactive VR scenario for participants to learn and practice victim-centered and trauma-informed interviewing techniques. We describe challenges encountered and lessons learned from the research and development process.

Keywords: Virtual Reality, Soft Skills Training, Gender Justice.

1 Introduction

Gender-based violence (GBV) is a pervasive problem that primarily affects women, girls, and LGBTQ+/gender non-conforming individuals and causes serious harm to families and communities [1]. The U.N. reports that, worldwide, one in three women have experienced physical and/or sexual violence at some point in their lives. Despite the prevalence of GBV crimes, less than 40% of women who experienced violence sought any assistance, and of those, less than 10% sought help from the police [2]. Victims who come in contact with law enforcement are commonly met with skepticism, hostility, neglect, and accusatory victim-blaming behaviors. Challenges to a victim’s credibility are especially common when the person is a member of a marginalized community. These hostile conditions pose a significant barrier for the victim’s ability to receive justice and minimize trauma.
When GBV victims’ initial reports are discounted by law enforcement, an investigation ends before it has begun. GBV cases often suffer from a lack of evidence gathering, which prevents proper investigation and prosecution, increases the traumatizing effects of the crime and exposes victims to re-offense or escalation of violence. We identified two key training areas that would improve the quality of GBV investigations and better support victims’ emotional needs, regardless of judicial outcomes. The first is helping officers understand the role of unconscious bias, also known as implicit bias, in their assessment and response to GBV crimes. The second is to educate officers of the effects of trauma on victims’ behaviors and their abilities to communicate the details of a GBV event.

Effectively addressing implicit bias is a complex training goal, and police investigations require officers to draw upon a highly dynamic constellation of procedures, techniques, and decision-making skills. An interactive virtual reality (VR) environment is an ideal format for officers to practice victim-centered, trauma-informed skills and uncover biases through interview scenarios with victims of GBV. Immersive, simulated interviews will provide law enforcement repeated opportunities to hone investigative approaches in a space that allows for risk-taking, exploration, and self-discovery. The ultimate goal for the VR training is to prevent additional harm to victims during the interviewing process.

2 Virtual Reality for Soft Skills Training

Virtual reality training experiences have proven effective in improving decision-making skills, eliciting empathy and creating an emotional connection between the trainee and the materials in many domains. In a study conducted by PwC, employees who completed the VR training course in diversity and inclusion felt 3.75 times more emotionally connected to the content than classroom learners and 2.3 times more connected than e-learners [3].

In an interactive narrative experience, learners are able to go through the module multiple times and make different choices. This supports skills-based learning, which is an effective pedagogical use of VR [4]. For these reasons, our prototype takes the form of an immersive VR scenario.

Law enforcement VR training solutions are currently concentrated in tactical topics, such as firearms training [5]-[7], or in first response scenarios, for example officer safety and de-escalation protocols for domestic abuse calls [8], [9]. We believe that a victim interview scenario is a novel area for VR training simulations and has the potential to increase the effectiveness of instruction based on current interviewing best practices.

2.1 Guiding Principles

- **Effective Use of VR.** While being mindful of trauma-inducing experiences, the prototype should be immersive and interactive in order to increase presence and
recall of information. The branching narrative adaptation of existing materials was written using a free online mind mapping tool before being implemented in a VR environment to be used with an HMD (see Fig. 1.). Informational interviews were conducted with experts in three fields: victim advocacy, police training, and VR soft skills development (for more on best practices, see [3], [10], and [11]). Based on this research, guiding principles for the prototype were defined:

- **Authenticity.** Scenarios, including crime details, assailant type, and victim profiles must be grounded in case studies, scenarios, role-play scripts or other materials provided by credible law enforcement or victim-centered advocate sources.

Fig. 1. In the VR interview scenario, the trainee needs to choose the appropriate response based on best practices for interviewing victims of gender-based violence.

3 Outcomes

Future work includes finalizing the prototype design based on feedback from our stakeholders on the content of the scenario, and then conducting a formal evaluation to determine if this new form of training is effective for increasing empathy and reducing bias. We also contribute lessons learned from adapting existing training materials into an
interactive VR scenario with a small team. Because of the novel use case of VR for learning, the importance of addressing issues of bias in law enforcement, and the potential for reducing harm to victims, we believe that this topic is very relevant to the iLRN community.

Acknowledgements

This work was developed in collaboration with the COURAGE in Policing Project at the University of Miami School of Law and the International Association of Chiefs of Police (IACP). It is supported by grants from DePaul University. The authors would like to thank Jeremy Blaker for his contributions to the initial research phase of the project.

References

K-12 STEM Education
Designing Effective Immersive VR Learning Experiences

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Abstract. How do we design effective immersive VR experiences? Looking Inside: Cells is a set of collaborative immersive virtual reality science learning simulations that were designed by applying best practices for learning experience design, taking advantage of the unique affordances of VR for learning. Simulations were designed with input from teachers and students and cover NGSS-aligned middle school science topics in cell biology, including plant cell, animal cell, and prokaryotic cells and their respective organelles, cell specialization, mitosis, and viral mutation. The interaction design of the simulation implements engagements with the learning materials that support deep learning. The collaboration design allows small groups to work on the simulation together. Emotional design was used to induce emotions that are conducive for learning. Classroom integration features are designed to support teachers’ use of the simulations through lesson plans, teacher professional development, a teacher dashboard, photo taking, and a spectator mode. Ongoing user research provides feedback from teachers and students that is used to refine the design with the goal to enhance learning outcomes.

Keywords: Immersive VR, Collaborative VR, Science Learning, Emotional Design.

1 Introduction

Looking Inside: Cells is collaborative immersive virtual reality science learning simulations covering middle school cell biology topics aligned to NGSS. The goal of the Looking Inside project is to develop research-based principles [1] for the design and evaluation of interactive science simulations in immersive virtual reality that promote collaborative learning. We applied best practices for learning experience design, which include the interaction design, emotional design, and collaboration design of the VR simulations. In addition, we supported the use of the VR simulations by teachers through a number of classroom integration design features. We will describe each of these design features in this paper.
2 Looking Inside: Cells

Looking Inside: Cells is a suite of interactive VR simulations for STEM learning in middle schools. All simulations are designed to facilitate collaborative, active learning experiences for small student groups. Allowing students to jointly explore interactive 3D simulations models provides them with the opportunity to make mistakes and come to a solution through dialogue and negotiation.

Looking Inside: Cells is comprised of several sections. In Build a cell, students use organelles to create an animal, plant, or prokaryotic cell. Specialize a Cell allows students to modify the generic model of a cell to create real, specialized cells that can be found in an organism, such as melanocytes, red blood cells, root hair cells, epidermal plant cells, e.coli, and blue-green algae. In Divide a Cell, students learn about mitosis by moving, removing, and adding organelles to progress the cellular division. Rather than identifying stages of mitosis in images of cells, students will be able to demonstrate their knowledge by creating each stage of the cellular life cycle. Finally, in Viral Mutations, students learn about mRNA, protein synthesis, and virus replication. These simulations were designed following best practices of learning experience design, which will be discussed next.

3 Learning Experience Design

3.1 Interaction Design

Looking Inside: Cells allows learners to actively engage with the simulations, following the INTERACT model [2]. They build cells by moving organelles to create a cell, changing generic cells into specialized cells by removing or changing organelles, and manipulate organelles to create cell division, see Fig. 1. These interaction modes are designed to foster relevant learning [3]. Explanatory feedback is designed to increase comprehension.
3.2 Collaboration Design

A central element of our VR simulation design is their collaborative nature [4]. Small groups of up to 4 learners can collaborate to interact with the simulations (see Fig. 2), and changes made by one user are updated immediately in the display of the other users. This feature allows for remote collaboration of learners and fosters shared cognition.

Fig. 1. Interaction Design in Looking Inside: Cells.

Fig. 2. Collaboration Design in Looking Inside: Cells.
3.3 Emotional Design

Emotional design is the use of a range of visual, auditory, and haptic design features to induce emotional states in the learner that are conducive to learning [5]. In *Looking Inside: Cells*, we employ two emotional design principles that have been validated by research. Visual design employs warm colors and round shapes where possible [6], see Fig. 3. Sound design employs short loops, a tempo between 70bpm and 110bpm, and a low dynamic range [7] and was designed to reflect and support the effects of the visual design.

![Fig. 3. Emotional Design in Looking Inside: Cells](image)

4 Classroom Integration Design

The integration of the simulation into the classroom is supported by sample lesson plans and protocol suggestions for teachers and teacher professional development in how to use the simulations in their classes. A photo taking feature (see Fig. 4) allows students to take photos of their work in VR and include them in their reports. A spectator mode allows visitors to observe students’ activities or to show the VR simulations on a smartboard. A dashboard [8] allows teachers to monitor student progress and identify students and groups who need additional help.
5 Conclusion

The design of effective immersive VR learning experiences should take advantage of the unique affordances of VR and base designs on best practices for interaction design, emotional design, and collaboration design. In addition, to support the use of the VR simulations by teachers, classroom integration design features should be included. In Looking Inside: Cells, we illustrate these best practices for learning cellular biology in middle school. Features we implemented were designed based on input from teachers and on our prior research. User research is ongoing, and we are refining the simulations according to the feedback we receive. Whether or not the Metaverse will be equitable, inclusive, and affecting positive change will be determined by the quality of the learning materials we design for it.

Acknowledgements

We would like to thank the Verizon Corporate Social Responsibility team for their generous support of this work. The opinions expressed are those of the authors and do not represent the views of Verizon.
References


Immersive Worlds: Inquiry Learning Through the Use of AR, VR, and XR

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Abstract. This presentation addresses the implementation of immersive learning in a K-12 STEM and Inquiry classroom. The creation of these spaces by students demonstrates the importance of the co-construction of learning experiences and the collaboration that can occur when even our youngest learners are introduced to the right tools in a carefully scaffolded framework. The skills demonstrated are vital for preparing the next generation for the immersive worlds of the future, whether it be education, social, recreational or workplace related.

Keywords: Virtual, Augmented, Extended, Blended, Reality, Technologies, Virtual Reality, Mixed /Augmented Reality, 360-degree photo or video, Robotics, Pedagogical / Learning-focused, Interdisciplinary, K-12 (primary).

1 Introduction

Over the past few years, the staff and students of Knox Grammar Preparatory school have been exploring AR and VR to enhance and deepen inquiry learning experiences. During 2021 the school has been further redefining virtual learning experiences through the creation of online workshop spaces on an extended reality (XR) web platform. This innovative approach allows the entire school community to engage with students in both synchronous and asynchronous experiences. Through this new medium, students can not only showcase online galleries of their final products but also explain the steps they followed in the inquiry process and demonstrate a wide variety of developing skills and competencies. Example of the extended reality platform developed by the Knox Prep students https://framevr.io/knoxpreppresentations.

The school has a focus on students being the creators and curators of the content in these virtual platforms as working collaboratively in this way develops future-focused dispositions and a highly agile skillset. Putting this into practice, students from across the grades recently ran live events in this virtual space, delivering tutorials to an audience of educators at a range of conferences around the world. They ran digital and design
technology workshops at the 7th International Conference of the Immersive Learning Research Network (iLRN 2021) and also at the International Society for Technology in Education Conference (ISTE 2021). The students were able to connect with participants in different parts of the world and ran engaging professional learning experiences which have since resulted in other schools adopting these technologies. Providing opportunity for our students to participate in virtual events such as these also forms an integral part of the school's drive to connect and form collaborations with communities in other parts of the world.

2 Audience and Outcomes

2.1 Audience

The target audience is K-12 educators, Software/Platform Developers. We will explore examples of creation within VR/AR current platforms and experience the future of extended reality as a way of engaging the school community at all levels. Kindergarten to Year 6 students will guide participants through a range of virtual, augmented, and extended reality projects. Sharing creativity in extended reality and coding simulations within virtual platforms will be discussed. Resources for implementing VR/AR and extended reality in an inquiry classroom will be provided.

2.2 Outcomes

The audience will gain an understanding of best practice methods of implementing virtual, augmented, and extended reality platforms into a K-12 education environment. A focus will be on inclusive activities which allow all students to engage and participate whilst allowing personalization and individualized learning to occur. This workshop is future focused, specifically targeting developing the skills and competencies within students ahead of their future endeavors in the interactive online immersive virtual spaces of the future.

3 Additional Information

To prepare for this presentation ahead of the hands-on workshop, please:

1. Check you have the latest version of the Chrome browser
2. Access the following site to familiarize yourself with how to move around https://framevr.io/
3. Check the top right corner menu (3 lines) containing all the links and resources you need
4. Sign-in to FRAME with the Single Sign-in option of your choice (Google/Microsoft)

5. Complete the ‘Your Info’ section of Frame so students and other participants can identify to whom they are speaking.

Aurora Simulator: A Software Application for Exploring the Aurora in Upper Elementary Science Classrooms

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Abstract. The Aurora Simulator is a web-based software application prototype designed to support exploration of the natural phenomenon of the aurora. The application is intended for use in a classroom setting with upper elementary school-aged learners and focuses on exploring the interactions of electrons entering the earth’s atmosphere with gas particles at a range of altitudes above the earth. The application features dynamic visual representations of gas particle-electron interactions that learners can initiate as they explore the simulation. Additionally, learners can create physical representations of electrons and interact with the application through a video sensing feature that detects physical objects based on color in the learner’s webcam view. During the session, participants will have the opportunity to engage with the Aurora Simulator application prototype. Participants can use built-in digital representations of electrons as well as physical representations of electrons of their own design to engage in the application.

Keywords: Nature, STEM, Augmented Reality, Elementary, Aurora.

1 Purpose of Application Prototype

Recommendations for improving science education in the context of the United States within the past decade have included designing learning experiences that engage learners in authentic science and engineering practices [2]. Simulation tools developed for use in science education can support learners in engaging in such practices [4], [5], [6]. While a simulation tool with affordances for exploring atmospheric gas particles has been developed [8], the author was not able to identify an existing tool with both features tailored specifically to the exploration of the aurora phenomenon as well as with the range of desired features for exploration within the simulation (such as engagement with both digital and physical representations of electrons). The Aurora Simulator software prototype was developed to address this gap. The Aurora Simulator is a tool designed for use in upper elementary science classroom settings that aims to provide an environment where learners can engage in authentic science and engineering practices in the context of exploring the
aurora. Rather than focusing on the transmission of facts, the application provides an environment that facilitates learners engaging in practices such as using a model and analyzing data. Additionally, the application prototype extends a screen-based experience into the physical world by allowing for engagement with physical representations of electrons.

1.1 Application Prototype Description

Please see the following short video for a demo of the application prototype: https://youtu.be/LYkI94pIxtk.

The Aurora Simulator software application aims for learners to develop an understanding of the nature of gas particle-electron interactions in the context of the aurora. The application seeks to provide a constructionist environment [3] where learners may construct an understanding of the aurora through their own personal exploration of the simulation. The application features a menu bar that allows for multiple menu items to be turned on or off at a given time, providing learners with a degree of agency to create different views and representations of the phenomenon. The affordance to explore the simulation in multiple ways aligns with the idea of epistemological pluralism [7] that acknowledges multiple ways of knowing and relating to the world.

![Fig. 1. Screenshot of application user interface with multiple menu bar items turned on.](image-url)
The augmented reality component of the application is accessed through the “Video” menu item on the menu bar. When turned on, the “Video” menu item changes the background of the user interface to the user’s webcam view, with a faint overlay of the space background that appears when the “Video” menu item is turned off also remaining visible. When “Video” is turned on, the application has been programmed to trigger gas particle-electron interactions when the gas particles are touching anything that is detected as the color black in the webcam view. The video sensing feature provides an alternative to mouse-based interaction. The flexibility to choose a physical representation of an electron rather than being restricted to the digital representations of electrons built into the software allows for some level of personalization and agency in the exploration of the simulation, potentially appealing to learners who prefer tangible objects over digital objects [1]. Additionally, through video sensing, multiple learners can potentially engage with the application simultaneously, facilitating a social learning experience.

![Fig. 2. Screenshot of application user interface with “Video” and “Gases” menu bar items turned on.](image)

Ideas for further developing the prototype include incorporating features that allow for a more in-depth exploration of processes related to light emission, as well as features that support exploration of other aspects of the aurora such as the shapes of auroral structures. Ideas for improvement to the video sensing feature include incorporating motion detection technology as a possible avenue for providing learners with opportunities for embodied learning experiences (such as tying learner motion to a variable quantity relevant to the
simulation) or if using color detection allowing for learners to select the color of the object to be detected. Future iterations of the application might also provide additional support for engaging in science and engineering practices, such as improving features for data analysis. Feedback from implementations in a classroom setting would also be beneficial in informing future prototype development.

1.2 Recommendations for Implementation

Based on the current prototype, recommendations for classroom-based implementation include introducing the simulation within an activity where learners are positioned as investigators of a natural phenomenon and are given agency to explore the simulation, make observations, and generate questions and analyses. The instructor might model basic navigation and use of the simulation as well as provide guidance to learners around the process of documenting their observations and questions. Following a period of learner exploration with the simulation, the instructor might facilitate a group discussion of observations, analyses, and questions to inform future explorations.

Acknowledgements

The author acknowledges faculty and students in the Communication, Media, and Learning Technologies Design program at Teachers College, Columbia University who provided feedback on this project.

References

Language, Culture, & Heritage
VR Piazza Italiana: Learning Language and Culture Through Presence and Embodiment

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Abstract. Piazza Italiana is a VR environment and interactive Italian built on Mozilla Hubs and meant to be integrated into the curriculum of a second-semester language class. Our Experience takes you “inside” a Beginner's Italian textbook chapter dedicated to food and shops. The environment is designed on the model of a typical Italian piazza, a center of town where people shop, visit coffeehouses and restaurants, walk, and congregate. Within this VR piazza we plan to showcase three different immersive spaces -- an ice-cream shop (gelateria); a grocery shop (alimentari); and a pasta shop (pastificio) where the visitors will be able to perform sequences of task-based activities that engage immersive to improve and better retain their learning of Italian. We want to show how VR's provision of simulated realities engages students to learn and adapt to a language by interacting with and deriving meaning from it, as they use an infinite range of virtually recreated real-life contexts to support the way they develop their speaking and listening skills.

Keywords: virtual reality.

1 Proposal

1.1 Relevance to the Topic

Our presentation will be the companion of a Guided Adventure we are concomitantly submitting. In the presentation we will discuss our process and show how our prototype argues in favor of WebXR custom built environments as mini labs where to consider the scientific, technical, and applied potential of digitally enhanced immersive learning environments for language and culture teaching. It explores research questions to advance a shared understanding of the needs of Higher Ed language learners as well as use cases for XR accessibility. It promotes inclusive design for immersive and XR technologies in educational institutions as well as in the broader reskilling ecosystem. And it collaborates with standard development organizations (e.g. W3C, XRSI, OpenXR, etc.) on
accessibility user requirements and practices for hardware, platform software, and content in higher education language classes.

1.2 Objectives

In determining the character of our experience, we had several sets of goals in mind: (1) course goals; (2) disciplinary goals; (3) campus goals.

(1) Course goals: In keeping with the principle of backward course design, we identified learning goals consistent with the unit in which we placed the immersive experience.

(2) Students’ interaction in the virtual environment should also allow them to meet pedagogical goals consistent with our discipline and defined by ACTFL’s World Readiness Standards [1].

(3) Finally, we wanted the objectives of the specifically VR learning environment to map onto the broader learning goals of our University’s General Education Curriculum, especially the IDEAs in Action Curriculum [2].

1.3 Perspectives

WebXR and a new way of thinking immersively about concepts which traditionally are presented in 2D forms via textbooks (or more recently videos on a screen) offers exciting opportunities for foreign language learners in particular. For example, outside of languages, research suggests that augmented reality visualisation had positive effects on the spatial abilities of engineering students. Given the importance for language learners to develop deeper, more idiomatic language in order to demonstrate their aptitude in speaking and writing, providing more realistic 3D virtual models of objects which are found in similarly three-dimensional form in the real world will result in equally improved levels of language ability, as demonstrated by the kinesthetic language learning on the Words in Motion platform [3].

To design the experience, we adopted a task-based-learning prospective. Within the TBLT framework, tasks are defined as activities “where meaning is primary; there is some communicative problem to solve; some sort of relationship with real-world activities; and the assessment of task is in terms of a task outcome” [4]. The driving force behind this approach - and one that VR supports through its provision of simulated realities is that students may learn and adapt to a language by interacting with and deriving meaning from it, as they use an infinite range of virtually recreated real-life contexts to support the way they develop their speaking and listening skills.
1.4 Looking Forward

During the piloting phase of the implementation of our project, we anticipate that 100-120 undergraduate students will be impacted directly. We hope to build upon the success of the pilot to expand it for use in French and Spanish in the following years. Such a broad effort will introduce 25 to 30 faculty and graduate teaching students to the pedagogies of immersive learning and teaching.

Eventually, we hope that many more students will be served by this initiative, as we become better trained in the use of these technologies and find innovative ways to integrate them into not only our lower-level courses but our intermediate and upper-level courses as well. We believe in a diffusion model that relies on a network of peer support for our colleagues who may adapt these technologies to their existing courses and to new courses as well and leads to collaboration with faculty and students in allied departments in the Humanities. Initiative and innovation in teaching and service have become an integral part of the professional development of our PhD students. Experiences in designing innovative lessons within emerging technologies development environments help our graduate students become confident and creative instructors, and moreover help them distinguish themselves when they go on the job market.

The ultimate beneficiaries of course are our undergraduate students, who will be empowered by the new tools with which they learn to communicate in a more effective manner in the foreign language, increasing their confidence and retention, as well as the communities all over the world that could be served by such innovations.

References

1. ACTFL’s World Readiness Standards [2015].
2. IDEAs in Action
A Mile in my Shoes: Immersive Platforms for Sharing Language, Culture, & Heritage

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Knox Grammar Preparatory School, Wahroonga, Australia
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Abstract. This presentation addresses the issue of sharing and retaining stories, language and heritage within any community. Communities are built on connections and over time and distance, these stories can get lost or details forgotten. This project provides an overview of one school's approach to capturing and sharing these vital narratives in the form of an immersive time capsule for generations to come. K-6 educators who seek to design and implement a unit of work that aims to: develop empathy in their students, realize the power of storytelling, share student learning through VR platforms, enable student creativity through the use of VR platforms, build an understanding of artistic expression and its forms enhance understanding of cultural perspectives.

Keywords: Immersive, Culture, Virtual, Heritage, Storytelling

1 Introduction

In their Inquiry unit for Stories of the World and its People, Year 6 students at Knox Prep investigated the big idea Artistic expression connects people. In the finding out phase of our learning, the case study explored different forms of artistic expression including oral storytelling, music, light festivals, and dance. Students learned about how these forms of artistic expression are used by diverse communities around the world to share their culture and stories with others. The main artistic expression that students focused on was storytelling. They spent time learning about and listening to examples from the Empathy Museum's Virtual Mile in My Shoes exhibition, which used artifacts and oral storytelling to share the stories of individuals.

Through these experiences, students were able to make connections to the stories they heard and between their lives and the lives of others. For their independent inquiry, students set about curating a virtual space, in FRAME VR, telling the story of an individual from within their family or community. They began by interviewing their chosen person and spent time reflecting on their story and the impact it had. Students then curated a virtual shoebox of artifacts and photographs relevant to the person. Each boy in Year 6 created an
audio recording telling the story of someone else, which is designed to be listened to while viewing the artifacts within the shoebox. The greatest learning that came from this unit was the way students developed connections with and empathy for others. Through hearing about the life experiences of others and understanding a different perspective, they were able to make connections.

2 Benefits of this Presentation

Observers will be able to understand the inquiry process, develop a unit of work that develops empathy in their students, builds an understanding of artistic expression and its forms, enhance understanding of cultural perspectives, realizes the power of storytelling of student learning shared through VR platforms, and enable student creativity through the use of VR platforms. It will benefit the audience, students, and employers to: engage with authentic student learning via immersive platforms, professional development in use of VR platform for showcasing student learning, enable students to develop skills and experience with this VR platform, and enable students to share learning with a wider audience due to this VR platform.

Ahead of the hands-on workshop please do the following:

1. Check you have the latest version of the Chrome browser.
2. Access the following site to familiarize yourself with how to move around
   https://framevr.io/
3. Check the top right corner menu (3 lines) containing all the links and resources you need.
4. Please sign into FRAME with the Single Sign-On Option of your choice (Google/Microsoft).
5. Please complete the 'Your Info' section of Frame so students and other participants can identify who they are speaking with.
6. Access and bookmark the following sites:
   https://learn.framevr.io/
   https://learn.framevr.io/resources
   https://framevr.io/promotingstudentagency
Fig. 1. Year 6 love to use office spaces to run student-lead workshops.

Acknowledgements

A special acknowledgement to all the hard-working Year 6 students at Knox Prep.
Envisioning the EUt+Verse: A Common VR Space for the European University of Technology Consortium

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Abstract. This session aims to present the vision and proposed specifications for EUt+Verse, a transcultural, multilingual, and trans-institutional VR environment for the Erasmus funded European University of Technology (EUt+) consortium. Starting from a project aimed to prepare EUt+ students and staff to overcome language and cultural barriers to international mobility, the EUt+Verse has developed into a more complex vision. The session will describe the work process undertaken by XR Project Team and share the Team’s experience with framing the project in accessibility and ethical approaches to XR.

Keywords: Transculturality, Multilingualism, Accessibility.

1 The European University of Technology Project

The European University of Technology (EUt+) [1] is an Erasmus funded project that brings together eight European universities of technology, namely,
- Technical University of Sofia - Bulgaria (TUS)  
- Cyprus University of Technology - Cyprus (CUT)  
- University of Technology of Troyes - France (UTT)  
- Darmstadt University of Applied Sciences - Germany (H_DA)  
- Technological University Dublin - Ireland (TU Dublin)  
- Riga Technical University - Latvia (RTU)  
- Technical University of Cluj-Napoca - Romania (UTCN)  
- Technical University of Cartagena - Spain (UPCT)
The EUt+ consortium aims to collaborate at co-constructing the future 'from eight to one’ integrated, diverse, and inclusive European University of Technology. The EUt+ shared vision is articulated around a central pillar, ‘Think Human First’, as the consortium views technology as human-centred, about people, about values, about actions, about objects in the immediate or distant environment (see Fig. 1).

Fig. 1. A Ut+ principles [2].

The EUt+ project is organised around eight work packages. Work Package 2 (WP2) deals with themes of inclusiveness, embeddedness, multiculturalism, and multilingualism.

2 XR Project Team

The XR Project Team works within WP2, in the EUt+ project. The Team involves 20 participants across the eight universities within the EUt+ consortium. About a third of the participants come from a technical background, with expertise in designing with and for immersive technologies, such as virtual reality or augmented reality. The rest of the team’s background is in the Humanities, with many having an expertise in intercultural and transcultural studies and/or Computer Assisted Language Learning. The Team was tasked with analysing the needs, visualising, designing, and developing an Extended Reality (XR) approach to support students and staff of the eight participating universities overcome language and cultural barriers in international mobility, as they collaborate and form closer bonds. The aim XR Project Team’s work is in line with the EUt+ vision as illustrated in Figure 1, above. It is to enhance the experience of physical student and staff mobility and collaboration, and to ensure that international opportunities for students are as inclusive as possible, while supporting plurilingualism and multiculturalism through immersive technologies.
3  EUt+Verse

The goal of the XR Group is that each student registered at the European University of Technology (EUt+) as well as all staff of the EUt+ will soon feel at home on every campus and be able to freely move from one country to another having been exposed to the multicultural and multilingual environment through the EUt+Verse.

3.1  EUt+Verse, the Vision

EUt+Verse is envisioned as an environment that can be used for meetings, work collaborations, curricular integrations as well as in the context of social, fun, and supportive activities. We want to make it easy and enjoyable to connect and initiate joint projects – courses, research projects, but also social, cultural and community building projects.

Through EUt+Verse staff and students will be given access to a three-dimensional space that will allow them to visit and experience the eight different campuses in the eight countries, connect with their counterparts and explore other cultures and languages. The applications and the affordances envisioned for the VR platform focus on the creation of familiarity with the different campuses, students and staff, and the lowering of thresholds for meeting new people. This will ideally facilitate the creation of friendships, work collaborations, and lasting student and faculty relations.

3.2  EUt+Verse, Work Process, Accessibility, and Ethical Approaches

The diversity of disciplinary backgrounds in the EUt+ Team made for a challenging but rich working environment as the group went through a period of adaptation to come to understand each other’s respective ‘languages’ in terms of disciplinary expertise and non-native use of English.

The EUt+ XR team’s collaboration evolved in different stages, following an iterative process, encompassing practical decisions on technical choices and, at the same time, dealing with the challenge to meet its objective for inclusivity. Integrating principals of Universal Design for Learning (UDL) and ethical considerations added to the multi-layered considerations needed to meet the project specifics for functionality, and multicultural and multilingual experience for all.

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Medical & Healthcare Education
eXtended Reality as Training Tool for Procedural Training: Learnings from the User-Centred-Design Process and the Implementation of Two Use Cases

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Abstract. Mindconsole GmbH has engaged with two customers in the development of two use cases regarding procedural training. Within the associated design process a number of stakeholder meetings has taken place were requirements and training goals have been defined and stakeholder roles identified. In addition, the detailed course of the procedures, the potential errors and distractions that can appear have been recorded. Based on these different sources of information we utilized our gamification knowledge and experiential and procedural learning principles to translate these requirements into implementation requirements for two virtual reality based self-led training applications. Frequent inclusion of future end-users in user-centred-design reviews within the implementation phase resulted in additional feedback and updated requirements that ensured high acceptance of the final applications. The final applications feature a three step self-led training approach: Initial training is assisted by a virtual robot trainer with speech interface, this is followed by a training phase where trainees are able to go through the procedures with or without text-based assistance (shiftable by the trainee). The final stage represents an examination where the trainee has to successfully go through the procedure without assistance. In order to evaluate acceptance and UX of the applications we conducted a qualitative evaluation with the future trainees. Therefore, we will report on the different requirements, the issues we encountered throughout the user-centred-design reviews and the results acquired in the final evaluation of the two applications.

Keywords: Experiential Learning, Phenomenological Learning, Safety Procedures, eXtended Reality.

1 Proposal

Please use this formatting template to submit your paper. It shows the fonts and styles required as part of the iLRN guidelines for the Practitioner Stream conference proceedings.
The proposal length is 1000 words maximum (excluding references and appendices). Your paper may include works in progress.

1.1 Relevance to iLRN

Note our work presented in this paper we set out to create prototypical XR applications that utilize gamified and phenomenological [5], [4] as well as experiential learning theories [1], [2], [3] in order to be able to study the advantages and learning improvements that can be achieved by these approaches. Our aim with this paper is to share the experiences and learnings we have gathered throughout the whole process of this user-centred-design (UCD) implementation process starting with the stakeholder workshops, the derivation of technical and implementation requirements, results of the re-occurring UCD reviews and the qualitative evaluations with the functional prototypes in the end.

In the course of the presented implementations, we have first determined how medical procedure and safety-relevant learning content is currently taught in existing curricula. Furthermore, together with our customers we identified safety-relevant problems that might be better trained with XR and phenomenological learning approaches compared to currently used methods. This assumption is based on the fact that XR will enable trainees to perceive and experience the learning content (= converted into phenomena) sensually and physically (physiological reactions caused by digital stimuli are described exhaustively in the literature). Thus, the trainee is involved in the phenomenon in an individual (personal experience) and at the same time intersubjective way (possibility of subsequent digital observation of his/her own actions in a situation). In addition, the training content can be presented to each participant in an equally controllable and repeatable way, or to train dangerous moments in a repeatable way. Hence, the XR assisted learning process should result in better learning performance.

Another important question we set out to shed light on was the integration of these new digital technologies into existing training concepts. Therefore, we engaged with trainers in design fiction workshops to ensure that integration does not lead to an additional burden for trainers and to better understand what benefits for them could be achieved. Based on this data, we created learning scenario descriptions and transformed them into prototypical digital learning content and game-based learning approaches in a further implementation step. Based on these prototypical implementations, an empirical evaluation has been conducted with the stakeholder groups regarding learning experience and performance. In the context of this evaluation, the future acceptance of trainers and trainees and the socio-economic feasibility have been considered. We will present these results as we will make the respective implementations accessible at the conference.

1.2 Purpose and Objectives

The purpose and the objectives of the described implementations have been set as follows:
• Analysis of existing curricula with regard to the teaching of safety-relevant knowledge and the learning success in this area.
• Analysis of safety-relevant problems.
• Definition of scenarios for the (learning) of safety-related actions.
• Implementation of new digital learning concepts for the two use cases based on the scenario definition.
• Ensuring that the new digital learning concepts can be integrated into existing forms of training and distance learning.
• Empirical evaluation of acceptance, the training and education experience as well as the learning success.

2 Perspectives

The perspective of the work presented here are insights gained from practitioners regarding the implementation of XR training technologies in accordance with theoretical frameworks from phenomenological and experiential learning as well as gamification approaches. Furthermore, practical trainee feedback to XR training implementation will be presented and made available to the scientific audience throughout our poster appearance. Thereby, we will contribute implementation (can be tried out at the conference) and evaluation results from applications used in real world learning and training settings.

3 Conclusions and Recommendations

Through our real-world experimentation and evaluation, we have identified that the training of safety and medical procedures through XR technologies is well accepted by trainees and delivers improvements in learning transfer performance (time and retention wise). Furthermore, we have derived a description language that enables a semi-automatic creation of the content structure and related trainee (inter) actions. Such a description language can serve as input for following AI based refinements of automated content creation that would drastically reduce costs and content production time.

References


Simulation for Healthcare Students: Lessons Learned from COVID 19

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Abstract. Part of the higher education (HE) experience of our healthcare students is to implement theoretical lessons learned within a practice environment – most often within the country's National Health Service (NHS). With the emergence of the worldwide Covid19 (C19) pandemic, HE institutions had to reconfigure ways to support students to experience practical elements of their course online or via simulation. With the help of external funding from Health Education England (HEE), Bournemouth University piloted a variety of simulated projects across a variety of professions including paramedicine and child and adult nursing. Students were able to access simulated skills via online and virtual reality (VR) resources, contributing to their learning experience during a worldwide pandemic. This has created a platform for further investment and educational pedagogy around simulation in healthcare provision, contributing to workforce development and future proofing educational establishment.

Keywords: Simulation, higher education, healthcare, students, C19.

1 Introduction

Higher Education Institutes that deliver education and clinical skills training to healthcare students in the United Kingdom (UK) have had to reconfigure education delivery due to the implementation of three national lockdowns spanning from March 2020 to March 2021 [1]. Bournemouth University offers a wide variety of healthcare degrees ranging from undergraduate degrees in Adult and Child Nursing to Paramedic Science. All healthcare degrees consist of theoretical and practical components. Whilst it remained relatively easy moving from face-to-face to online theoretical delivery via Teams or Zoom, addressing the practical components, which include clinical skills and students attending NHS trusts for practical experiences, was far more difficult. To address this change in educational pedagogy, Bournemouth University embarked a variety of online and virtual reality simulation projects. These were funded by Health Education England (HEE) as the C19 pandemic stopped face- to-face teaching and led to a new paradigm in healthcare that
increasingly involved technology and innovative ways to provide education and training [2]. Simulation is a valuable way of enhancing technology and improving patient care and safety and with the support of remote facilitation, has been shown to significantly improve the performance of healthcare learners [2]. Using immersive technologies such as VR can revolutionize healthcare education and offers new and innovative ways to engage all students.

Our project consisted of three pilot projects: VR feedback as a reflective tool for paramedic students, simulated online case studies for adult nursing students and 360-degree camera filming with VR for child nursing students.

1.1 Pilot Projects

The first project - Exercise Martian Attack! - was aimed to reconceptualize simulation during C19 for paramedic students with the creation of a short video setting the scene for clinical tasks first year paramedic students needed to achieve. Three-hundred-and-sixty-degree film clips (sample in Fig 1) captured these simulated scenarios and debriefs and were added on a virtual platform hosted by Panopto so that students could reflect on the scenarios in their own time to aid their learning and reflection. The film clips were accessible through a range of technologies, from google cardboards to Oculus Quest™, added the high-fidelity aspect of realism to the student’s learning experience.

Fig. 1. The introduction to Martian Attack! for paramedic science first year students.
The second project used virtual simulation case studies hosted by Laerdal® to teach nursing students how to recognize and respond to deteriorating patients in a timely manner. The case studies included anaphylaxis, acute exacerbation of asthma, chronic obstructive pulmonary oedema and blood transfusion. This pilot’s work was published [3] and evidenced that virtual simulation had a significant effect on improving knowledge and clinical skills in student nurses when recognizing and responding to deteriorating patients.

The third study – Assessing baby Robin – aimed at using 360-degree videos (Fig 2) accessed via Google Cardboard and Oculus Quest™ headsets to scale the clinical simulation experience for child nursing students. Evaluation of this pilot project showed that using virtual simulation helps prepare students for in-person simulation, saving face-to-face time and allowing students to access the platform at times which are most suitable for them.

![Fig. 2. A snapshot of the 360-video clip used to assess Baby Robin.](image)

### 2 Conclusion

Simulation is the future of healthcare and has grown significantly in the last few years [4]. It also provides an interesting and dynamic alternative to face-to-face didactic teaching as evidenced by C19, which created new opportunities to use and deliver simulation to healthcare students. Simulation can also help to redesign models of care and support student redeployment as was evidenced during this pandemic and these pilot projects provided a basis for further external investment. Simulation can also extensively contribute to how we support delivery of healthcare to our future workforce that is safe, of high quality and promotes improvement within the health and care systems in the UK and further afield.
Acknowledgements

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Co-creative Virtual Reality Content Development in Healthcare; Evaluation Methods and Curricular Integration.

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Abstract. Virtual Reality (VR) has evolved prolifically in healthcare education. Through participatory design methods, an iterative design process can cater to highly complex bespoke themes and learning objectives. However, another key challenge for VR in healthcare education remains open and this panel session aims to explore. Higher education institutions (HEIs) are reluctant to integrate VR and other immersive media in their curricula. Vocational education and continuous professional development actors in healthcare are using these resources but only experimentally. Individuals usually consider these educational resources novel but also, at times, something of a novelty. Two are the core challenges in the acceptance and curricular integration of these immersive learning resources. The first and primary, is the establishment of a valid, uniform, pedagogically sound evaluation framework for all dimensions of VR resource utilization in healthcare education. The second challenge, tied to the first, is the accreditation of educational episodes that contain VR resources as core instrument of instruction. These challenges, their theoretical underpinnings and a glimpse on emerging trends are going to be tackled in this panel. Taking cues from the considerations of real-world anatomy resources developed for the ENTICE project, experts in the fields of medical education, immersive resource evaluation and healthcare policy-making will explore these themes. Short introductory opening statements from the panel will serve as jumping – off points for practitioners in healthcare education, technologists and learners to exchange views and synthesize a collaborative position regarding these important challenges for immersive healthcare resources.

Keywords: Virtual Reality, Evaluation, Healthcare, Education, Curricular integration.
1 Relevance

Virtual Reality and other immersive media are established as a recognized immersive learning modality in the field of healthcare education. Both its cognitive and affective impact is identified ([1]-[4]). VR facilitates engagement, affectively, but it also is unrivaled in building a scientific paradigm through visualization of complex, sometime abstract concepts and mechanisms ([5], [6]). This audiovisual immediacy, however comes at a price.

The global healthcare market even within the COVID-19 financial hardship stabilized in 2021 at USD 1.207 billion with an estimate for 2028 at USD 11.658 [7]. To put the cost side of these numbers into perspective, the cost of a VR evacuation protocol training exercise in 2019 was priced at $106387.00 [8]. This resource was made sustainable due to the reusability of the material against the recurring costs of each live training exercise.

In that context, participatory design approaches further reduce overheads, time and resource-wise, in digital content development [9]. Several toolsets and iterative development strategies like SCRUM and AGILE have been implemented to support co-creative methods ([10], [11]). Furthermore, visual programming and brainstorming tools, together with semantic back-ends facilitate this process technologically [12].

Moving past the content creation challenge, the next hurdle that emerges is that of educational acceptance. While bespoke VR resources can and have been individually evaluated/accepted for purpose, a complete, valid, uniform, pedagogically sound evaluation framework for VR resources, even within the scope of healthcare education is not yet prolific.

2 Purpose and Objectives

Healthcare education is one of the most rigorously regulated fields regarding accreditation of curricula, training resources and programs. Out of 195 countries in the world, 183 of them have at least one national body that is responsible for accreditation of either healthcare-specific or general educational activities [13]. Of course, there are several transnational or international institutional stakeholders, which advise or even federate national regulatory bodies such as the World Federation of Medical Education under the auspices of the World Health Organization [14]. The end goal of this rigorous environment is the prevalence of Competence Based Medical Education and Entrustable Professional Activities, that is verifiable, results oriented curricula that will reliably create a capable and effective healthcare workforce [15]-[17].

In that environment, VR resources are sometimes viewed at best as a luxury and at worse as a technological novelty by veteran medical educators. That is why a rigorous, evidence-based evaluation endeavor is always necessary for every healthcare education resource.
Even beyond that, as VR resources become more prolific in healthcare education, the necessity emerges for a consistent, if not rigorously validated, streamlined evaluation framework for VR resources. Several endeavors have been conducted to adopt general instruments of technology evaluation (e.g. TAM [18]) with significant progress [19] a VR-specific “360o evaluation” framework for healthcare education is still missing. Such a framework, validated towards competence based medical education, adopted for VR in healthcare, but not resource specific would be the core prerequisite for a massive shift in scale of proliferation for these immersive media in healthcare curricula.

3 Context and Theoretical Framework

The core problem one faces when tackling the “VR powered educational episode” evaluation, as a holistic use case and not as a single novelty, is the fact that there is not a “one size fit all” evaluation methodology. One can evaluate the technology using standardized instruments and questionnaires. Alternatively, they can evaluate knowledge retention through topical bespoke questionnaires. However, they are not able to create a “one size fit all” validated instrument that evaluates the efficacy of a VR empowered educational episode. This does not mean that it is impossible to endeavor towards a holistic framework of evaluation for immersive educational episodes. The fact of the matter remains that from its inception technology enhanced learning, even more so VR, was deemed a constructivist’s tool of instruction. It should easily follow, then, that to manufacture the holistic framework for its educational evaluation, one should resort to a qualitative-mixed methods approach, the arsenal of choice for evaluating constructivist pedagogical endeavors [20],[21].

This simple realization is behind the evaluation planning of the ENTICE project. Since its inception we focused in evaluating the VR empowered educational episode and not the resource itself. In that context our approach and our aim for a holistic VR medical education evaluation framework will revolve around a mixed methods approach with overarching context provided by qualitative evaluation and technical details, or refinements provided by formal quantitative instruments (e.g., TAM etc. [19]).

4 Conclusions

The previous discussion about the theoretical underpinnings and the technical necessities of evaluation, usefulness and subsequent, curricular integration is not yet closed. Immersive medical education through VR and other such modalities comprises a multitude of diverse stakeholders. Even the dimensions of evaluation of these resources cannot be categorically defined without taking into account the context of the educational episode. That is why, in the ENTICE project, edu-centric anatomy VR and 3D printed
resources are evaluated framed in the educational episodes for which they will be deployed. That is why a mixed methods approach, starting from formal questionnaire instruments but incorporating, as a matter of protocol, not ad-hoc, qualitative instruments like semi-structured interviews is necessary. Qualitative results provide the correct “positioning” of both technical and pedagogy-oriented instruments and allow for a true competence based medical education with these resources. Mixed methods reveal VR resource’s applicability scope, facilitating both fitness for purpose and repurposing potential in the context of competence-based education in healthcare.

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Marine XR: The Impact of an Immersive Learning AR App on Student Motivation and Engagement with the Biology, Ecology and Conservation of Basking Sharks

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Abstract. There is growing evidence that technology-enhanced teaching can foster engagement in scientific literacy for all students. For example, immersive educational technologies, such as augmented reality (AR), focus on engaging students by providing interactive experiences that intrinsically motivate them to explore both virtual and real environments for science learning. We developed a "tap-to-place" highly immersive augmented reality application, Marine XR, that uses the principles of gamification, simulation, role-playing and immersion to engage students in scientific concepts. Marine XR focuses on one of the world's ocean giants, the basking shark, to teach students fundamental scientific skills, while simultaneously emphasizing the importance of ocean conservation. We conducted a controlled experimental study comparing the impact of Marine XR to a more traditional web-based learning module in a large, first-year environmental sciences class under remote learning conditions (~200 students). Specifically, we measured how motivation, engagement, engrossment, and cognitive load differed between the two groups within the context of their attitudes towards science (as assessed by the Modified Attitudes Towards Science instrument). In addition, we investigated whether Marine XR could increase motivation to participate in a subsequent learning experience. The results of the study and its consequences will be discussed.

Keywords: Augmented Reality, Serious Games, Marine Biology, Gamification, Simulation.

1 Introduction

Preparing our students to help solve the world’s most complex challenges necessitates an interdisciplinary approach to teaching and learning that fosters the development of STEM competencies (science, technology, engineering, and mathematics). Hands-on and experiential learning has always been a cornerstone of science education and as post-secondary institutions transition to hybrid campuses, it is critical that we create engaging
digital experiences that maintain and expand on our capability to develop scientific literacy and knowledge in our students. An important consideration in creating these experiences is minimizing the ‘engagement gap’ between science and non-science students, which threatens to reinforce disciplinary siloes and jeopardizes equitable learning and enhanced scientific literacy within the general public. There is growing evidence that immersive educational technologies, such as augmented reality (AR), are excellent at engaging students from diverse disciplinary backgrounds by providing interactive experiences that intrinsically motivate them to explore both virtual and real environments for science learning.

The use of augmented reality (AR) in education, defined as “technology which overlays virtual objects (augmented components) in the real world”, has rapidly increased over the last decade [1]. One area where AR tools have been used frequently is in science education [2]. At present, there is a literature gap surrounding the relationship between immersion in augmented reality and learning. Further exploring this field can make a great contribution to science education as immersion is theorized to support insights of complex scientific phenomena, situated learning, and transferring skills learned to the real world [3]. Georgiou and Kyza further explored these relationships by focusing on motivation as an individual difference contributing to the discrepancies in results among studies [4]. Both domain-specific motivation and cognitive motivation were predictors of immersion on different levels [4]. Domain-specific being able to effectively predict student engagement, an entry-level of immersion. On the other hand, the students' cognitive motivation effectively predicted higher levels of immersion including engrossment and total immersion. Overall, results from the study supported the positive relationship between immersion and conceptual learning [4].

1.1 Motivation and Engagement

Student academic achievement is often highly influenced by their motivation levels as well as engagement, making these factors a great foundation for educational studies. According to content and bibliometric mapping analysis, both high engagement and increased motivation in science concepts were observed when using augmented reality applications [2]. Many science and biology discipline-focused studies that examined these factors found that incorporation of AR technology had a positive motivational impact on the students [2]. A study by Ferrer-Torregrosa et al. (2014) explored AR in anatomical education and it was found to be beneficial for student motivation, as it allows for independent work and spatial interpretation [5]. Immersion, on the other hand, involves both cognitive and emotional involvement [4]. The higher levels of immersion, engrossment and total immersion were predicted by the students' cognitive motivation. The greater the degree of cognitive motivation the student has, the better they will focus on the activity and by extension be immersed into it. In general, AR has been suggested to increase science interest [6] and
therefore, for the delivery of science concepts, using AR could help increase both the students' motivation and engagement and by extension, their overall academic achievement.

1.2 Research Study

In this research project, we developed an AR experience on ocean ecology and one of Canada’s ocean giants, the basking shark, to teach students fundamental scientific skills, while simultaneously emphasizing the importance of ocean conservation and environmental sustainability (Fig. 1). We conducted a controlled experimental study comparing the impact of Marine XR to a more traditional web-based learning module in a large, first-year environmental sciences class under remote learning conditions (~200 students). Specifically, we measured how motivation, engagement, engrossment, and cognitive load differed between the two groups within the context of their attitudes towards science (as assessed by the Modified Attitudes Towards Science instrument). In addition, we investigated whether Marine XR could increase motivation to participate in a subsequent learning experience.

Fig. 1. A screenshot from the Marine XR application showing students looking for sharks in the ocean environment.
Acknowledgements

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References

The Mystery of Lehigh Gap: Game-based VR for Informal Learning

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Abstract. Game-based Virtual Reality (VR) holds much potential to enhance informal education settings, whether in libraries, museums, environmental centers, or at home. We have designed and developed Mystery of the Lehigh Gap, a VR game for adolescents and adults to learn about the historical changes that occurred in the Lehigh Gap, Pennsylvania, USA due to a zinc smelting plant that operated from 1898-1980. We present the design principles that guided our project’s development, which were derived from the research literature on designing learning for informal science education environments, and the affordances that gamified VR can provide. Our iLRN poster with accompanied video presents the first section of the Mystery of the Lehigh Gap. It highlights the narrative context and a series of mini-games in which players learn about historical mining, transportation, and industrial processes at a zinc smelting plant that converted a pristine landscape with vegetation to a barren moonscape. During our poster session, we will discuss our design and development work.

Keywords: game-based VR, environmental education, game design.

Introduction

Learning about one’s watershed with game-based VR can have a positive impact on engagement and learning [1], particularly in informal learning environments and at home. Engagement is critical to learning in informal STEM education [2]. The level of engagement with exhibits and artifacts, however, often varies for adolescents and adults in informal education centers. Game-based VR learning activities require interactivity and during informal education, learners are engaged by experiences that offer interactivity [2],[3]. According to Learning Science in Informal Environments [2], a goal of informal education is to introduce new media technologies (for example, game-based VR) into
learning environments to enhance and modernize the quality of the visitor experience and improve learning.

Games have potential to advance multiple learning goals. Studies have demonstrated the potential of digital games to support learning in terms of conceptual understanding (e.g., [4], [5]), process skills and practices (e.g., [6], [7], epistemological understanding (e.g., [8, 9]), and players’ attitudes, identity, and engagement (e.g., [10], [11]). Furthermore, games have shown promise to promote motivation in learning with individuals from non-dominant racial, ethnic, and economic cultural backgrounds [12].

Game-based VR presents several characteristics of great appeal to learners and can be an enhancement to informal education settings, whether in libraries, museums, environmental centers, or at home. Features such as active control of the user experience and authentic representations of real-world situations can increase engagement and learning. Furthermore, gamified headset VR focuses users’ attention on learning tasks and does not deflect attention [1]. In a VR game environment, authentic imagery, content, animations, video, and narration can be incorporated to provide learners with a highly immersive learning experience. Since VR technology allows for such supports in an immersive environment, it can be designed to promote improved access to environmental content, especially when learning about historical changes over time with regards to how anthropogenic activities affect a natural environment.

We have designed and developed Mystery of the Lehigh Gap for adolescents and adults to learn about the historical changes that occurred in the Lehigh Gap, Pennsylvania, USA due to a zinc smelting plant that operated from 1898-1980. The design principles for our project draw heavily from the research literature on designing learning for informal science education environments and the affordances that gamified VR can provide. These include:

1. **Situate learning experiences both locally and historically.** Learning experiences should reflect a view of science as influenced by individual experience as well as social and historical contexts [2].

2. **Design for diverse populations.** Learning environments should be both accessible designed to engage participants’ cultural contexts, including everyday language and local cultural practices [2].

3. **Use multiple and varied representations.** Use effective combinations of imagery, 3D visualizations, animation, audio, and text to enhance learning and transfer (see [13]). Concrete, sensory, and immersive experiences can promote deeper understandings and sense-making of concepts [14].

4. **Engage learners in challenging tasks.** Distinct challenges within a learning game keep learners engaged and challenged. Designing for the right challenge-skill balance promotes engagement and an intrinsically rewarding experience for the learner [15].

5. **Feature authentic issues.** To make learning engaging, learners need to feel the
relevance and authenticity of the learning activity [16].

6. **Provide a strong narrative.** A game designed for informal use requires strong narrative elements to generate excitement, interest, or enthusiasm for learning [17]. “Mystery” narratives use questions, problems, or missions to enhance learner motivation [18] (Wilson et al., 2009).

7. **Provide supportive guidance and motivational feedback.** Guidance in the form of advice, feedback, prompts, and scaffolding can promote deeper learning [19]. Support is also enhanced by different forms of engaging feedback such as badges or points [20].

Our iLRN poster with accompanied video will present the first section of the *Mystery of the Lehigh Gap*. The VR experience begins with a series of cut scenes to introduce the player to the mystery: how the north side of the Kittatinny ridge went from pristine landscape with vegetation to a barren moonscape and then to a grassland (see Fig. 1.). First, the player is introduced to a short animated video that presents the geologic formation of the Lehigh Gap (see Fig. 2.). After the video, the game shifts to the year 1845 where two non-playable characters (NPC) townspeople discuss a zinc mine discovery. The game then time travels to 1853 where Joseph Wharton, an authentic historical figure, discusses zinc ore mining and the idea of forming a zinc ore business. Then, the player engages with two mini-games to mine zinc ore (see Fig. 3.) and anthracite coal, the fuel source for a zinc smelting plant. After that, players time travel to 1912 where NPC Stephen Palmer discusses the formation of his New Jersey Zinc Company plant. There, the player engages with two other mini-games that highlight the process of transporting anthracite coal via canal boats (see Fig. 4.) and zinc ore via trains to the plant. Finally, players go inside the plant where NPC workers discuss the smelting process to make zinc ingots. The player starts furnace firing by playing a mini-game to heat up a plant furnace to 2700 degrees and then engages with a zinc smelting mini-game to make a zinc ingot (see Fig. 5. and 6.).

Users of our initial prototype mini-game found the games engaging and reported that the games helped them to understand how raw materials were mined and transported to a zinc smelting plant. The players noted that the games enhanced their understanding of the industrial processes involved with zinc ore. In addition to describing the game, our iLRN poster will also present the VR game’s UI features. During our poster session, we will discuss how VR games can enhance informal education settings, whether in libraries, museums, environmental centers, or at home.
Fig. 1. Images from the opening cut scene to introduce the mystery.

Fig. 2. Images from the formation of the Lehigh Gap video.

Fig. 3. Image showing the zinc ore mining mini-game.
Fig 4. Image showing the anthracite coal transportation mini-game.

Fig 5. Image showing the furnace firing mini-game.

Fig 6. Image showing the zinc smelting mini-game.
References

Workforce Development & Industry Training
Between Skills and Success: Developing Workers’ Dispositions for Applying Skills in an Uncertain, Disruptive World

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Abstract. Dispositions—what people tend to do with their skills when the occasion calls for it and how—are a vital link between having a skill and effectively applying it in real life. During the pandemic, we saw that inculcating skills for a particular role was not enough to prepare workers for economic inclusion under turbulent workforce conditions, as the individual’s dispositions oftentimes determined that person’s response to the disruptions. Adding dispositions to current models of capacity building may make a crucial difference in workers’ responses to this turbulence. To this end, immersive technologies can potentially improve dispositional training efforts and assessments. The simulated settings can vary in context and complexity to more closely depict the diversity experienced in real life, allowing learners to perform and be evaluated under wide-ranging circumstances. The current use of immersive media in resilience training for military and healthcare personnel serve as potential paradigms for application in education and workforce development. To verify these potentialities, we recommend additional research in the development and testing of scalable curriculum and measurement strategies for dispositions related to vulnerability and turbulence.

Keywords: Dispositions, Workforce Development, Immersive Media.

1 Introduction

Approximately 114 million people worldwide lost their jobs in 2020 alone [1]. Millions of others experienced extensive transformations to their roles and workplace conditions. Some of these workers and professionals successfully pivoted, while others struggled to adjust to the new circumstances.

Even in the wake of virtual schooling, some teachers and school leaders who had previously excelled in their roles struggled to effectively deliver, while others quickly transitioned their practices to online environments [2]-[3].
A major factor that differentiated between these two responses may be dispositions, such as a growth mindset, adaptability, and resilience [3]-[6]. During the pandemic, we noticed that inculcating skills for a particular role was not enough to prepare workers for economic inclusion under turbulent workforce conditions. Whether a worker also possessed the associated dispositions that encourage and enable using those skills determined the extent to which that person felt empowered or paralyzed by the disruptions.

Over the coming half-century, forecasts suggest continued rapid changes in jobs and employer needs [7], [17]. Though these future shifts might not occur as dramatically or as suddenly as COVID-19, they will no doubt impact the education and workforce sectors. Thus, adding dispositions to current models of capacity building may make a crucial difference in workers’ responses to this turbulence.

The objective of this presentation is threefold. First, we will highlight the importance of training for dispositions, particularly those valuable during disruptive periods. Second, we will inform practitioners and leaders about six ways that they can support learners in fostering helpful dispositions. Lastly, we will suggest the suitability of immersive media to facilitate rich, authentic dispositional training and assessment at scale and propose further research in this area.

2 Significance of Dispositions

Dispositions—what people tend to do with their skills when the occasion calls for it and how—are a vital link between having a skill and effectively applying it in real life [8]. As the definition implies, dispositions require the necessary skills or abilities—the competencies to express a certain behavior or perform a specific type of task, physical or mental, at some level of proficiency [9]. In addition, dispositions hinge on a person’s inclination, the intention to engage in the behavior; sensitivity, the probability of noticing occasions to engage in the behavior [8], [10]; and appraisal, the understanding of how much of a behavior is appropriate for the situation [11]. All these elements of a disposition must be present for it to be successfully expressed.

When we train for skills and deem learners prepared to exercise those skills when they pass our assessments, some learners’ skills will still remain latent unless the training also builds the related dispositions for the expression of those capabilities.

3 Inculcating Dispositions

Dispositions can be triggered, obstructed, enhanced and delayed by contextual factors such as educational interventions and workplace culture. For a disposition to be enhanced, learners must understand the meaning of the skills and dispositions they are honing, feel intrinsically motivated and build the situational awareness to apply them, recognize the
costs and benefits of deploying a disposition, and possess the metacognitive abilities to reflect on their skillfulness and areas for improvement [8], [12]-[14].

Existing frameworks suggest that practitioners and leaders can create the curriculum and culture to support learners in fostering helpful dispositions. Specifically, they can:

1. Explain what the disposition under consideration means and what its associated skills encompass,
2. Present examples,
3. Encourage students to treat the examples as models to be analyzed and followed,
4. Justify the exemplified behavior,
5. Develop authentic scenarios and exercises for practical application and prompting student reflection, and
6. Cultivate an overarching culture of dispositional excellence [9], [13].

4 Immersive Media for Inculcating and Assessing Dispositions

Immersive technology holds the potential to improve dispositional training efforts and assessments for workers and professionals.

Given the contextual nature of dispositions, inculcation needs to leverage situated, authentic practice, which we can now do at scale through immersive environments like virtual reality. The simulated settings can vary in context and complexity to more closely depict the diversity experienced in real life, allowing learners to perform under wide-ranging circumstances.

Moreover, assessing learners in diverse simulated experiences improves our ability to evaluate whether they will react appropriately when a similar set of conditions present themselves beyond the simulation. Current assessment methods (e.g., self-reported surveys) fall short of evaluating the transfer of disposition attainment across situations. Trainees who appear to possess a disposition in one context might not express that disposition in another, a disconnect we cannot capture with current evaluation methods. By crafting a multitude of environments and scenarios that closely resemble real-life situations, putting individuals in the scenarios, and seeing first-hand if they display the disposition(s), immersive media can potentially bridge this gap.

The use of immersive media (e.g., virtual reality) in resilience training for military [15] and healthcare [16] personnel serve as potential paradigms for application in education and workforce development. To verify these potentialities, we recommend additional research in the development and testing of scalable curriculum and measurement strategies for dispositions related to vulnerability and turbulence.
Acknowledgements

As members of The Next Level Lab, the authors appreciate the contributions of their lab colleagues as thought partners in this work. The Next Level Lab is based at the Harvard Graduate School of Education. It brings together expertise in cognitive science, neuroscience, the learning sciences and innovative learning design and technology towards research and innovation to address emerging and urgent issues in K-12 and Workforce Development and to increase access and equity in developing mastery across the lifespan.

References


Fundamental Research & Theory in Immersive Learning
New Efficacies for Audience/Performer Interactivity and Responsive Narrative in Immersive Theatre

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Abstract. Immersive virtual reality (IVR) has substantial possibilities for students to learn remotely through exploration, collaboration, and socialization. IVR is well suited to theatre, which relies on interpersonal attributes to demonstrate actor relationships and character development. IVR theatre can break down the fourth wall to connect audience members and actors in the same physical space, thereby removing the barrier of the stage and placing the audience within the storyline. In this study, a high-caliber youth theatre group was tasked with writing, workshopping, directing, rehearsing, and performing a play for a live audience in AltspaceVR. Grounded by current literature on the affordances and limitations of IVR for learning, this research followed six high school students imagining, designing, and delivering an immersive theatrical performance. Findings report how youth are experimenting with immersive technologies to take traditional theatre in new directions, including audience interaction, responsive narrative, and actors/actresses performing as digital avatars. We highlight pedagogical strategies and design recommendations for working with youth to integrate IVR theatre experiences in secondary education.

Keywords: immersive theatre, youth, interactive performance, digital avatars, student agency, community engagement

1 Introduction

In the context of this study, there were limited possibilities for students to become involved in extra-curricular school activities due to COVID-19 provincial mandates. Schools were not permitted to host any instruction outside regular school hours to reduce the potential of COVID-19 transmission. IVR was a new communication tool utilized as a direct and necessary solution to address 2021 pandemic restrictions, offering a safe alternative for students to gather, express artistic creativity, and develop theatrical production competencies. Youth taking on the challenge of performing as digital avatars was an impressive and innovative undertaking; live IVR theatre performances are still an elusive concept for most actors and professional theatre companies. To date, most inquiries focus on productions with adult performers [1, 2]. This research reports best practices for working...
with secondary students in IVR, to guide other researchers and educators for using immersive design when the need or opportunity arises.

![Student characters in performance.](image)

**Fig. 1.** Student characters in performance.

## 2 Learning Activities

The theatre students collectively designed the plot and wrote their characters under the creative direction of an instructor. Students designed virtual avatars with specific costumes and visual appearances to appropriately represent their characters (see Figure 1). The youth wrote the script with purposeful involvement of audience members as part of the narrative, utilizing and adapting to the affordances of the IVR medium to enhance the performance impact. The youth performers memorized lines and delivered an original reality TV show experience called *LIMBO: A Fate Better Than Death*. Audience members were referenced throughout the performance and asked to vote on their favourite contestant. Before the show began, the audience members were requested to put a skeleton hoodie on their avatar to become a part of the ‘dead’ studio audience (see Figure 2). As the performers developed relationships with audience members by including them in the narrative, the fourth wall (or the boundary of the traditional theatre stage separating actors from the audience) was removed. The audience played an integral role in the storyline of the IVR theatre performance.
3 Learning Affordance: Sustainable Performance

A significant advantage identified by the theatre students was how performing in IVR can be affordable and environmentally friendly. Rather than performers and audience members individually commuting to a venue, everyone was able to participate in immersive theatre using a head-mounted display or computer compatible with AltspaceVR requirements. Instead of needing numerous set, costume, and prop pieces to be designed and then thrown away, the youth were able to utilize digital elements to reduce the ecological footprint of their performance. Similarly, [1] explored *Alice’s Adventures in Wonderland* with multiple performers and audience members. The creators were able to change the scale of the environment to tell the story, stage a scene for multiple perspectives, and share this in real-time. Overall, the carbon footprint was reduced by limiting the physical elements required for the IVR performances.

4 Recommendations for IVR Theatre Instructors

- *Set realistic expectations for students.* Using new technologies that students are less familiar with will have a learning curve and it is important not to expect students to know how to do everything right away. Also, IVR studies have noted that the synchronous timing of online communications is challenging, and it can be time consuming to resolve technical problems in a live performance [3, 4].

- *Empower students as creators and partners in production.* Generally, learners will care more about something where they feel a sense of agency and ownership.
Ownership in learning has been achieved in previous VR studies by allowing students to work at their own pace, with directional freedom in creating art and virtual worlds [5, 6]. Including learners in making major decisions involving their work and giving them as much creative freedom as possible will result in a more meaningful experience than if youth are told how to do everything.

- **Focus on learning objectives.** It is essential to ask what the purpose of the learning is and make sure that IVR is useful for achieving this purpose. [7] suggests rigorous instructional design must ensure consistency between the curriculum, the teaching approach, the learning context, and the assessment procedures. IVR should not be used for the sake of using IVR because of its coolness factor. Instead, it should be a tool selected for achieving learning outcomes or targets.

- **Schedule time for collaborative challenges.** It is important to make time for students to create together and learn to trust each other. Examples include creating a scene from a list of 10 impossible things or adding a scene inspired by a favourite TV show. Practicing various written or improvised scenes will inspire creativity, collaboration, and improved theatre competencies.

- **Practice vocal projection.** The human voice is the most alive characteristic in the virtual world, so it is advantageous for actors to fine-tune the vocal delivery of their dialogue. [2] identifies sound technology and vocal performance (pitch and accent) as features that elevated the IVR performance. There are a variety of individual and group drama exercises to support students in developing the voice of their character.

- **Be inclusive and open-minded.** Educators should allow diverse representation of student avatar identity, within the limitations of what is appropriate and culturally sensitive for school settings. [8] suggests that users who created an avatar of their ideal self-reported greater psychological immersion than those who created a replica of an avatar that mirrors their actual self. Open-mindedness to youth expression and personal creative choices will make youth feel more comfortable and welcomed in the IVR environment.

- **Have fun.** Attitudes and positivity are infectious, so if teachers have fun with the process, students will likely have a memorable learning experience. Anticipate unforeseen problems and intentionally encourage yourself and the students to stay motivated when issues arise.
References


Implementing VR Across the Curriculum

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Abstract. I will share my experience evangelizing for the adoption of virtual reality technology at a small liberal arts college. I will then share concrete examples of how virtual reality is being used in different areas of the curriculum including anatomy, kinesiology, interior architecture, education, nursing, and communications.

Keywords: Virtual Reality, simulations

1 Agenda

Outline of the agenda for the oral presentation:

- Evangelizing for VR
- Categories of VR
- 5 Examples Across the Curriculum
- Technical Overview
- Vision for the Future of XR

2 Summary

Virtual reality can transform the way educational content is delivered. The immersive experience of VR engages students in powerful ways. This session will describe how to introduce virtual reality technology to your faculty, and highlight specific examples of how virtual reality is being used by faculty in five different departments at Endicott College. The session will include some foundational information about equipment and costs. Then we will explore how VR is being implemented in biology, interior design, education, communications, and nursing. We will also learn how to set up a "VR Lab" as a central campus location to demonstrate the technology to staff and students.

In addition to demonstrating how VR can be used for content consumption, the session will also share examples of how students can create original VR content in collaborative group projects. This session is appropriate for people who are new to the world of virtual reality as well as those with some previous experience.
3 Sample Recording

[1] shows an example of a similar presentation from February 2021 (fig. 1).

![Image of virtual reality](image.png)

**Fig. 1.** Still screen from presentation (video).

References

Autonomy Illusion in Immersive Virtual Learning Environments

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Abstract. With the prevalence of virtual reality (VR), new research has focused on its applications in various fields, including education. The notion of presence has been touted as advantageous for learning in the virtual environment; however, there has been little research on the subject concerning learning. This paper examines one of the themes from the interpretive phenomenological analysis (IPA) of a pedagogically informed virtual learning experience simulating the local solar system through the lens of five grade nine students. Data for this study was gathered through semi-structured interviews and video observations of the experience to understand the relationship presence has on learning in virtual environments. This paper highlights the sense of autonomy participants felt that led to a phenomenon identified as autonomy illusion. Autonomy illusion is the feeling of control over learning brought on by the removal of conventional classroom delimiting factors in place of environmentally designed delimitations, creating the illusion of freedom described as a symbiotic dichotomy of two opposing features, pedagogical freedom and environmental imposed delimitations, which help define the illusion.

Keywords: Virtual Reality, Virtual Learning Environments, Presence, Pedagogy, Learner Autonomy.

1 Introduction

This paper is based on a work-in-progress thesis investigating the lived experiences of grade nine students as they explored an intentionally designed immersive virtual environment. The purpose of the environment was to recreate an authentic depiction of the local solar system using virtual reality (VR), designed around a specific learning objective, the scale of local space. Central to the investigation was the concept of presence or the psychological reaction to the virtual environment resulting in the cognitive suspension of disbelief [1]. Presence has often been cited as beneficial for learning in virtual environments; however, there has been limited research on the relationship between presence and learning [2, 3, 4]. It was believed that the examination of presence and learning through a phenomenological lens could help VR-learning move beyond technological novelty by establishing a
foundation of pedagogically informed data to direct practical applications and further research.

2 Method

The original research utilized interpretative phenomenological analysis (IPA) to frame and illuminate its conclusions through a constructivist and experiential learning lens. IPA is a form of qualitative research that investigates how people make sense of life experiences using phenomenology, hermeneutics, and idiography [5, 6]. Due to IPA's elaborate and time-consuming data analysis, a homogeneous convenience sample of five grade nine students was established [5]. Potential participants were selected based on having sufficient VR experience to be able to participate without a new orientation, possible compliance with school district COVID regulations, and guardian approval. Data collection was broken into three consecutive days for each participant:

- Day 1: Engagement in VR experience.
- Day 2: Semi-structured interview.
- Day 3: Member check.

Data was scrutinized case by case, cross-examined, and compiled into group experiential themes based on convergence and divergence of the theme, which is in line with best practices outlined in IPA studies [7].

<table>
<thead>
<tr>
<th>Participant (Pseudonym)</th>
<th>VR Experience</th>
<th>Self-Reported Learning Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam</td>
<td>High</td>
<td>Self-exploration of materials</td>
</tr>
<tr>
<td>Frank</td>
<td>Mid-Level</td>
<td>Hands-on</td>
</tr>
<tr>
<td>Sonia</td>
<td>Minimal</td>
<td>Lectures and textbook</td>
</tr>
<tr>
<td>Zara</td>
<td>Minimal</td>
<td>Reinforcement and memorization</td>
</tr>
<tr>
<td>Netta</td>
<td>High</td>
<td>Construction of concept through creation</td>
</tr>
</tbody>
</table>

3 Results

A theme resulting from the original study was a sense of autonomy. All participants cited a profound sense of freedom as they explored the experience. At first, this phenomenon was attributed to the capabilities of the experience, as users could manipulate all spatial
dimensions, moving freely throughout the simulated space. "I think it was just being able to go... anywhere, right? Like I was in my own spacecraft, which I could control" (Sonia).

However, it shortly became apparent that while spatial freedom enabled a perceived sense of autonomy, it was not the sole contributor. Part of the pedagogical approach for this experience was the removal of conventional didactic learning strategies, resulting in the disposal of a specific set of linear instructions often given to learners to come to a prescribed solution. Frank directly felt this freedom, remarking, "I was trying to learn an outcome but it wasn't like follow this specific set of instructions... it just felt like I could do whatever I wanted" (Frank). Other participants reported this pedagogical autonomy to different degrees, with Zara highlighting the construction of her learning, "...it was more me learning myself and like, figuring it out as I went..." (Zara), and Sonia conveying a sense of freedom, "...it felt really good to just be in control and just... be free..." (Sonia). Adam further pushed the idea of pedagogical freedom by stating, "...it wasn't like a worksheet where it's like you have to answer this question... you get to explore on your own time... see[ing] different things" (Adam).

Furthermore, all participants spoke to the experience being less stressful than traditional classroom structures. Frank was particularly vocal about his frustrations in the classroom, declaring, "...we're more stuck to a strict schedule, we have to go through the curriculum... in a certain order" (Frank). While others like Sonia spoke about the pressures she feels because of these expectations: "[I] try to get so much done that I just feel like sometimes it's too much... so when I did that, it felt really good to just be in control" (Sonia).

Discussion

The findings demonstrate that participants experienced a sense of autonomy enabled by the pedagogical scoping being delegated to the virtual environment rather than the classroom. To better understand this phenomenon, let us look at a traditional classroom in the K - 12 system, where the teacher must articulate a learning objective to various learners with different needs and levels of knowledge. A teacher may implement classroom management strategies to limit the scope of the lesson through artificial delimitations, such as limiting inquiry to a specific learning objective or encouraging a specific methodological approach. These interventions are designed to ensure the success of most learners; at the same time, they require learners to conform their learning to the specific approach used in the classroom. The data suggests that learners begin to feel like passive observers in their learning rather than active participants resulting in stress and disengagement.

Using an intentionally designed virtual environment can remove the requirement for the teacher to create delimiting strategies in the classroom. As in the original research, a pedagogically designed virtual environment can establish boundaries for learning by the purposeful inclusion or exclusion of different entities, actors, and interactions. When learners engage in the environment, their engagement is naturally limited by the limitations
of the environment as opposed to a prescribed set of classroom expectations. This approach allows learners to explore their learning naturally, akin to an authentic learning environment [8].

This sense of autonomy is both real and illusionary. Real in the sense that learners have more control over their learning activity. However, this freedom is an illusion as the environment limits the scope of interactions, resulting in a symbiotic dichotomy that helps inform this phenomenon's moniker, autonomy illusion. Autonomy illusion is inspired by Slater's place and plausibility illusion [1] as they also focus on the qualia of the virtual experience and the construction of a user-specific facsimile of the perceived reality.

References

ALIVE: Avatar Learning Impact assessment for Virtual Environments

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Abstract. Currently, accurate representation of physical spaces and, especially, human interactions in Virtual Reality (VR) can often feel clunky, unrealistic and require specialist knowledge and development. Our project explores avatar use through the Unreal Meta Humans tool (an extraordinary new 3D character creation technology), specifically, testing the use of realistic avatars in soft skills training and social interactions. This is a proof-of-concept project to generate ideas that address this gap in knowledge, do fast, low-cost prototyping and user testing to further our understanding of the field. We built and tested the recognition of basic emotions in Meta Humans and cartoon avatars in VR. The aim was to understand whether the realism of the avatar impacts our perception of basic human emotion and the sense of immersion in VR. This work aims to advance the study of artificial social interactions, and guide industry practice.

Keywords: Human Computer Interaction, Avatars, Virtual Reality

1 Introduction

Virtual Reality (VR) offers boundless opportunities for social communication divorced from physical location. One of the benefits of VR as a social platform is the ability of avatars to convey non-verbal communication. The effectiveness of avatars for this purpose depends on their appearance (realism, resemblance to the user, and the degree of available personalisation) [4] and behaviour (subtlety, realism, and expressiveness) [5]. It should be noted that this does not necessarily mean that the avatar should replicate the player’s physical form, but instead can represent their self-image [6]. If successful, two people using VR avatars can use this non-verbal communication to build intimacy that is not possible when using only a desktop computer [7] and roughly equivalent to in-person communication [8].

Despite the strengths of avatars for visualcomms, there are downsides to their current
implementation. Most notorious of these is the Uncanny Valley effect where observers have a negative reaction to increasingly human-like entities, manifesting as a cold, eerie, and repellent feeling [9]. There are several hypotheses for why this effect exists, but recent evidence suggests that it could arise from a general aversion to objects which deviate slightly from familiar patterns [10]. As human faces are a strongly recognised pattern, they then elicit a stronger response than other objects. One of the challenges of avoiding the uncanny valley is that it reduces with greater realism, however, so does the transmission of emotional information [11]. This means that lower quality avatars are less uncanny, but to convey the same emotional intensity they have to be more exaggerated, consequently leading to high uncanniness. MetaHumans created in Unreal Engine 4 have achieved very low uncanny feelings by combining high fidelity models with motion capture [16], therefore breaking a key barrier to virtual agents.

A significant application of facial emotion research has been the development of interventions to improve the social cognition and skills of participants. While this has been primarily applied to clinical groups such as schizophrenia [21], the results are also applicable to the wider population [22]. Early findings suggest that the effectiveness of these interventions increases when using VR avatars compared to 2D images [23]. As MetaHumans currently appear to have achieved a high level of realism without inducing uncanniness at baseline, it is possible that they will be capable of expressing intense human emotions without becoming exaggerated. When combined with motion capture technology, they may be able to facilitate high quality social interaction between two or more people.

This will open opportunities for both organic human connection and social skill training opportunities. This study will be the first to measure the emotion recognition accuracy and uncanniness of MetaHumans.

2 Methods & Preliminary Results

MetaHumans (unrealengine.com) currently have 18 avatars and we wanted to include the basic seven emotions often used in psychological experiences. To avoid large number of trials, we have selected six MetaHumans (younger avatars of three racial profiles (Caucasian, Asian and Black), male and female). Each of the six avatars was animated using iPhone face capture technology. Full experimental design is summarized in Figure 1. Alongside images of emotions selected (paulekman.com) and an image of the full set of MetaHumans avatars.
Fig. 1. Summary of Experimental Design.

Ethical approval was received from the University of Glasgow and participants were tested April 2022. A total of 7 participants took part in the study. Oculus Quest (oculus.com) was used for the display. Meta Humans set resulted in 126 trials and Wolf3D (woolf3d.io) avatars set was also 126 (avatars were matched to the age, gender and race of Meta Humans as much as possible). As the resulting number of trials was 254, testing session was split into two with a break in between. Demographics form was filled in at the start of the experiment. Experiment took approximately an hour to complete.
Fig. 2. Testing environment (café) with the avatars and rating panel (desktop version of this app for demonstration): top set shows meta humans in the environment, where the bottom set shows Wol3D avatars in the same environment.

We have just completed data collection and the results are being prepared for analysis. At the time of the presentation we will be able to discuss our findings.
3 Discussion & Future Directions

Virtual Reality (VR) offers boundless opportunities for social communication divorced from physical location. This promise is especially relevant as the globalisation of information eclipses the globalisation of goods and people. We wish to understand how improving the realism of the avatars (teachers and students) can contribute to more effective teaching strategies. Cutting edge real-time rendering technology of Unreal Metahumans can simulate real-life social situations more accurately, including teaching scenarios. Moreover, understanding human facial expression is one of the key cues for social interactions alongside the body language. Body language capture and perception in VR is one of the next research steps for us.

Understanding how nuanced facial expressions are and how they might depend on body language perception is an overarching question for social interactions in the virtual space. Exploring how these social cues are used in the virtual teaching space is essential for furthering our comprehension of student-teacher interactions. Social aspect of teaching has been challenged over the pandemic and a lot of current teaching still takes place online. Equipped with improved avatars, immersive teaching tools such as Edify can make any teaching activity more personable and engaging. Understanding the role of embodiment and perception of social actions in virtual environments has potential for social skills training and interventions outside of teaching. Therefore, findings of this project can extend to further research and industrial applications.

Acknowledgements

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Onboarding for Immersive VR: Accessibility, user experience and guidelines

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Abstract. Virtual Reality (VR) is a rapidly evolving form of technology that constructs an entirely digital world, within which we can interact with three-dimensional content. This technology has the potential to enable us to rethink learning and teaching, creating new, fully immersive worlds tailored to our individual preferences. User experience of VR as facilitated by onboarding processes has been studied with regards to wider issues of accessibility such as cybersickness, perceptual differences, sensory sensitivity and neurodiversity. However, the focus has been on the efficacy of interventions rather than onboarding processes and VR user experience more generally. We will focus on supplementing existing research and suggesting guidelines for the design and implementation of onboarding processes, with an emphasis on individual user experience and population heterogeneity. With the rapid growth of VR and immersive learning applications in recent years, as well as the importance of remote learning in a post-COVID environment, personalisable and accessible applications of VR are crucial.

Keywords: Virtual Reality, Onboarding, Accessibility.

1 Introduction

Previous definitions of Virtual Reality (VR) in research have been imprecise [6], [19], [20] and are difficult to identify, as both the technology and relevant research encompass a variety of applications. VR can be defined as “an artificial environment experienced through a variety of senses, which is created by a computer and accessed via a display... with input devices (e.g., controllers)” [19]. As VR technology is refined, more sophisticated hardware such as Head-Mounted Displays (HMDs) allow for more realistic interactions between users and VR [3], [10], [17]. The potential for immersive learning practices utilizing advanced VR technology is being recognized in recent literature, and it has been shown to increase user enjoyment of learning and develop skills related to visual and spatial learning, knowledge retention and psychomotor skills [1], [2], [10], [25], [28]. It may also surpass practical limits in learning, affording access to geographically
inaccessible areas such as inside the human body, and outer space [4], [10], [15].

However, alongside precise definitions of VR from which research might benefit in the creation of tailored and specific implementations, applications of VR in immersive teaching have been slow to develop. This may be due to a lack of guidelines surrounding practical implementation of educational VR, particularly in multi-user settings [3], which highlights the need for such research. Furthermore, the practical implications of employing VR in education must be considered. Potential limitations to utilizing the technology include cybersickness, excessive cognitive load, hardware limitations, stress and sensory issues.

1.1 Accessibility

It is apparent from the literature that the experience of VR is highly personal and influenced by individual differences [9], [10]. Therefore, to effectively examine VR within the context of learning, the emphasis must be on individual user experience. Part of this consideration must be centred on accessibility, so that VR is studied and designed with a diverse population of individuals and their differences in mind. As Mott et al. [16] have correctly pointed out, VR, like any other technology, is designed with implicit assumptions of use. That is: an implicit assumption of the capabilities of the user. Often, minority groups might not meet these assumptions, and so run into issues of accessibility. VR is no different, and developing accessibility in VR involves intersectional, multimodal approaches to VR design and implementation, and inclusive design for cognitive, sensory and physical disabilities and differences.

Several key barriers are found to limit accessibility of VR for a diverse population with limited mobility, physical disabilities, vision impairment, hearing impairment, sensory sensitivity, proprioception issues and intellectual disabilities [5], [11], [24], [28]. Some research exists evaluating guidelines to overcome accessibility issues in VR, such as the use of zooming, inverted colours and auto-reading for people with limited mobility and low vision [7], [23] with varying degrees of success.

However, it is still valuable to focus on the barriers to accessibility of mainstream VR technology, and on solutions that could be introduced.

1.2 Onboarding & Guidelines

There is a lack of research surrounding individual user experience and guidelines for onboarding processes to use VR as a therapeutic and educational tool, particularly with regards to diversity of learning experience and population heterogeneity. More focus has previously been on the efficacy of interventions rather than user experience [20]. Focusing on onboarding more generally will allow us to streamline these processes, catering to a more diverse population with an emphasis on individual user experience. Some have already attempted to address the importance of onboarding processes in user experience and accessibility of VR. Škola et al. [21] have studied user experience of VR as facilitated
via onboarding processes. Their study acknowledges that accustomization to VR technology (headsets, controllers and Virtual Environment (VE)) is crucial in improving user experience and learning effects, thus exploring the benefits of effective onboarding practice. Their study also found that levels of engagement, presence and immersion improved overall user experience, lessened events of VR sickness and reduced the cognitive load of the task.

Janßen et al. [9] also highlight the importance of onboarding processes to the subjective experience of VR. They acknowledge that uncertainty regarding the experience influences how willing people are to take part, and how much they enjoy the experience. They equally emphasise how individual differences, such as age and gender, influence the effectiveness of educational VR. Harth et al. [8] also illustrate the impact prior knowledge and individual differences have on the level of immersion experienced by users in VR.

Thus, it becomes imperative to introduce onboarding guidelines in immersive VR learning, as a continuation of research such as that of Škola et al. [21] and Meyer et al. [14], who found that ‘pre-training’ in VR reduced cognitive load of learning tasks and increased learning efficiency.

2 Conclusion

Given that Virtual Reality is a relatively new research field, the formulation of guidelines around VR use has not yet been completed, especially for specific implementations of VR such as immersive learning. As a result, to maintain the rapid growth of reliable and valid research, it is important to lay out and explore guidelines with respect to the accessibility of immersive learning. Using a person-oriented approach, accounts of subjective user experience, such as perceived barriers to the access of VR, can be examined. With the current COVID-19 pandemic, technologies borne of social isolation and distancing are now used by many. Guidelines for the use of VR in socialising, connection and learning may therefore become more important than ever [16], [18].

Upon reviewing existing literature, we will present our work on how we addressed the gaps concerning appropriate guidelines around the implementation of VR learning practices. In our presentation we will present the set up and proof of concept work on the onboarding procedures for VR. In considering accessibility, neurodiversity, and the importance of multi-user labs, we will suggest an appropriate framework, in the form of onboarding processes, designed to address such questions of accessibility.

Acknowledgements

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References


Exploring Immersive Storytelling for a Post COVID-19 Tourism Industry

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Abstract. Beginning in 2015, a vocational training program was created for students of tourism and hospitality using virtual and augmented reality. This ongoing research in the power of immersive learning applied to vocational training in the tourism and hospitality industry has had a few milestones worth reporting to tourism education professionals. Due to the pandemic forcing this program to shift to more distance and asynchronous delivery, it has evolved into something that might be telling as to how the tourism industry is set to be disrupted by the proliferation of immersive technology like virtual and augmented reality.

Keywords: Immersive Tourism, My Hometown Project, Immersive Storytelling, Virtual Tours, Vocational Training

1 About the My Hometown Project

Starting in 2015, a pilot program was developed to explore the affordances of virtual reality for learning environments in higher education, starting with uses in tourism studies and language learning. Over several iterations many different tools and approaches were employed, resulting in many stages of development [1, 2]. Each stage looking to make what is most useful of previous designs and exploit those aspects in later iterations. The result now is a variety of more specific projects and programs, one of which is now called the ‘My Hometown Project’ [3, 4, 5]. The early stages of this work began with using virtual reality as a tool to prepare students for guiding tourists in English to major tourism destinations in Japan [6,7,8]. Later stages began to develop software and curriculum to scale and deploy the program to larger and more diverse groups. The project is again growing to include students from many countries, different age groups, and starting to employ new practices in the design of virtual travel and international exchange in VR [9, 10, 11, 12, 13, 19].
1.1 In the Classroom and Face-to-face

Some of the first more full scale deployments of this project was as a part of a training program to prepare students of the Global Tourism Department at the Kyoto University of Foreign Studies [2, 3, 4, 14, 19]. The department had a volunteer program that got students to guide foreign tourists around key sightseeing spots around Kyoto. The program hit some major pedagogical points for the department including real world experience and the application of the English language in practical contexts. A 5-week module was designed to give students an opportunity to practice tour guiding in VR and learn some underlaying concepts for the task such as experience design and storytelling. Students responded enthusiastically to the training and some of the encouraging themes from previous learning designs were present as well, such as the reporting of connection and intimacy between participants. These findings were published, and a new iteration of the project was being prepared for deployment when the full force of a global pandemic forced drastic changes. These changes were not just to lack of in-person classes but the disappearance of tourist and tour operators in Kyoto [15, 16]. The program that was once an in-person onboarding for in person tour guiding found itself unable to meet in person and had no tourists to guide when the training was complete. Not only that, but some of the tools that were employed such as Google Tour Creator and Google Expeditions were announced to be sunset and would no longer be available. The program was forced to pivot quickly [17, 18].

Fig. 1. Students working on VR tours in tour guiding onboarding training.

1.2 Evolving to Face New Challenges

The challenges to the next iterations of this program were clear. The program needed to be deliverable at a distance and additions must be included to offset the absence of practical applications in tourism. This would seem at first glance good reason to employ a whole new approach or begin an entirely new set of learning activities [20]. But virtual reality and the potential it affords for this situation were unique and therefore were leaned into further for
the project. An online course was designed to give students most of the in-class lectures and activities from the previous version. Lessons about storytelling, basic graphic design, 360 photography, and case studies of VR in tourism were taught in self-paced modules that lasted 4 weeks [22, 23]. These modules have also been iterated on since with the goal of best facilitating students to make virtual tours of the highest quality. As most of the in-class work was peer and group work in giving and reviewing tours, this had to be designed into an online setting. For this a persistent virtual world was created, as sort of a gallery of VR tours [24]. This allowed students to browse and take tours but also facilitated that serendipitous meeting with course members and teachers [25, 26].

![Fig. 2. Example of WebVR Tour Gallery.](image_url)

1.3 Developing a platform for the My Hometown Project

One of other challenges of running a long-term program based on emerging technologies is the mortality of software and platforms. The main platform of choice to create, host, and share tours was Google Tour Creator and Google Expeditions. Both platforms went out of service in 2021 and were announced to be sunset in 2020. This has happened to me a couple of times before. New technology services using emerging tech like AR/VR often are shifting business models, are found un-sustainable, or the developers turn focus to something else. In 2015 I was developing some English language learning materials using augmented reality using software from a German company. Before deploying final stages of the research, the company was acquired by Apple and was unable to renew services for the remainder of the research. So, like in this instance, I was forced to put on my developer hat and get to work. It is much more costly, both in terms of time and cost to develop your own software for these purposes, but it is proving that it is the safer option. A platform for creating and sharing virtual tours was created. Later an interface to browse and take tours was added. It was then integrated into online learning courses.
2 Call for Collaborators

With students now joining from many countries and cultures, the project has begun to spawn several interesting new research questions based on virtual reality in travel. Most notably for the purpose of getting back some form of study aboard programs that have been highly restricted and still facing rising costs and other restrictions. This project is now iterating into a platform to facilitate international and cultural exchange though virtual travel. I would like to welcome participation of individuals, classes, and institutions to contact me about your possible involvement.

Fig. 2. Latest Online Materials for the My Hometown Project.
Acknowledgements

I would like to thank Mehrasa Alizadeh and Amelia Ijiri who have facilitated this project and research on different occasions. They have been my closest collaborators in developing this project [1, 3].

References

Designing AR/VR Learning Experiences for K-12 and Higher Education

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Abstract. Join us for an insightful panel presentation with Canadian teacher-scholars, instructional designers, and multimedia developers. Each panellist will share a case study and research findings focussed on integrating AR/VR technologies in service to the teaching and learning mission. We highlight the need for designing immersive learning experiences and environments to meet specific educational goals and learning objectives. Practical recommendations will offer tangible curricular resources and innovative instructional strategies. We aim to inspire and provoke discussion around immersive education challenges and possibilities, including accessibility, safety, assessment, presence, social interaction, and shifting learning into the global classroom. Guests will gain a deeper understanding of how AR/VR technologies are impacting K-12 and higher education.

Keywords: Immersive Learning, Instructional Design, Gamification, Pedagogy, AR, VR.

1 Introduction

The panellists will report a series of five-minute case studies to offer practical recommendations for integrating AR/VR technologies for learning: 1) Meaningful Integration of AR/VR in the Classroom, 2) The Haunted Garage: Gamifying Learning using Mozilla Hubs, 3) AR to Enhance Science Education, 4) Seeing All the Facts You Learned: The Lived Learning Experience of Students in a Pedagogically Focused VR Experience, 5) Immersive Learning through VR in Elementary Science, 6) Reimagining Early Childhood Environments with Immersive Learning, and 7) High School Theatre in Immersive VR. Case study abstracts are described in Sections 2 to 8.

Discussion questions addressed by the panellists (see Fig. 1):
1. If you could make one thing possible in AR/VR for education, to enhance teaching and learning for yourself or your students, what would it be?
2. What are the current technical challenges or pedagogical limitations for immersive education?
3. How can AR/VR learning experiences foster play as a foundation for learning?
4. How can we achieve greater teacher engagement (e.g., providing a good case for those curious about immersive technologies but haven't experienced them)?

Fig. 1. A rehearsal of the panel presentation for the iLRN 2022 conference.

2 Meaningful Integration of AR/VR in the Classroom

AR/VR applications can be integrated into lessons across the curriculum with basic knowledge of technology at a viable cost. AR/VR tools can bridge the gap between students’ need for experiential learning and traditional passive teaching methods. This study reviewed research papers on educational AR/VR to synthesize the affordance and constraints for classroom learning. Two detailed lesson plans were created to demonstrate meaningful integration of AR/VR in a science class at the Grade 8 level. Findings report that AR/VR can make learning more engaging, increase students’ knowledge retention, create an environment for a better understanding of abstract concepts, and allow students to learn experientially. While integrating new technologies has pedagogical limitations and reluctance from stakeholders, AR/VR can positively change how 21st-century learners interact and learn in the classroom. AR/VR offers meaningful opportunities for all educators to embrace new educational innovations and enhance their daily lessons and teaching routines.
3 The Haunted Garage: Gamifying Learning Using Mozilla Hubs

At the University of Saskatchewan Language Centre, I am a member of a student support team providing cultural, linguistic, curricular, and technological support in a hybrid model for international students. Learning English online hosts benefits in terms of accessibility and recordable content but also has challenges for meaningful student engagement. To enhance the student learning experience, we hosted open Zoom sessions on Fridays for all levels of our program to meet and interact. The design of the Zoom sessions was complex, with many logistical and technical conditions and factors to consider, including multiple time zones, Zoom fatigue, student demographics, varying levels of ability with online gaming, bandwidth and hardware limitations, study environment and terminology. One particularly successful activity was utilizing Mozilla Hubs to introduce Halloween. This activity allowed students to present themselves as something other than just a face on a screen by paralleling the practice of wearing costumes at Halloween using avatars they created. Students embraced the freedom to speak and listen more actively, to have their avatar jump, fly, run, touch, and explore the virtual environment. As Halloween is not a global practice, students were excited about a novel online classroom experience. This activity met the university’s Learning Technology Ecosystem Principles in terms of being accessible, active, creative, designed for student growth and ownership, and most importantly, enabling connection among students worldwide.

4 Augmented Reality to Enhance Science Education

This research explores the affordances and constraints of an AR beehive exhibit designed to spark students’ curiosity about science. In this case study, AR technologies increased intrinsic motivation for interacting with the learning materials, leading to students attaining personal understanding and developing relational connections to science concepts. AR allowed students to explore the beehive exhibit creatively in an interactive digital experience that augmented the physical learning environment. The AR experience offered a situated and contextualized knowledge exchange by connecting science learning with entertaining, hands-on activities. Findings indicate that the AR activities enhanced student agency to learn in their ways and on their terms, thereby increasing critical thinking and curiosity for solving science problems. The presentation will describe the design framework used for developing the AR application and strategies to align the immersive design with specific learning goals.
5 Seeing All the Facts You Learned: The Lived Learning Experience of Students in a Pedagogically Focused Virtual Reality Experience

This research explores the relationship that presence has on learning in virtual environments designed for high school students. Data will be reported from an interpretive phenomenological analysis (IPA) of a pedagogical informed virtual learning experience simulating the solar system. Participants include five grade nine students; methods include semi-structured interviews and video observations. Grounded by a phenomenological lens, the study contributes to understanding the sense of autonomy and freedom (real and illusionary) that participants perceived in the virtual learning experience.

6 Immersive Learning through Virtual Reality in Elementary Science

Many teachers struggle to provide hands-on experiments for their kinesthetic learners. Setting up, cleaning up, and collecting all the supplies for large class sizes is exhausting and time-consuming. While Adobe Flash Player offered a treasure trove of free and accessible science learning tools, Flash was recently discontinued. Teachers who use Flash interactives and animations are now challenged to provide students with supplementary science experiences (without the prohibitive material requirements and extra preparation time). Fortunately, recent advances in immersive technologies allow teachers to offer high-quality, hands-on science learning opportunities through VR. As with most new technologies, teachers are often unsure where to begin or what VR applications are worth their time exploring. This research guides elementary science teachers on meaningful possibilities for integrating powerful and engaging immersive learning experiences into their classrooms and schools.

7 Reimagining Early Childhood Environments with Immersive Learning

Play is foundational to effective early childhood learning environments. By using a multisensory approach to learning whereby children are engaged in open-ended play using various learning tools and collaborative opportunities, they can deepen their understanding of the world around them. They form relationships with others and discover new topics they are passionate about pursuing. Integrating play-based immersive experiences to spark curiosity and passion for learning is a novel idea for enhancing early childhood education (ECE). Recent technical innovation in designing immersive environments expands the
possibilities for supporting children to learn in authentic and creative ways within a holistic ECE program. This presentation will explore the benefits and constraints of immersive learning as a catalyst for play-based early childhood learning experiences. I will highlight practical and imaginative ways for integrating immersive learning with the ECE environment to support academic and social-emotional skills.

8 **High School Theatre in Immersive Virtual Reality**

Grounded by current literature on the affordances and limitations of immersive virtual reality (IVR) for learning, this research followed high school students designing an immersive theatrical performance. A youth theatre group was tasked with writing, workshopping, directing, rehearsing, and performing a play for a live studio audience in AltspaceVR. Findings report how youth are experimenting with immersive technologies to take traditional theatre in new directions, including responsive narrative, actors/actresses performing as digital avatars, and placing the audience within the storyline. The presentation will highlight pedagogical strategies and design recommendations for working with youth to integrate IVR theatre experiences in secondary education.

**References**


CHEX Sponsored Workshop Series: Cultivating Standards for Immersive Learning Environments through Design

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Abstract. Join CHEX leadership and other iLRN members for a series of workshops designed to reveal and define standards for Immersive Learning Environments. Your participation will help shape our understanding of technical, engagement, and narrative standards that contribute to the way we create and utilize these environments. This five part series will take place over the course of the in-person conference and you may attend all or just a selection of these sessions. Pre-registration is encouraged, and materials will be shared in advance of the in-person workshop. These materials will include access to a collection of videos, highlighting projects that showcase a wide range of immersive learning environments designed and used by iLRN community members. During these in-person sessions we will use Design Thinking workflows to Discover, Empathize, Ideate, Define, and propose concrete Next Steps for the creation of standards around Immersive Learning Environments. Outcomes from this series of in-person sessions will shape ongoing collaborations with the IEEE Technical Committee on Immersive Environments (TC-ILE).

Keywords: Design Thinking, Immersive Learning, Technical Standards, Engagement Standards, Narrative Standards, CHEX.

1 Introduction

Your enthusiasm and engagement will drive the content and outcomes of these fast-paced design sessions. TC-ILE pre- and virtual conference activities include videos showcasing a wide variety of Immersive Learning Environments. The Video Showcase will be shared during the week before the in-person conference and will highlight important aspects of Immersive Learning Environments.

• Session 1. Define the space: Discovery & Empathy. Fast-paced introductory session to help define shape of the three main “Working Sessions.”
• **Session 2, 3, 4. Working Sessions: Technical, Narrative, and Engagement Standards.** Three design thinking sessions. Each session will focus on one type of standard. Participants will be guided through the following design thinking process: Discovery – Empathy – Ideation – Define – Testing – Feedback.

• **Session 5. Reporting Out.** The final goal is to create a descriptive style document that tells the story of these workshops and suggests iLRN community-defined standards for creating and using Immersive Learning Environments.

1.1 **Topic and Relevance**

To answer the call for the iLRN network to contribute to emerging standards through our partnership with IEEE Learning Society in describing methodologies for creating, employing, and assessing Immersive Learning Environments, with a focus on Technical Standards, Engagement Standards, and Narrative Standards.

We will use Design Thinking workflows to Discover, Empathize, Ideate, and Define the critical components and Next Steps in the creation of standards around Immersive Learning Environments. Our final workshop deliverable will be a descriptive style document that synthesizes the outcomes of these workshops that will be shared with the iLRN, the IEEE TC-ILE, and CHEX communities. This will also provide recommendations for next steps to be taken by iLRN and CHEX leadership around the topic of immersive learning environments.

1.2 **Target Audience**

Our first audience for these workshops is CHEX membership, as well as any other attendee at the in-person iLRN annual conference interested in immersive learning creating and/or using Immersive Learning Environments. Non-higher education participants will still find the style of workshop useful in shaping their own understanding of this important topic and opportunities to illustrate connections stemming from higher education will be included in the workshop process.

1.3 **Outcomes**

As a result of engaging with the design process, attendees will develop more empathy and a deeper understanding and a broader landscape of what to consider when designing all stages of Immersive Learning Environments. A better perspective of the current landscape of the Immersive Learning community and how individual efforts correlate with emerging community standards. We expect to design and share a document describing some best practices and ways forward around this topic. Additionally, participants will have the
opportunity to establish new personal connections with other members of the Immersive Learning community.

Become a member and join CHEX: https://immersivelrn.org/pages/champions-in-higher-education-for-xr-chex

![CHEX logo](image)

**Fig. 1.** CHEX logo.
Special Track 1: Self and Co-regulated Learning with Immersive Learning Environments (SCILE)
Pedagogical Approaches to Graduate Education in Learning Experience Design Using Immersive Technologies Online

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Abstract. This Practitioner Stream oral presentation chronicles the effort to develop a 100% online immersive technology course within a college of education at a Carnegie R1 Doctoral University in the Mid-Atlantic region of the United States. Immersive technologies hold great promise as technological tools to improve teaching and learning in higher education. In industrial applications, immersive technologies such as augmented reality (AR), virtual reality (VR), and mixed reality (MR) already serve critical training needs in diverse fields such as commercial aviation, the military, and healthcare. While these industries, many well-financed, are pushing the boundaries of what is possible in training and development, the teaching and learning space could benefit from new or enhanced instructional approaches and opportunities in the field of higher education, which was significantly disrupted by the COVID-19 pandemic.

Keywords: Learning Experience Design, Augmented Reality, Virtual Reality, Immersive Technology

1 Introduction

The design of the course evolved from an existing face-to-face, two-credit hour elective format to a 100% online course with no prerequisites. An assistant professor with experience in online program conception and online teaching served as the chief designer of the course and worked with an external instructional designer employed by the university’s online program management (OPM) company. As described by Cheslock [1], OPMs provide universities with numerous benefits, among which course development resources, technical support, marketing, and integration, in exchange for a percentage of tuition revenues. In the OPM model at this institution, the faculty served as the course designers while their development was assigned to the OPM. Over a period of six months, faculty members worked with the instructional designer to draw up design blueprints and develop the course. The development of the course was guided by the university’s core
values and its mission statement, which center on student agency and promote collaboration, diversity, inclusion, fairness, and freedom.

2 Principles of Learning Experience Design

All elements of the course are within the framework of higher education, though with a focus on the hands-on use of immersive technology tools as a preparation for workplace learning, which is typically outside the education space. For example, the course includes several custom-created videos in which the chief executive officer of an immersive technology company discusses the applications of such technologies in various industries. These videos include embedded, interactive questions that students can answer during sessions designed to engage participants online; research supports the use of embedded video quiz features to promote student learning [2]. Similarly, recorded student reflections posted to video-based discussion forums are encouraged to promote the students’ understanding of immersive technologies [3],[4]. The designer also applied these principles to the student learning experiences developed for the course [5]:

1. Learning is promoted when learners are engaged in solving real-world problems.
2. Learning is promoted when existing knowledge is activated as a foundation for new knowledge.
3. Learning is promoted when new knowledge is demonstrated to the learner.
4. Learning is promoted when new knowledge is applied by the learner.
5. Learning is promoted when new knowledge is integrated into the learner's world.

Anecdotal student feedback in online instructional design graduate courses indicated that the asynchronous learning environment presented challenges for students, highlighting the need to support more robust social interactions to improve social presence. As described by Garrison and Vaughan [6], high levels of social presence, teaching presence, and cognitive presence in hybrid learning environments are shown to improve learning outcomes. In view of this, efforts were made to enhance these elements.

3 Learning Technologies

One of the challenges for the course, worth two graduate credit hours, was to find the best way to implement hands-on technologies for students to use, through the creation of augmented, virtual, and immersive technologies. Students were given a choice of which immersive technologies they wanted to explore, and a list of widely available and free or inexpensive tools, for example Blippar and Google Cardboard.
While the course was 100% online, a large percentage of students at the university lived geographically close to the main campus; these students had access to two centers equipped with loaner immersive technologies, such as virtual headsets and 360 video cameras. In these environments, students were free to work on their own or collaborate with students majoring in a variety of disciplines from across the university, supported by a staff education technology specialist in a Community of Inquiry [6].

To enhance online social presence, the design team included Voice Thread, an online discussion platform with engaging multimedia tools. Use of the Kaltura video collaboration software was also planned to support immersive technology presentations.

Student learning activities were inquiry-based and included, but were not limited to, online discussions, a design thinking workshop, a design challenge, and hands-on explorations of immersive technologies.

Video and film were used as teaching tools throughout the course to teach principles of instructional design [7] and design thinking [8] as human-centered approaches to innovation used by students to develop prototypes that attempt to solve instructional problems.

In addition, an online design thinking model was created to teach students problems of practice [9] and to contextualize the use of the immersive technologies within a realistic higher education context.

Evaluation is a student survey of instruction [10].

4 Conceptual Frameworks

Clark and Mayer’s [11] textbook on e-Learning informed design decisions for each module of the 7.5-week course. The designer sought to define student learning as a cognitive process that must also be accompanied by social interaction, in which learners leverage a feedback loop to inform changes in their learning behaviors [12].

5 Commitment to Universal Design

As part of the Diversity and Inclusion Unit, students were also exposed to the concept of Universal Design [13]. Universal design is a paradigm focused on the creation of learning environments that support and/or address the needs of all learners from the ground up. This includes accessibility.

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