Georgian College Digital Transformation: Best Practices Report

A Project Funded by Georgian College and the Future Skills Centre

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This report was produced as part of a project funded by the Future Skills Centre (FSC), with financial support from the Government of Canada's Future Skills Program.

FSC is a forward-thinking centre for research and collaboration dedicated to preparing Canadians for employment success. We believe Canadians should feel confident about the skills they have to succeed in a changing workforce. As a pan-Canadian community, we are collaborating to rigorously identify, test, measure, and share innovative approaches to assessing and developing the skills Canadians need to thrive in the days and years ahead. The Future Skills Centre was founded by a consortium whose members are Toronto Metropolitan University, Blueprint ADE, and The Conference Board of Canada

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1. Executive Summary

The world's digital landscape underwent a rapid transformation, further accelerated by the COVID-19 pandemic. This shift marked the rise of extended reality (XR) technologies, encompassing augmented reality (AR), virtual reality (VR), and mixed reality (MR). These innovations have fundamentally changed how people interact with digital content, blurring the lines between the physical and virtual worlds.

Georgian College, recognizing the potential of these emerging technologies, embarked on an ambitious Digital Transformation Strategy project in April 2021, funded by Future Skills Centre Canada and Georgian College. Completed in September 2023, the project delved into the application of XR technologies within a post-secondary environment, aiming to assess their impact on students, faculty, and staff. This exploration was particularly timely, considering the global shift towards remote interactions in education and work due to the pandemic.

The project's goal was to delve into the application of XR technologies within a post-secondary environment, assessing their impact on students, faculty, and staff. This was especially relevant given the global shift towards remote interactions in education and work brought on by the pandemic. Central to this strategy were three pilot projects, each designed to elevate the experience, knowledge, comfort, and usage of XR technologies within the Georgian College community. These projects provided practical, hands-on opportunities, significantly enhancing digital literacy, and preparing the community for a future increasingly reliant on such technologies.

Integral to this initiative was its alignment with the college's Equity, Diversity, Inclusion, and Belonging (EDIB) initiative. By integrating XR, the project aimed to make educational and professional opportunities more accessible and inclusive, ensuring equity in the digital transformation journey.

This report serves as a Best Practices guide, outlining the successes and challenges encountered during Georgian College's journey with XR. It is intended as a resource for other institutions and organizations looking to embark on their own XR journeys.

Five Key Recommendations for Organizations Seeking to Integrate XR

1. **Focus on Inclusivity and Accessibility**: Align XR initiatives with broader institutional goals of equity, diversity, and inclusion. Ensure that XR experiences cater to a diverse range of users, making education more accessible to all community members.
2. **Prioritize Cross-Departmental Collaboration and Training**: Implementing XR technology successfully requires a dedicated, interdisciplinary team. Regular training and professional development for both faculty and staff are crucial for effective use and integration of XR into educational programs.
3. **Develop a Comprehensive Onboarding Process**: Ensure a detailed orientation for XR hardware and software to familiarize users with the technology. This includes instructions for using, cleaning,

and maintaining XR devices, as well as guidance on the various applications and experiences available.

4. **Implement Pilot Projects for Testing and Refinement**: Conduct pilot studies to evaluate the suitability and effectiveness of XR tools in educational settings. This allows for a better understanding of what works best in your specific context and facilitates continuous improvement.
5. **Document and Share Best Practices and Lessons Learned**: Actively document the process, challenges, and successes of your XR implementation. Sharing these insights both internally and with other institutions can help others in their XR journey and contribute to the broader community of practice.

This report provides detailed insights into the project's execution, including the effective strategies and encountered hurdles, provide a comprehensive understanding for others to learn from. The goal is to offer a well-documented path that others can follow, enhancing the adoption and integration of XR technologies in education and beyond.

In summary, the Georgian College Digital Transformation Strategy has significantly enhanced the college's learning and working environments, establishing a valuable framework for other academic institutions embarking on their own digital transformations. The insights and best practices gleaned from this project provide invaluable guidance for others on similar digital journeys.

2. How To Use This Document

This Best Practices Report presents Georgian College's ongoing journey and experiential learning in the realm of Extended Reality (XR). We present this document not as a definitive guide, but as a dynamic resource that reflects our current understanding and experiences with XR technologies. It is crafted with the intent to share our insights, challenges, and successes, providing a roadmap that other organizations can adapt and build upon in their unique contexts.

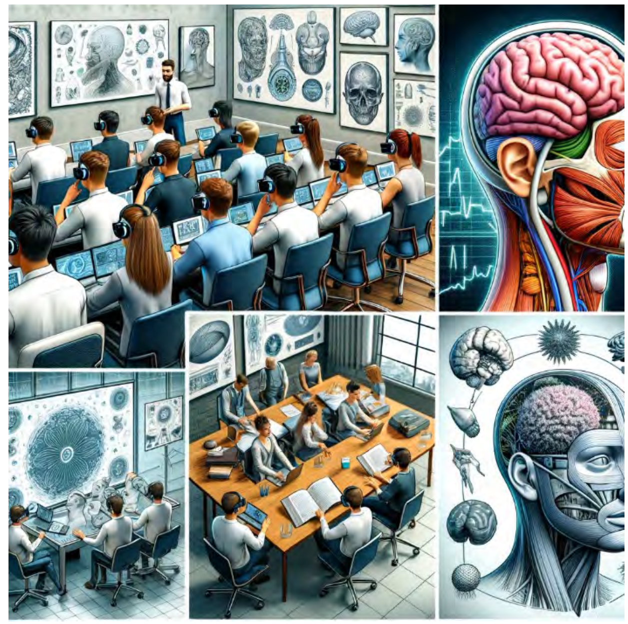
We hope that this document serves as a starting point for your institution's exploration of XR. It is designed to spark ideas, provoke questions, and encourage innovation. As we continue to expand our knowledge and expertise in XR, we look forward to updating this document with new insights and best practices.

As you peruse these pages, we encourage you to view our journey as an evolving narrative. Georgian College is still in the process of discovering, experimenting, and refining our approach to XR. This document is an invitation to join us in this exploration, to learn from our experiences and to contribute your own insights.

3. FSC Funding: Shock-Proofing the Future of Work

The Future Skills Centre (FSC) focuses on advancing skills development across Canada, with Georgian College hosting one of the largest funded projects under the Shock-proofing the Future of Work grant stream, issued in the spring of 2020. FSC's approach is based on five pillars: Agile Labour Market Responses, Responsive Career Paths, New Tools for Data and Tech Skills Training, fostering innovation for future success, and replicating effective strategies. From 469 proposals, only 65 were selected for a share of $46 million, emphasizing FSC's selective and strategic investment. The funded projects adhere to principles of grant management, evidence generation, research, knowledge mobilization, and innovation labs, ensuring impactful and sustainable skill development. Georgian received $955,000 from FSC which was matched one-to-one by Georgian College’s Digital Innovation Fund.

4. XR as a Transformational Education Technology



Extended Reality (XR) technologies, including Virtual Reality (VR), Mixed Reality (MR), and Augmented Reality (AR), have begun to significantly transform educational paradigms. Initially popular in entertainment, XR is becoming a compelling medium in education, offering immersive and interactive experiences that were previously inconceivable in traditional classrooms (XR Today, 2022; Angel-Urdinola et al., 2021; Cicek et al., 2021; Bailenson, 2018).

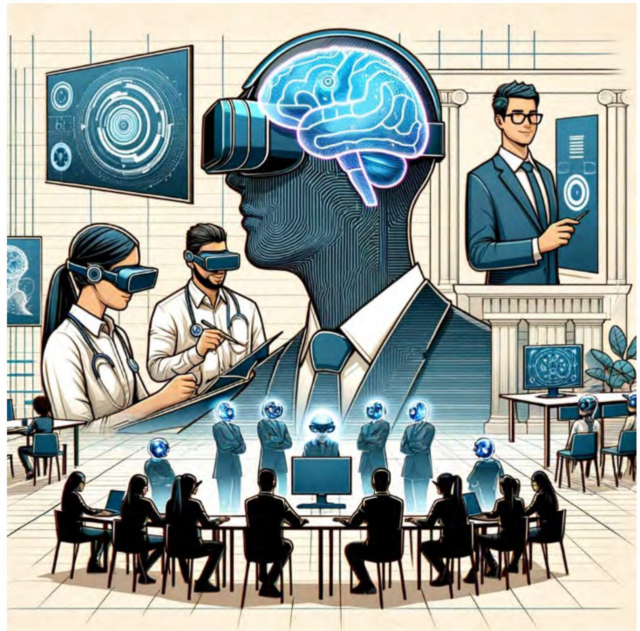
Jeremy Bailenson, from Stanford University's Virtual Human Interaction Lab, emphasizes that VR experiences should be viewed as actual experiences, impacting learning and behavior, XR enables the simulation of scenarios that are either too dangerous, impractical, or expensive to replicate in real life, thus enhancing the depth and retention of learning (Bailenson, 2018).

The strategic integration of XR into educational curricula is vital. However, the design and development of XR in education often do not adequately consider learning theory and research findings from the learning sciences (Hamilton et al., 2021). There's a risk that XR is chosen more for its novelty than its educational efficacy, sometimes leading to worse learning outcomes compared to traditional methods.

There are difficulties in studying VR in educational settings, however a consensus is emerging. Most studies suggest that VR enhances student engagement, enjoyment, and their motivation to learn, resulting in overall positive learning experiences (Checa et al., 2023; Hamilton, et al., 2021; Cikajlo, 2019; Huang et al., 2019; Makransky & Lilleholt, 2018; Kavanagh et al., 2017; and Fogarty et al., 2017).

VR has been shown to be useful for teaching content where students must comprehend the 3D spatial arrangements of objects (Jensen and Konradsen, et al., 2018), especially when this is difficult to depict in two dimensions, such as in the fields of engineering, architecture, manufacturing (Fogarty et al., 2017), and anatomy (Schloss, et al., 2021; Gloy et al., 2021; Zinchenko, et al., 2020; Markesky et al., 2019; Reymus et al., 2020; Liou and Chang, 2018). VR is also effective for procedural training where learners must perform a set of tasks in a specific order, such as safety training, mechanical assembly, and repair procedures (Rainford et al., 2023; Hamilton et al., 2021; Blumstein et al., 2020; Allcoat and von Mühlenen, 2018). For instance, in their 2020 study, Blumstein and colleagues found that students trained in VR correctly performed 63% of fracture nailing surgical steps, compared to just 25% by those taught through traditional methods. (Blumstein et al., 2020). In these cases, the performance improvements are enhanced when the subject matter is complex (Gloy et al., 2021; Schloss et al., 2021; Markesky et al., 2019). Some studies suggest that VR learning experiences may also increase memory retention in the short-term (Hamilton, et al., 2021; Huang et al., 2019; Krokos et al., 2019; Allcoat and von Mühlenen, 2018; Ostrander et al., 2018; Glenberg, et al., 2016) but more work is need in this area since longitudinal studies are few.

Many methods have been used to measure efficacy, motivation, engagement, retention, and other learning outcomes, where multiple-choice surveys are most common (Hamilton, et al., 2021; Suh Prophet, 2018). Measuring student performance using more robust metrics, such as correctly completing a procedural task, identifying, or arranging structures in a 3D space, or quantifying less-concrete factors like motivation, engagement, enjoyment, perceived choice, or tension during or immediately after VR exercises, can reveal where VR benefits or fails students under specific learning conditions (Hamilton, et al., 2021).



Despite its potential, many colleges lag in adopting these technologies. This delay poses a significant risk, as the demand for technology-enhanced education is growing rapidly. The importance of XR in the future of education cannot be overstated. It represents a paradigm shift in educational delivery and experience (Hamilton et al., 2021).

In summary, while XR offers significant potential for enhancing education, its integration needs to be approached critically, balancing its innovative aspects with a thorough understanding of educational theory and the potential shortcomings and barriers to adoption. Institutions that embrace this shift will lead in providing innovative and effective educational experiences. As the digital landscape continues to evolve, XR integration will be key to staying relevant and competitive in education.

5. Project Summary

Why This Project Was Needed

- The project aligned with Georgian College's Digital Innovation Strategy.
- There is a demand for graduates with advanced digital skills, comfort working and collaborating remotely.
- There is a growing need for graduates and employees who are familiar and competent with Extended Reality (XR) technologies.
- Need to modernize higher education:
  - New learning modes for students,
  - New teaching tools for faculty,
  - New work tools for staff and administrators,
  - Opportunity to exploring implementation of XR in a large organization,
  - Examine how XR might create or reduce barriers for people, especially those from rural communities and under-represented groups such as indigenous people, newcomers, LGBTQ2+, youth and people with disabilities.

Georgian's Digital Innovation Strategy launched in late 2020 in direct response to the challenges presented by the COVID 19 pandemic. 50% of the project's funding came from the DI Strategy to ensure the project's success.

COVID-19 and the Push Towards Digital: The pandemic accelerated digital transformation in post-secondary institutions, significantly impacting educational methods and increasing the importance of digital competencies, including XR technologies. This shift necessitated programs that address the digital skills gap (Tableau, 2021).

Demand for Digital Skills in the Workforce: The evolving nature of work, increasingly reliant on technology, has led to a steep rise in the demand for digital skills. This change is not only in traditional tech-centric roles but across various sectors, highlighting the need for graduates who are equipped with the appropriate skills and attitudes (Urban Institute, 2019; Brookings Institution, 2002-2016).

XR's Educational Potential: XR offers a transformative platform, providing immersive experiences that bridge theoretical knowledge with practical application. Its integration into education goes beyond pandemic-induced needs, offering long-term benefits in engagement, retention, and experiential learning (Hamilton, et al. 2021; Suh & Prophet 2018).

Modernizing Education with XR: The project aimed to modernize higher education by integrating XR technologies in many areas of the college, thereby enhancing teaching and learning, interactions, remote collaboration, and tools for daily work. It also examined XR's potential in creating inclusive educational experiences, particularly for underrepresented communities, where XR could remove barriers and create new opportunities for engagement and learning.

Inclusivity and Accessibility: The project emphasized inclusivity by investigating ways to offer different types of XR experiences that could cater to diverse groups, including those from rural areas and marginalized communities.

Georgian's FSC project was not just a response to immediate pandemic-driven needs but a strategic step towards embedding digital and XR competencies in education, aligning with broader workforce trends and future-proofing education.

6. Project Objectives & Outcomes

Georgian’s Digital Transformation Project had five objectives that were addressed through three pilot projects. The three pilots represented three levels as follows:

Pilot 1: *College Level* – focusing on open access to XR devices and applications for as many students and faculty.

Pilot 2: *Department Level* – focusing human anatomy courses taught in the Health and Wellness Department, specifically for nursing, paramedics, acupuncture, athletics, and massage therapy.

Pilot 3: *Course Level* – focusing on a compulsory communication course (Comm 1016) with over 800 students.

Objective		Approach	Pilot Project	XR Devices and Software
1	‘Level-up' as many employees as possible with new XR skills and constructive attitudes towards XR in the workplace and classroom.	Provide XR experiences widely to the college population, coupled with training and information.	Pilot 1, 2, 3	2D and 3D applications accessed with PC / laptop or VR headsets. ILRN Virtual Campus, EngageVR, Altspace VR, virtual labs, remote collaboration software (REMO).
2	Unlock new XR tools for staff, faculty, and students that enhance the Georgian experience.	Provide access to XR devices and software for learning, communication, and connection.	Pilot 1, 2, 3	
3	Pilot advanced XR tools for curriculum delivery in key departments to develop best practices for use and expansion.	Conduct a scientific study of the use of VR to teach anatomy in Health and Wellness programs; and the use of study adaptive learning software to bolster student success.	Pilot 2 (VR Anatomy) Pilot 3 (Adaptive Learning)	2D (PC-based) and 3D versions of 3D Organon and Body Maps experienced with Quest II VR headsets. Lessons accessed through a virtual lab. Cerego adaptive learning software provided to students through BlackBoard learning management software.
4	Use XR tools and training to lower barriers for underrepresented students and promote equity, diversity, and inclusion at Georgian.	Review XR devices and software through the EDIB lens, documenting potential for XR to create or reduce	Pilot 1	2D and 3D applications accessed with PC / laptop or VR headsets. ILRN virtual campus, BodySwaps, and a variety of other VR applications.

		barriers for all users.		
5	Measure the impact of these organizational changes at the College over the duration of the project.	Conduct a college-wide survey and post-experience surveys.	Pilot 1	Standardize surveys administered to students through College operations (March and Oct); and experience surveys provided to participants after XR experiences (e.g. BodySwaps).

Research Questions

The project research focused on four questions, each linked to at least one of the Pilot Projects.

Question	Pilot	Primary Evaluation Tool
QUESTION 1: Does exposure to XR and participation in XR improve staff & faculty attitudes and comfort with XR over time?	Pilot 1 and 2	College-wide survey and post-experience surveys.
QUESTION 2: Can XR be used to increase empathy and lower barriers for underrepresented groups in the college community?	Pilot 1 Pilot 2	Post-experience surveys for BodySwaps VR experience. Post-experience survey for 3D Organon subjects.
QUESTION 3: How can iVR be implemented in Health, Wellness, and Sciences to enhance learning and skills of students?	Pilot 2	Pre and Post Standardized survey for 3D Organon subjects.
QUESTION 4: How can adaptive learning software (Cerego) improve student performance in a compulsory course (Communications: COMM 1016).	Pilot 3	Student test scores (pre and post); and student survey.

Project Outcomes

Project Success and Implementation

The project was a significant achievement for the college, successfully deploying over 300 VR headsets and a variety of 2D and 3D XR applications across the student, faculty, and staff body. It explored how XR technology was adopted in educational and workplace settings, focusing on best practices and considerations for equity, diversity, and inclusion. VR technology is now integrated into 4 program areas, being explored in over 20 others, and interest continues to grow at all seven Georgian campuses.

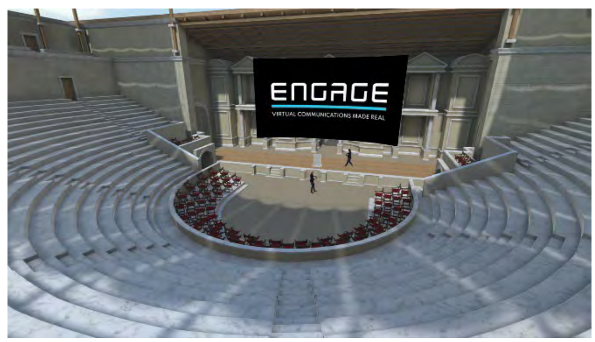
Team Composition and Expertise

A dedicated team of XR experts was formed, including an XR Manager (Rob Theriault), a Lead XR Researcher (Dr. Isabelle Deschamps), and an XR Technician (Victor Skierski). The team was supplemented by specialists such as James Fielding (adaptive learning lead), Dr. Mria Ray and Laleh Khodaparast (focusing on XR for Applied Research), and Dr. Jamie Doran (an external expert and project manager). Beyond the core team, dozens of students and faculty are expert-level XR users and are acting as XR evangelists throughout the College.

Launch of ILRN Virtual Campus

The ILRN Virtual Campus was a notable outcome, attracting over 1,000 students and faculty members. The virtual campus hosted nine courses, numerous events organized by various Georgian departments and clubs, and drew in hundreds of external visitors for events like the Teaching and Learning Conference and the ILRN Conference in 2021 and 2022.

XR Tools and Engagement



The project introduced a suite of XR tools, including EngageVR, BodySwaps, 3D Organon, BodyMaps, REMO, and Virbela, among others. These tools were tested extensively across the college, with over 1,500 Georgian students and staff, and more than 2,000 public members participating in XR experiences. To gauge the adoption rate and effectiveness of XR technologies, an XR survey was conducted twice during 2022/2023.

Research and Non-Research Outcomes

The project yielded both research and non-research results. The research findings have been separately documented for publication. This Best Practices and Lessons Learned Report encapsulates the non-research findings, detailing the management of this complex project over a 2.5-year period and the insights gained, useful for internal sharing at Georgian or with other institutions and large organizations exploring XR deployment.

XR Survey Results

The college-wide XR survey was issued twice but the response rate was lower than desired (approximately 100 students & staff responded). Due to the low response rate the data was not analyzed statistically to determine correlations between groups or variables. However, a few of the raw results are worth noting here. This survey was conducted in March 2022 (post-pandemic) but participants were asked to recall their exposure to XR pre-pandemic in some questions.

Awareness & Usage

- 99% of respondents were aware of VR post-pandemic as compared to ~82% pre-pandemic.
- 21% of faculty and 19% of student respondents reported owning their own VR headset.
- 69% of the student respondents were aware of AR, compared to 74% of faculty.
- ~35% of faculty and students had used VR during the previous year.
- 34% of the student respondents had used an AR application in the previous year compared to 24% of faculty respondents.

XR and Education

- 68% of faculty felt that VR will enhance student learning.
- 57% of faculty felt that AR will enhance student learning.
- 50% of students felt that VR is an important tool for the classroom, and 47% indicated it will be an important workplace tool.
- 41% of students felt that AR is an important tool for the classroom, and 56% indicated it will be an important workplace tool.

Metaverse

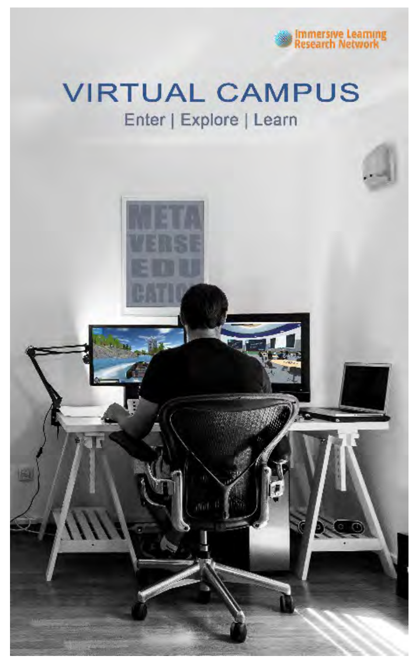
- 41% of students and 68% of faculty reported that they knew about the Metaverse (virtual worlds that exists only online)
- ~40% of the student and faculty respondents reported that they had a social circle that they only interact with online.

We want to avoid drawing too many sweeping conclusions from the limited results we obtained from the XR survey, however, we can say that awareness of XR at the college is high and that most respondents feel that AR and VR will play a role in enhancing education. The adoption rate of XR by the students and faculty (i.e. regular use of AR or VR in their day to day life) is low (<20%) but we know from other survey data that users misreport their usage when then do not fully understand what applications or devices qualify as XR. For example, many survey respondents stated that they had never made an avatar but also reported that they used the ILRN virtual campus which requires them to create an avatar. In another instance respondents said they never used an AR application but later indicated that they frequently use SnapChat filters which uses AR. Clearly, there is a lack of understanding surrounding the nature of XR in its many forms and a high likelihood that the usage level across students and faculty may be higher than reported.

7. The ILRN Virtual Campus

Georgian College, in collaboration with the Immersive Learning Research Network (ILRN), embarked on an innovative journey by introducing the ILRN Virtual Campus, powered by Virbela, as part of Pilot 1. This virtual platform, launched in November 2020, served as a digital analogue of a physical academic campus, complete with various spaces for teaching, conferences, socialization, and other events. Over the course of its implementation, more than 600 users signed up, with approximately 500 active accounts. The virtual campus facilitated a wide range of activities, from department meetings and college orientation sessions to conferences and indigenous events, marking a significant stride in Georgian's digital engagement.

Benefits of the ILRN Virtual Campus



1. **Enhanced Remote Learning and Interaction**: During the COVID-19 pandemic, the ILRN Virtual Campus was pivotal in enabling continuous learning and office work, even when physical presence was impossible.

2. **Diverse Applications**: The campus was utilized for numerous purposes, including teaching (with over 148 class sessions for 16 different courses), department meetings, and indigenous events.

3. **Preparation for Future XR Technologies**: The project provided valuable experience for students and staff, acquainting them with XR technologies and virtual world interactions, essential for future career landscapes.

Challenges of a Virtual Campus

1. **Software Installation and Access**: Users initially faced difficulties in downloading and installing the software, leading to delays in access.

2. **Onboarding Issues**: The process of onboarding staff and students encountered challenges, including errors in user information and difficulties in account creation and avatar setup.

3. **Decline in Post-Pandemic Usage**: There was a notable decrease in the usage of the virtual campus by students and staff after the easing of COVID-19 restrictions. This may have been partly due to online fatigue.

Recommendations for Implementing a Virtual Campus

1. **Streamline Access**: Simplify the process of accessing a virtual campus. We achieved this through the introduction of the Georgian College Hub, a central access point that allowed users with Georgian credentials to access our private spaces.
2. **Provide Technical Support**: Establish dedicated technical assistance for users, especially during onboarding phases.
3. **Regular Updates and User Training**: Keep the software and hardware up to date and provide regular training for users to stay abreast of technological advancements.
4. **Monitor and Adapt to User Needs**: Regularly assess user engagement and needs to adapt the virtual campus accordingly, ensuring it remains a relevant and effective tool.
5. **Create Engaging Content**: Develop engaging and interactive content and activities within the virtual campus to maintain user interest and participation.
6. **Foster Community Engagement**: Encourage and facilitate community-building events and activities to enhance the sense of connection among users.

Virtual Campus – Final Thoughts

Georgian College's experiments with ILRN Virtual Campus were enlightening and enriching. By venturing into this digital landscape, we not only enhanced our understanding of virtual environments but also connected with numerous organizations in the digital space. These interactions were pivotal in revealing how 'Metaverse' spaces like these could benefit education. Looking back, it's clear that our journey with the virtual campus transformed our perspective on educational experiences and collaboration, showcasing the potential and adaptability of educational institutions in the face of innovative technologies.

8. Lessons Learned & Key Insights Summary

In this section, we present a carefully curated collection of our most significant recommendations and insights derived from this project. Our aim is to concisely encapsulate the essential lessons learned, offering guidance and valuable insights for those undertaking similar ventures in the realm of XR within post-secondary education. This compilation is the result of thoughtful reflection on our experiences, intended to serve as a practical and informative resource for educational professionals exploring this innovative technology.

- **Team Building for Cross-Departmental Collaboration:** Implementing a large-scale XR project in a post-secondary institution requires a dedicated team, especially when the project spans multiple departments and campuses. Successful execution hinges on collaborative efforts and clear communication among various stakeholders.

- **Understanding and Leveraging Institutional Dynamics:** It's vital to assess the institution's readiness for adopting new technologies, identifying early and late adopters, as well as resistors. Creating opportunities for experimentation and incremental skill-building fosters a positive environment where participants can learn from both successes and failures.
- **Starting with Simple, Impactful Experiences:** Begin with straightforward, introductory experiences in VR, which can be particularly striking for first-time users. Positive initial interactions with XR technologies are key in cultivating widespread interest and acceptance.
- **Adapting to Rapid Technological Evolution:** The fast-paced evolution of XR technology necessitates strategic planning in purchasing and deploying hardware and software. Investing in XR tools with specific applications in mind, rather than mass acquisition, ensures relevance and usability.
- **Strategies for Inclusive and Effective Study of XR Use:** To comprehensively study XR usage, it's often more effective to make participation mandatory, ensuring a diverse and unbiased sample. However, also consider offering alternative options for those who may not be comfortable with VR headsets (such as 2D versions of the same software).
- **Piloting and Selecting Suitable XR Technologies:** Given the constantly improving stare of XR development, conducting pilot studies and demonstrations is critical in selecting appropriate technologies for educational use. Not all advanced XR tools may be suitable for a post-secondary environment.
- **Broad Deployment and Support Challenges:** Widespread deployment of XR tools requires enthusiastic support across departments. Success is closely tied to the perceived benefits for students, faculty, and staff, and must be supported with proper technical assistance.
- **Overcoming Technical Barriers and Building Infrastructure:** Expecting and preparing for technical challenges is crucial. Addressing technical challenges, such as VR headset software installation and upgrade issues will be ongoing. Establishing a robust tech and user support system ensures smooth operation and enhances user experience. Team members with strong troubleshooting skills are invaluable assets in managing these issues effectively.
- **Identifying and Addressing Participation Barriers:** Understanding and addressing barriers that prevent students from engaging in research projects, such as stress level, course loads, time

constraints or technology apprehension, is essential for successful integration of XR in educational settings.

- **Linking VR to Curriculum and Motivation:** For effective integration of VR into the curriculum, its use must be directly tied to course outcomes and incentivized, such as through the allocation of points or mandatory practice sessions.
- **Changing Perceptions Through Experience:** Initial reluctance to try XR often stems from misconceptions. Once individuals engage with the technology, their perspectives frequently shift, and they open up its educational potential. This is particularly true for administrators and faculty who may be approaching the technology with a preconceived notion of its quality or fidelity. Some older users will remember the first wave of VR headsets and applications that failed to take off in the early 90s due to under performing hardware and software. This is not longer the case.

9. Strategy and Tactics

This section provides some insight into how the project developed its strategy for success and approached the implementation for XR deployment in a large educational institution like Georgian College.

Strategic Thrusts

Our initiative sought to experiment with XR in an educational setting, exploring its potential to significantly enhance and transform educational experiences. This involved a strategic focus on integrating XR into curricula, fostering experiential learning, encouraging experimentation, and committing to digital innovation, equity, and diversity. Several strategic thrusts guided our tactics:

- Rapid and Broad Deployment of XR
- Utilizing VR's Educational Capabilities
- Experiential Learning through VR
- Strategic Integration of XR in Curriculum
- Digital Innovation and Modernization of Education
- Promoting Equity, Diversity, and Inclusion
- Enhancing Learning and Working Environments with XR
- Pilot Projects for Best Practices in XR
- Faculty Engagement and Curriculum Integration
- Continuous Evaluation and Adaptation to Technological Advances

Important Tactics

1. **Utilizing Off-the-Shelf VR Software**: Adopting readily available VR software enabled quick and widespread dissemination of XR experiences across various departments.
2. **Implementing a Effective Training Program**: Training for faculty and staff was crucial to ensure effective use and integration of XR technology into the curriculum, stand-alone experiences, and public or college events.
3. **Developing a Collaborative Approach**: Engaging multiple departments and securing the involvement of deans and faculty members encouraged cross-campus collaboration and broader acceptance of XR technologies. This project reached almost all departments at Georgian with the strongest participation from Health and Wellness, Trades, Indigenous Studies, Arts, Social Innovation, and Research, Innovation, and Entrepreneurship.
4. **Strategic Technology Acquisition**: Instead of mass procurement, the college strategically acquired XR tools specific to various use cases, ensuring relevance and efficient utilization.
5. **Incorporating XR into Pedagogical Practices**: Tying the use of XR tools to actual course outcomes and integrating them into existing curricula ensured that these technologies enhanced the educational experience rather than being mere technological novelties.

Catalysts for Success

1. ***Leveraging the Powerful (Visceral) VR Experience:*** Georgian College capitalized on the immersive and visceral nature of VR to significantly enhance engagement and enthusiasm among users. This powerful experience transcends traditional learning methods, creating a compelling and memorable educational environment that resonates deeply with students and faculty.

2. ***Tying VR into the College's Existing Plans for Remote Learning:*** The integration of VR into the college's pre-existing remote learning strategies was a key factor in its success. By aligning XR technologies with ongoing digital education initiatives, the college ensured a seamless and relevant adoption of these tools, enhancing the remote learning experience.

3. ***Providing Multimedia Tools for Content Creation:*** By equipping students and faculty with multimedia tools like video cameras, Georgian College empowered them to create and share their own content through XR platforms. This approach not only fostered creativity but also encouraged active participation in the XR ecosystem, enriching the educational content available online.

4. ***Taking a Human-Centered Approach That Embraced Equity and Diversity:*** The college's human-centered approach, focusing on equity and diversity, was instrumental in creating an inclusive XR environment. By prioritizing the reduction of barriers for all users, Georgian College ensured that XR technology could be used in a way that was accessible and beneficial to a diverse range of learners.

5. ***Actively Seeking Faculty Champions to Evangelize the Technology:*** Identifying and supporting faculty champions was a strategic move that helped in propagating the benefits of XR technology across the campus. These champions played a crucial role in recruiting students and fellow faculty members, thereby amplifying the reach and impact of XR in the college's educational framework.

6. ***Proactively Documenting Best Practices Throughout the Project:*** Georgian College's commitment to documenting best practices as the project progressed was a key element in its success. This ongoing documentation not only facilitated continuous improvement but also provided valuable insights for future XR implementations, both within the college and in the broader educational community.

10. Administration and Project Management

Administration and Project Structure

Top level administration of this was provided by the Executive Director, RIE (Dr. Mira Ray). A Project Manager (Dr. Jamie Doran) was contracted in to manage the final year of activities and wrap up the project. Three Pilot Leads, reported to the Project Manager. The Leads oversaw the activities and research associated with Pilot 1 (Rob Theriault, Centre for Teaching and Learning: Barrie Campus), Pilot 2 (Dr. Isabelle Dechamps, Health and Wellness: Barrie and Orillia Campuses), and Pilot 3 (James Fielding, Trades: Muskoka campus) respectively.

XR Team

The XR Team was comprised of Georgian staff from several departments and campuses. An important outcome from this project has been the interdisciplinary collaboration. The XR coordinated the research and project activities which intersected with students, faculty, and staff across almost every department. There are few programs that achieve this level of interdisciplinary collaboration.

The key roles were as follows:

FSC Project Manager: Oversaw project activities and finances, tracked project outcomes, coordinated XR Team meetings, collected project metrics, completed FSC reports, led project communications, contributed to knowledge mobilization, and reported to Executive Director. The Project Manager also led the writing and reporting process for: the research publication (Pilot 2), XR Survey, and Best Practices Report.

XR Manager: Led Pilot 1 activities, acted as XR subject matter expert, led device and software selection and deployment, contributed to knowledge mobilization, coordinated the work of the XR Technician.

Lead Researcher: Oversaw research planning and experimental design for all three pilot projects. Acted as the Pilot 2 Lead. Oversaw a small Data Team (post-graduates and co-op students) that helped to collect data and analyse data. The Lead Researcher managed the Research Ethics Board (REB) approvals and amendments as they were required. This role was also involved in knowledge mobilization, reporting our research approach and outcomes to internal and external audiences. The Lead Researcher also helped analyse the research results of the pilots and helped to write the Pilot 2 research paper.

Adaptive Learning Manager: Oversaw the activities of Pilot 3. Managed the selection of adaptive learning software and the integration with Black Board learning management software. Supervised the work of post-graduate and co-op students who helped with data collection, analysis, and reporting.

Data Lead: Was responsible for developing the approach to data analysis for Pilot 1, 2, and 3. This was a post-graduate position, drawing on a recent grad from the Research Analyst Program. This role also assisted with conducting an extensive literature review and writing the research paper for Pilot 2. The Data lead also supervised the work of co-op students who assisted with data analysis and data visualization.

XR Technician: Was responsible for device setup, upgrades, troubleshooting, and tech support for all three Pilot Projects. Was also instrumental in setting up technology demonstrations for large XR events.

Virtual Campus Lead: Was responsible for assisting the Georgian population with access to the ILRN Virtual Campus. They provided tours, helped organize and run virtual events, contributed to communications about the virtual campus, and did outreach activities to departments, faculty groups, and student organizations. The role also provided tech support for users inside the virtual world.

Operations Officer: Was responsible for tracking project finances and developing spending forecasts with the Project Manager. Assisted with procurement and hiring.

Finance Support: Assisted with procurement and employee time-tracking for reporting purposes.

XR Team-Building and Professional Development

Team building and professional development played a crucial role in their project's success. The XR Team was a small group, consisting of six core members: a Project Manager, Lead Researcher, XR Manager, XR Technician, Pilot 3 Lead, and the Operations Officer. Throughout the project, several co-op students and other staff members also joined the team as new work arose. The team met bi-weekly throughout the project to share developments, challenges, successes, and news about the XR sector. Much of the project took place during the COVID pandemic which necessitated online meetings. However, the team met regularly in the ILRN Virtual Campus.

To facilitate hands-on experience with XR technologies, each core team member was assigned a VR headset to take home and explore. This initiative aimed to ensure that everyone on the team was familiar and comfortable with VR, gaining first-hand experience with the technology. The Lead Researcher and XR Manager collaborated with faculty members led the VR Anatomy Study (Pilot 2). These collaborations were instrumental in developing lesson plans and the assessment tools that became part of the scientific research.

The team explored various virtual worlds using platforms like Altspace VR or EngageVR, often accompanied by other staff, faculty, and guests. These outings were not only used for planning and exploring the potential of XR for education but they also acted mind-expanding team building experiences.

Additionally, the XR Manager continues to run an online course titled "VR Educator," which offers a Microcredential in XR Education. The course enrolls 20 to 30 teachers and enthusiasts per semester.

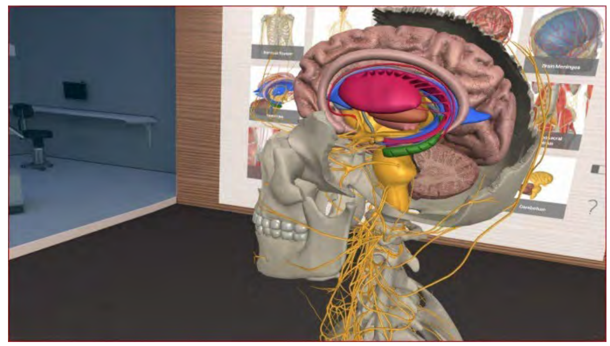
As part of their professional development, the XR team visited several public XR installations, such as The Infinite in Montreal and Van Gogh: The Immersive Experience. These visits provided valuable team building experiences as well as insights into how roaming VR and mixed reality could be applied in educational environments. Moreover, the XR Manager, along with some faculty from Georgian, explored a variety of educational VR applications suitable for Georgian's programs, including FLAIM, a firefighting VR training tool. These explorations were key to understanding and leveraging the latest software applications in XR for training.

11. Researching XR in a Post-Secondary Environment

General Comments

Conducting research in a college setting presents unique challenges, differing significantly from the university research environment in terms of pace and procedural requirements. One of the primary factors contributing to this slower progression is the necessity of navigating more bureaucratic barriers. For instance, securing permissions from Deans is critical, especially for confirming faculty hours and remuneration, which often extends the research timelines.

Another pivotal aspect of college-based research is the adherence to ethical standards, particularly when students are involved. Obtaining approval from the Research Ethics Board (REB) is essential, yet this can be a time-consuming process. The REB, being a volunteer committee that meets monthly, requires researchers to factor in additional time for obtaining necessary clearances, thus impacting the overall research schedule.



Furthermore, the creation of control groups in a college context is fraught with challenges. Due to the requirement of equal treatment and resource allocation among students in the same program, forming true control groups becomes nearly impractical. In experiments involving Extended Reality (XR), for example, student participation must be voluntary, without any obligation to partake in activities. This necessitates a balance, as students not involved in the experiment may also seek access to the XR technology, either during or post-study, which needs to be managed to maintain fairness and equity in resource distribution.

Evaluating XR Experiences for Research Purposes

In evaluating Extended Reality (XR) experiences for research purposes, a variety of unique factors must be considered. These range from assessing user enjoyment and technical performance to examining educational outcomes and user engagement. Each of these aspects plays a crucial role in understanding the effectiveness and impact of XR technology in educational and research settings. This section outlines the key elements to consider in XR experience evaluation, providing a clear framework for comprehensive analysis.

Standardized Surveys: Utilizes established survey formats to consistently evaluate user experiences and reactions, ensuring comparability and reliability in data collection.

- ✔ **Enjoyment Assessment:** Gauges participant satisfaction and engagement through post-experience surveys, a method distinct from traditional research where enjoyment may not be a focal point.
- ✔ **Motivation Evaluation:** Assesses how effectively the XR experience stimulates and maintains user motivation, a key factor in educational and training contexts.

- ✔ **Engagement Assessment:** Measures the level of user immersion and active participation in the XR experience, crucial for gauging the effectiveness of interactive elements.

Learning Outcomes: Measures the educational effectiveness of XR applications, emphasizing the alignment of VR content with specific, often challenging, learning objectives. It may be impossible, due to privacy issues, to directly measure the long-term benefits of using XR on final grades in a program. Instead, short-term assessment of retained knowledge might be possible. In this study we attempted to look at student grades over a whole semester but were unable to obtain pre-test data from our volunteers (very low participation in pre-tests).

Technical Evaluation: Focuses on the technical robustness and performance of the XR experience, including software stability, hardware compatibility, and user interface efficiency. This study had ongoing technical assessment of new devices and software. The findings are captured in this Best Practices Report. The XR Manager and XR Technician led this aspect of the project.

Comfort and Accessibility: Examines ergonomic aspects of VR equipment and the inclusivity of the experience, ensuring it is accessible and comfortable for a diverse user base. Post-experience surveys as well as anecdotal feedback from participants provided information about device and experience comfort.

Built-in Assessment Tools: Investigates the presence of integrated tools or analytics in the VR application for tracking user performance and learning progress. This data may be obtained from the software company or through an in-app utility tool.

Teacher-Student Interaction: Evaluates the capability of teachers to be present in the virtual environment alongside students, fostering interactive and guided learning experiences.

Recording for Evaluation: Involves capturing audio and video within the XR experience for thorough analysis and debriefing, aiding in a comprehensive review of user interactions.

Recruitment and Participation Factors

This section delves into the multifaceted challenges and strategies associated with recruiting participants for Extended Reality (XR) research studies. It addresses the complexities arising from students' academic loads, external disruptions, and the evolving post-COVID landscape. Additionally, it explores the effective roles of faculty engagement, incentivization techniques, and the importance of maintaining consistency in research experiences. Finally, it touches on the inherent limitations faced in conducting long-term studies in academic settings, offering insights from specific case studies.

Recruitment Challenges: Recognizes the struggle to recruit participants for XR studies, often due to the students' workload from their courses. This challenge suggests a need for a careful balance between students' academic responsibilities and their participation in research. The reluctance to commit to full studies might stem from perceived or actual additional workload, representing a significant barrier to enrolling students in XR research.

Impact of External Factors on Enrollment: Highlights how unforeseen external factors, like faculty labor disruptions and the COVID-19 pandemic, have adversely affected student enrollment in VR workshops. These circumstances necessitated more direct and intensive recruitment strategies, including reaching out directly to faculty and students, to mitigate the impact of these disruptions.

Faculty Engagement: Stresses the importance of involving faculty members as advocates for the research. When faculty understand the research objectives and see the potential benefits for their teaching and students' learning, they can effectively encourage student participation, significantly boosting research participation rates.

Adapting to Post-COVID Conditions: With the easing of COVID-19 restrictions and the return to in-person studies, there was a notable increase in participant recruitment. However, challenges persist in ensuring participants complete the necessary surveys, an essential component of data collection in research studies.

Incentivization Strategies: Addresses the use of incentives like VR headsets or gift cards to motivate participants to complete surveys. Despite these efforts, such incentives were not as effective as anticipated. This led to the conclusion that incorporating VR experiences and surveys into the curriculum, where students receive credit or marks, may be a more effective strategy to ensure maximal participation.

Consistency in Experiences: Advises maintaining a uniform approach across various programs and courses to simplify the learning process for students. By reducing the need for students to adapt to different methods each time, this consistency can enhance their overall experience and willingness to complete required tasks.

Limitations in Long-Term Studies: Discusses the challenges inherent in conducting long-term controlled studies in an academic setting, particularly when students must volunteer and have the option to opt out of assessment tools. Despite these challenges, the Pilot 2 study in nursing courses yielded promising results, highlighting the potential of long-term XR studies in academic research.

Data Analysis

For researchers embarking on Extended Reality (XR) studies, this section offers a series of recommendations on data analysis approaches. It emphasizes the importance of customizing methods to suit specific research designs, choosing appropriate evaluation metrics, and utilizing advanced tools for insightful analysis. Additionally, it provides guidance on the strategic dissemination of research findings, drawing on insights from pilot studies in the XR field.

Customized Analysis Techniques: Emphasizes the need for tailored analysis methods based on the unique data and research questions of each study. Considers multivariate regression analysis, structural equation modeling, and content analysis as potential approaches for analyzing complex XR data sets.

Evaluation Metrics Selection: Highlights the importance of using diverse evaluation metrics. Where randomized controlled studies are not feasible, direct group comparisons, as used in Pilot 2, are recommended. The combination of Likert scales, multiple-choice surveys, and open-ended questions provides a comprehensive suite of metrics for analysis.

Utilization of Advanced Tools: Advises leveraging AI and statistical tools for data organization, validation, and analysis. AI tools are particularly effective in analyzing qualitative responses, enabling the identification of patterns and trends.

Insights from Pilot Studies:

- **Pilot 1:** Utilized surveys to gauge XR attitudes, empathy towards avatars, technical aspects, comfort, and enjoyment.
- **Pilot 2:** Conducted a comparative study between immersive VR and 2D PC versions for anatomy learning, focusing on engagement and motivation rather than learning outcomes due to pre-test completion issues.
- **Pilot 3:** Employed adaptive learning software to analyze student engagement with an online grammar curriculum, using built-in analytics to track progress and lesson access.

Regression Analysis Application: Recommends application of regression analysis where possible, such as in Pilots 2 and 3, providing a statistical approach to understand the relationships between variables in the studies.

Anecdotal Data Collection: Utilizes the collection of anecdotal feedback from students and faculty, analyzed using AI tools for pattern recognition in text responses.

Publication Strategy: Suggests a strategic approach to publishing results, recommending social channels or professional networks for public sharing and peer-reviewed journals for scientific or academic findings.

12. Technical Challenges, Solutions, and Recommendations

Onboarding for XR

This section provides comprehensive recommendations for effectively onboarding participants in the use of virtual reality (VR) headsets, covering aspects of hardware orientation, software usage, and practical demonstrations.

Hardware Orientation

XR Headset

- **Powering Up/Down**: Teach participants how to switch the headset on and off.
- **Detailed Orientation for Loans**: If the headset is being loaned out:
    - **Cleaning Instructions**: Explain how to properly clean the headset.
    - **Charging Guide**: Provide information on how to charge the headset.
    - **Lens and Headset Protection**: Advise on how to protect the lenses and general care for the headset.
    - **Storage Instructions**: Explain how to store the headset and controllers in the case.

Controllers

- **Straps Usage**: Instruct participants on putting their hands through the straps to prevent accidental dropping.
- **Controller Functions**: Guide them on which parts of the controllers are used for specific software functions.
- **Detailed Orientation for Loans**: Provide comprehensive instructions if the headset and controllers are being loaned.

Software Orientation

- **Digital Guardian Creation**: Teach participants how to create a digital guardian and explain its role in ensuring safety.
- **Software Experiences**: Brief them on what experiences they should expect within the software application.
- **Movement Navigation**: Explain different movement options within the application, such as walking, teleportation, and smooth motion.

Demonstration

- **Participant Trial with Casting**: Allow participants to try VR while casting their experience to a monitor. This enables you to provide real-time instructions and observe their interactions.

Additional Tips

- ⓘ **Feedback Mechanism**: Establish a system for participants to provide feedback or ask questions, either during or after their VR experience.
- ⓘ Safety Precautions: Emphasize the importance of physical space and safety while using VR to prevent accidents.
- ⓘ **Technical Support**: Ensure there's a system for technical support in case participants encounter issues with either the hardware or software.

Building an XR Lab

Setting Up a VR Lab: Dedicated vs. Non-dedicated Space

In many colleges and universities, finding a room for a VR lab is a challenging task. Ideally, a dedicated VR lab would be the best solution. This setup would facilitate the scheduling of student groups from various programs in a manner that avoids conflicts with class schedules. In such a lab, having tech support is crucial to assist both teachers and students with the VR experience. However, for institutions with limited space, a multipurpose room is a practical alternative if a central space, like the College Library, is not available. Multipurpose rooms and classrooms can function as a VR lab, with movable desks and chairs. Georgian College, for instance, utilizes a low-profile, wall-mounted computer cabinet in their labs, which only protrudes 6 inches from the wall. This flexible arrangement allows for secure storage of computer and VR equipment when not in use and provides space for VR activities when scheduled. However, this setup implies that scheduling might be unpredictable and thus requires teachers and possibly students to be trained to handle technical VR issues.

Operational and Resource Management in VR Labs

Effective management of a VR lab requires careful consideration of several operational factors. Staffing, crucial for monitoring and assisting users, may involve student volunteers for efficiency. Tracking the usage patterns of different programs and apps by students will be important for resource allocation. Additionally, orientation for VR lab staff (which may be library staff if the VR lab is in the library) in VR technology is essential.

Financial aspects, such as the funding of application costs and handling subscription fees, need clear policies, particularly regarding access across various student groups and departments. Faculty resources should focus on providing specialized XR training for teachers, aiding in XR app selection, and integrating XR into instructional design.

Research involvement is also key, not only for exploring new opportunities but also for deciding the necessity and responsibility for regular student surveys in XR usage.

Lastly, exploring income generation through external bookings can provide financial support for ongoing costs and equipment updates. This holistic approach ensures the VR lab functions optimally as a dynamic educational tool.

Naming and Defining the Space

Finally, deciding on a name for this space is also important for attracting attention and student participation. Options like "Extended Reality Hub," "Alternative Reality Hub," or "Metaverse" reflect the innovative nature of the facility. The chosen name should encapsulate the essence and purpose of the space, aligning with its role as a cutting-edge educational and research resource.

Securing Sponsorship for the VR Lab

To address the financial aspects of establishing and maintaining the VR Lab, seeking a sponsorship is a strategic move. A sponsor would not only provide essential financial support but also gain the opportunity for naming rights to the space. This arrangement offers a mutually beneficial partnership: the sponsor gains visibility and association with innovative educational technology, while the lab benefits from the necessary funding to enhance its offerings and sustain its operations. Such a collaboration underscores the importance of community and industry partnerships in advancing educational resources and technology.

XR Device Deployment in Educational Settings

Preparation and Expertise in XR Technology Deployment

Deploying XR technology in educational environments requires preparation and specialized expertise, particularly for immersive VR systems. The complexity and technical demands of these systems necessitate a team with specialized knowledge to ensure the technology is correctly configured, optimized, and maintained for educational purposes. This approach underscores the importance of having dedicated personnel to manage and troubleshoot XR devices and accessories.

Management and Accountability for XR Equipment

An efficient digital sign-out system is crucial for managing XR equipment. It enhances accountability among students, linking the return of equipment to academic processes like grade release. Implementing such a system, however, requires consultation with the school's legal department to align with institutional policies and legal considerations. This step is vital in establishing a responsible and trackable process for XR equipment distribution.

Transitioning to User-Friendly VR Solutions

The shift from PC-based to standalone VR systems marks a significant evolution in XR technology deployment. These standalone systems offer enhanced accessibility and ease of use, allowing headsets to be shipped directly to students or made available for sign-out at a centralized campus location. This transition addresses the need for more accessible and adaptable XR solutions in the educational context.

Accessibility and Utilization of VR Labs Campus

VR Labs serve as vital resources for students, offering opportunities to explore applications and practice curriculum-related activities in a virtual setting. These labs, accessible at numerous campuses, function as both technological resource centers and hubs for innovation, enabling students to engage with XR technology in a supportive educational and experimental environment.

Training and Support for XR Technology

Usage Training sessions for students and faculty are integral to the effective use of XR technology. These sessions, ranging from one-on-one to group formats, cover not only the physical handling of the equipment but also the operation of the software. They address issues like disorientation or physical discomfort, advising users to stop using the headset if they experience such symptoms and only resume once they feel better. Some users will not be able to avoid motion sickness when using immersive VR and will need non-immersive options where possible.

Safety Protocols and Usage Guidelines

Safety protocols and usage guidelines are a key part of the training for XR device usage. This includes having 'spotters' to supervise students in VR environments and educating users on the proper use of VR Boundaries to prevent accidents. The use of a room scale VR Boundary, or a stationary boundary combined with a chair, is recommended for many applications as it not only ensures safety but also helps reduce motion sickness in users.

Equipment Maintenance, Upgrades, and Replacement

The XR Team's technical support is responsible for the maintenance and upgrading of XR devices. These devices are configured using multi-device configuration systems, and software updates or upgrades are often conducted remotely. Device replacement is also a critical aspect, with most devices having a usable lifespan of 3 to 4 years before becoming obsolete.

13. Infection Control for Virtual Reality (VR) Devices

Guidelines on When to Avoid Using VR Devices

Illness or Symptoms: VR devices should not be used by individuals showing any symptoms of illness or with conditions that could be transmissible.

Open Cuts or Sores: Avoid VR device usage if there are open cuts or sores on the face or hands, as these are potential points for pathogen transmission.

Precautions Before Using a VR Headset

Hand Hygiene: Users should perform hand hygiene for 20 seconds using an alcohol-based hand sanitizer (60% or higher).

Headset Protection: Optionally, users can wear an OR cap to protect the headset straps and a VR face cover for added hygiene.

Retrieving and Preparing the VR Headset and Controllers:

- If a UV-C disinfecting device is available, retrieve the headset and controllers from it.
- Without a UV-C device, all surfaces of the VR headset and controllers should be wiped down and allowed to air dry.
- Use VR lens-specific disinfectant wipes for the lenses.
- Wipe down any associated computer, keyboard, mouse, and cables with non-alcohol-based wipes.

Post-Use Cleaning and Sterilization

UV-C Sterilization: After use, place the headset and controllers in a UV-C device for the manufacturer-recommended duration (typically 1-5 minutes).

Disposal and Cleaning:

- Dispose of the head cap / OR Cap appropriately (if applicable).
- Clean hands again with alcohol-based hand sanitizer for 20 seconds.
- Use approved non-alcohol wipes to clean the VR cable, keyboard, mouse, and any other accessories.
- Clean VR lenses only with approved lens cleaners.

Final Hand Hygiene: Perform hand hygiene again after all cleaning activities.

Sterilization Devices and Recommendations

Device Options: Various providers offer sterilization equipment, ranging from single headset units to multi-unit sterilizers. Notable providers include Cleanbox, CoralUV, GlobalVision, and UVISAN.

Educational Setting Considerations: For educational environments, multi-unit sterilization devices are recommended. This allows for a continuous rotation of sterilization, enabling some devices to be cleaned while others are in use.

Automated Sterilization Process: Sterilization is typically a rapid and automated process, which facilitates efficient handling of multiple units for successive student use.

Accessory Sterilization: Along with headsets, cases and VR accessories should also undergo sterilization to ensure comprehensive infection control.

14. Software Selection

Software Considerations

Collaborative Selection Process

Involvement of Stakeholders: The selection process for XR software should be a collaborative effort involving teachers, library staff, and the individual responsible for deploying VR/XR technology. This collaboration ensures that the chosen software aligns with educational goals and technical capabilities.

Duration and Acclimatization to VR Experiences

Optimal Duration: VR experiences should generally not exceed 20 minutes to accommodate initial user comfort levels.

Extended Use with Acclimatization: Over time, as students become more accustomed to the VR headset, they may express a desire to engage in longer sessions of immersive learning. This should be considered when planning the curriculum and scheduling VR lab time. Students who are shipped VR headsets may grow accustomed to the digital environment, spending greater lengths of time in immersive teaching software or other VR activities.

Alignment with Learning Outcomes

Course-Specific Objectives: The software selected should directly address specific learning outcomes for courses. This alignment ensures that the VR experience is not only engaging but also academically relevant.

Clear Objectives for Students: Teachers planning to use VR applications in their courses should provide clear learning outcomes or objectives for each software application. These objectives should be made available to students to guide their learning process.

Integration into Course Assignments

Customized Assignments: Teachers are encouraged to develop assignments tailored to the VR experiences. These could include reflective writing, quizzes, or other activities that reinforce the learning objectives achieved through the VR experience.

Types of VR Software

Finding specific VR applications suitable for various subject areas in post-secondary education can be challenging due to the breadth and diversity of available software. However, based on the general trends and examples in the field, VR applications are prominently used in science and technology, health sciences, arts and humanities, military, and aerospace, among others. For more targeted VR applications in subjects like architecture, engineering, art, history, indigenous studies, etc., more specialized research or consultations with educational technology providers may be necessary, as the applications can vary widely within each field.

Considering Custom VR Applications in Education

Creating custom VR applications for education allows for precise alignment with curriculum requirements and the integration of assessment tools, enhancing the learning experience. However, this customization comes with significant costs and maintenance demands. These applications often require regular updates to stay relevant with evolving curricula and user needs, adding to the long-term financial and resource commitments. Therefore, while custom VR apps offer tailored educational experiences, they also necessitate ongoing investment and development.

Custom Mixed Reality for Practical Skills Training

Custom-designed mixed reality applications effectively combine digital and physical environments, offering substantial benefits for hands-on training. These applications are particularly suited to scenarios requiring manipulation of tools, controls, or objects. In trade sectors like construction, electrical work, plumbing, and welding, where accurate skill execution is critical, mixed reality offers a valuable tool for skill development and practice. It's also highly beneficial in health and wellness education for training with medical devices and equipment.

In fields that use very large machines not available at the College or impractical to use in training exercises, such as manufacturing equipment, boilers or HVAC systems, renewable energy systems, wastewater equipment, large machinery like backhoes, loaders, and forklifts, mixed reality applications provide a safe and interactive platform for learning. This technology helps bridge the theoretical and practical aspects of learning, allowing students to practice and refine their skills with tools and equipment in a controlled, immersive environment. This approach provides an opportunity to gain 'hand-feel' in situations that would traditionally be impractical or impossible.

Library of VR Software

The following shared document list several types of VR software that could be used for post-secondary courses or as extra-curricular applications available in VR Labs. Link to software for various subject areas suitable for higher ed.

15. Hardware Selection

Standalone vs. Tethered VR Headsets

For general classroom use and student experiences, standalone VR headsets are recommended. These headsets operate independently of a PC, eliminating the need for a high-powered gaming computer. This makes them more feasible logistically and financially in a post-secondary environment. In contrast, tethered VR headsets, which require connection to a gaming computer, offer higher quality and performance. These are more suitable for specialized VR labs, where the need for higher performance for certain applications justifies the additional setup and cost. Some VR devices can function both as standalone and tethered units, providing a versatile solution that caters to different performance needs.

Supply Chain Considerations

Supply chain challenges have led to delays in acquiring even small quantities of these devices. It's advisable to place orders well in advance, especially for larger numbers (20+ units), to ensure timely availability. Note that supply delays can be in the order of months for large numbers of devices. If smaller numbers are needed, we recommend purchasing them directly from retail outlets like Best Buy, Amazon or Walmart.

Setup and Maintenance of VR Headsets

Upon arrival, VR headsets require updating to the latest operating software and configuration with the desired applications. Utilizing a multi-device management system can streamline the process of updating and configuring multiple units simultaneously. Additionally, investing in semi-hard or hard-shell cases for each unit is recommended for safe storage and transportation. These cases, costing between $30 and $50, can accommodate the headset, controllers, accessories, and instructional materials.

The Emergence of Augmented Reality in Education

Emergence of Augmented Reality in Education: Augmented Reality (AR) is rapidly emerging as a potentially disruptive technology in education. Offering Mixed Reality (MR) experiences, AR devices are not only expected to complement but potentially replace some existing Virtual Reality (VR) applications. In the next 2-3 years, AR glasses are projected to become a staple in educational settings, serving both as personal devices for students and instructional tools for educators.

Exploration and Adoption of AR Technologies: As this shift towards AR technology gains momentum, it becomes increasingly important for educational institutions to actively engage with these developments. Exploring and testing various AR glasses will be crucial in understanding their potential and applicability in educational contexts. This exploration phase might also involve seeking external funding to support the acquisition and integration of AR technologies as both teaching aids and resources for applied research.

Affordability and Availability of AR Glasses: AR glasses, also referred to as smart glasses, are currently available and vary widely in price points, from $400 to $8,000. The market offers a variety of smart glasses, with the Ray-Ban Meta glasses ($400) being among the most recent and popular. Other notable options include the Razor Anzu (<$100), Rokid Max ($200-$500), Nubia Neovision ($500 to $1000+), and several new models anticipated to be released in 2024. This diversity in products and price ranges makes AR technology accessible and adaptable to different educational budgets and needs.

Current Devices

The following list of devices is not a complete list. The devices below are listed roughly in order of current popularity and usage. Standalone refers to a VR headset that does not need to be connected via a cable (tether) to a computer. For a fulsome comparison of the latest VR, AR, and MR devices, visit **vr-compare.com** which provides comparisons by functionality, price, quality, and performance specifications.

Please visit this shared file for a Link to recommended VR headsets

VR Headset	Price Range	Format	Notes
Oculus Quest 2	Medium	Standalone	Affordable with high-quality VR, most popular VR device.
Meta Quest Pro	Medium	Standalone	Affordable with high-quality pass-through MR capabilities.
Meta Quest 3	High	Standalone	High-performance, high-quality with MR functionalities.
Valve Index (2)	High	PC-Tethered	Superior comfort, high fidelity visuals, precise tracking.
PlayStation VR	Medium	Standalone	Popular among PlayStation console gamers.
HTC Vive Pro 2 & Cosmos Elite	High	PC-Tethered	Sharp display, wide range of motion, external tracking.
HTC Vive XR Elite	High	Standalone	A high-performance, all-in-one XR headset that transforms into a pair of portable immersive glasses.
HP Reverb G2	Medium to High	Standalone	High-resolution display, improved audio quality.
Pico Neo 3	Medium	Standalone	On par with Quest 2
Pico 4	Medium	Standalone	High-quality MR capabilities.
Shiftall: Meganex	High	PC-Tethered	Ultra-lightweight and compact VR headset compatible with SteamVR, with OLED display.
Lynx R1	High	Standalone	Compact headset easily handles AR and VR.

VR Headset	Price Range	Format	Notes
Pimax Crystal	High	PC-Tethered	Ultra-high-quality MR.
Shiftall: Meganex	High	PC-Tethered	Ultra-lightweight and compact VR headset compatible with SteamVR, with OLED display.
Devices Anticipated in 2024			
Pico 5	High	Standalone	High-performance, high-quality with MR functionalities.
Somnium VR1	High	PC-Tethered	HD MR, eye- and hand-tracking with wide field of view.
Apple Vision Pro	High	Standalone	HD quality MR, anticipated release is early 2024

16. VR Events and Experience Spaces

Space Planning

Room Scale VR: Allocate a 10x10 foot space for each VR station, with a 2-foot buffer zone for safety. The number of stations depends on expected attendance. For large groups like a whole class, consider the feasibility and adjust accordingly.

Flexible Accommodation: Offer options for those unable to participate in VR due to various reasons, ensuring inclusivity. This could be a 2D PC-based version of the experience, or a viewing monitor to allow people to watch someone else inside the VR experience.

Sound Management

Silent Experiences: Most educational XR applications are silent, allowing multiple users to engage simultaneously without disturbance.

Multiplayer Simulations: For experiences requiring communication, like nursing or public speaking simulations, consider separate scheduling, soundproofing, or loaning headsets for off-site use.

Hardware Considerations

PCVR Stations: Equip VR labs with gaming computers for high-end graphics experiences.

Standalone VR: Offer standalone VR headsets for broader application compatibility and off-site use.

Maintenance: Ensure regular charging of headsets and replacement of controller batteries. Consider having back-up devices and accessories on hand.

Staffing Requirements

Greeters and XR Guides: Consider having staff available to explain what participants can expect from the experience and what to do if they experience motion sickness or discomfort. Guides can also help users understand learning expectations and direct people to pre- or post-experience surveys for data collection purposes.

XR Support: Staff the lab with personnel having basic technical skills to assist students and faculty when device troubleshooting is required.

Spotters: Have one or more spotters on site to watch participants and ensure people are using the devices safely and remaining inside the VR boundary.

Effective Scheduling and Engagement

Promotion: Actively promote the XR Lab or event to faculty and students. Engage an educator familiar with experiential learning to highlight the lab's potential. Consider sharing the event details through social media, especially those used by the target audience, e.g. Instagram, Facebook, Snapchat, WhatsApp, Linked In, etc.

Feedback and Expansion: Survey users for feedback on the quality and effectiveness of the experience. Consider asking participants about equity, diversity, and inclusion factors, seeking to better understand where barriers may be removed for participants. This kind of data can be used to plan future lab and event expansion.

VR Experience Selection

Software Licensing: Preferably use free or perpetual license VR experiences. Consider the cost of annual licenses at the program level.

Staff Orientation: Ensure staff are oriented with VR logistics, device handling and cleaning, and nuances of the VR experiences on offer.

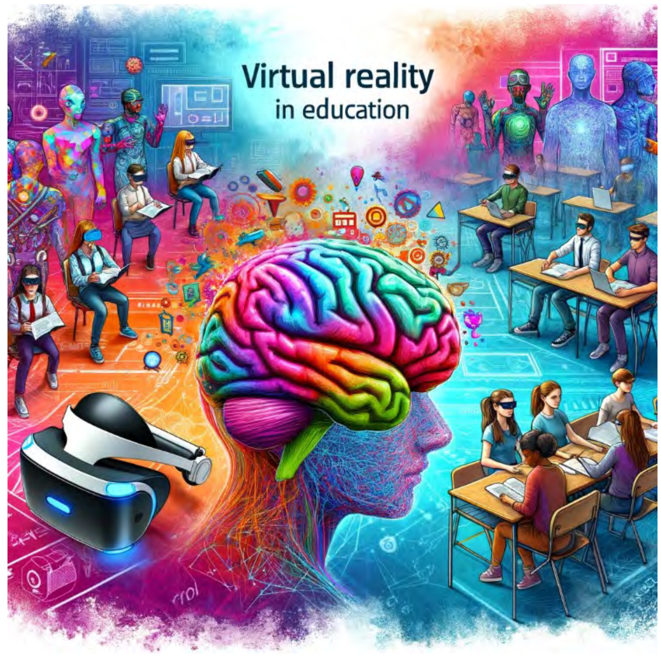
Maintaining Hygiene

Disposable Masks: Provide disposable masks for participants.

Cleaning Equipment: Utilize disinfectant wipes and/or UV-C cleaning devices for headset sanitation.

Refer to Section: 13. Infection Control for Virtual Reality (VR) Devices

17. Ethics



Research Ethics Board (REB) Requirements

The REB played a crucial role in studies that collected and analyzed student-generated data. This involved a detailed focus on data management and privacy, requiring comprehensive scrutiny and transparent disclosure of processes to participants through consent forms.

Addressing Technological Challenges

We recognized the need to find solutions for the lack of affordable VR technology suitable for educational purposes. For instance, the Oculus Quest 2's initial requirement for a Facebook login posed privacy concerns, necessitating alternative approaches to safeguard student privacy and usability.

Guidance for REB Approval

We recommended that other FSC funded projects requiring REB approval should consult researchers experienced with REB processes. The approval could be time-consuming, taking up to three months if study modifications were needed. Dr. Isabelle Deschamps, a member of the Goegrian REB committee, played a key role in guiding these processes, ensuring ethical compliance, especially in the experimental design of our three pilots.

18. Equity, Diversity, and Inclusion

GBA+ Implementation: Our EDI Director identified the Gender-Based Analysis Plus (GBA+) tool as an effective method to assess new XR technologies, offering an alternative to a standard EDI Tech Policy. The GBA+ tool, which has evolved over 20 years to encompass broader equity considerations, assists in identifying and addressing barriers posed by new technology or its usage. Implementing this tool involved conducting EDI training inclusive of the GBA+ microcredential.

Aligning with the College's EDIB Initiative: Our FSC project aimed to align with the College's EDIB initiative, gaining new tools to assess or evaluate XR software, hardware, or experiences through an EDIB lens. The development of these tools, based on the GBA+ framework, was undertaken in partnership with our EDIB Centre.

Accessibility Considerations: We acknowledged the importance of accessibility for those unable to tolerate VR headsets or experiences. Providing PC access as an alternative and addressing the need for closed captioning in Social VR platforms for the hearing impaired were key considerations. While discussions on this feature were ongoing, there was no implementation as of June 2022.

Avatar Creation and Selection: When selecting off-the-shelf XR applications, we strongly recommend investigating the range of avatar customization options they offer. It's essential to ensure that these applications provide a diverse array of choices in terms of skin color, clothing, and gender representations. While the industry has historically offered limited options, often restricted to binary genders and a narrow spectrum of appearances, there is a noticeable trend towards more inclusive and varied selections. By prioritizing applications that support a wider representation of identities, we can better align our choices with our commitment to equity, diversity, and inclusion, enhancing the user experience for all participants.

19. Knowledge Mobilization

In the world of Extended Reality (XR), knowledge mobilization extends beyond mere skill enhancement; it's fundamentally about forging connections within the relatively small, yet burgeoning XR community to share ideas, successes, and failures. Our XR journey at Georgian comprised diverse initiatives that not only facilitated skill development but also emphasized the importance of networking with other leaders in XR education. This section details our multifaceted approach to disseminating knowledge and engaging with various stakeholders, offering insights and strategies for those seeking to navigate and contribute to the evolving landscape of XR.

Knowledge Mobilization Activities

- **Training Sessions**: Conducted over 75 training sessions for students, faculty, and staff, both in-person and online.
- **Speaking Engagements**: Delivered over 60 speaking engagements, including several keynote addresses.
- **Conferences and Events**: Attended more than 10 significant events such as eCampus, CiCan, AWE, and IRLN 2023.
- **YouTube Presence**: Created 13 YouTube videos, accumulating over 1600 views.
- **VR Educator Course**: Engaged over 100 participants in the Virtual Reality Educator Course.

Publications and Presentations:

- **Journal Article**: Preparing an article entitled "Using Virtual Reality to teach Anatomy in a Post-Secondary Education Setting" for The Canadian Journal of Learning and Technology, focusing on VR's impact on college students' motivation.
- **Best Practices Report**: Compiled a report on best practices in the field.
- **Staff News Articles**: Featured in multiple staff news articles.
- **Conference Presentations**: Delivered presentations at several conferences.
- **Data Visualizations and Studies**:
  - Pilot 1: Included visualizations from the BodySwaps Study and an XR Survey.
  - Pilot 2: Featured 3D Organon and BodyMaps visualizations.
  - Pilot 3: Showcased data on Cerego Adaptive Learning Outcomes.

Recommendations for Knowledge Mobilization in XR:

Our XR Team recommends the following activities to effectively mobilize knowledge in XR, fostering a community of learning and innovation in this rapidly evolving field.

1. **Diverse Training Programs**: Offer a mix of in-person and online training sessions to cater to different learning preferences and to reach a broader audience.
2. **Engaging Speaking Engagements**: Actively seek opportunities for speaking engagements, including keynotes at conferences, to share insights and raise awareness about XR technologies.
3. **Conference Participation**: Attend and participate in relevant conferences and events to stay updated with the latest trends and network with industry professionals.
4. **Utilize Online Platforms**: Create and share content on platforms like YouTube to reach a global audience. Videos can be a powerful tool for demonstrating the impact and potential of XR.
5. **Specialized Courses**: Develop and offer specialized courses, such as a VR Educator Course, to provide in-depth training and practical experience in XR.
6. **Publish Research and Reports**: Document and share your findings through journal articles, best practices reports, and staff news articles to contribute to the academic and professional discourse in XR.
7. **Data Visualization**: Use data visualizations to effectively communicate the outcomes of various projects and pilots, making the information accessible and engaging.
8. **Regular Updates and Sharing**: Regularly share updates, learnings, and case studies from your projects to build a body of knowledge that others can refer to and learn from.

20. Awards and Recognition: A Catalyst for XR Momentum

At Georgian, our XR initiatives have not only achieved significant milestones but also garnered notable awards and recognition. These accolades have played a vital role in building momentum around XR for education within our institution and beyond.

Highlighted Awards

1. **Gold Indigenous Education Award 2023**: Awarded by the World Federation of Colleges and Polytechnic, this accolade recognized the innovative use of virtual reality for language learning in Indigenous Studies at Georgian College. Recipients included Michele O'Brien, Angeline King, Rob Theriault, and Greg McGregor.

2. **Virtual World Society, Nextant Educator Prize 2022**: This prestigious award, given for outstanding contributions to the global immersive landscape, was awarded to Rob Theriault for his work in immersive technologies.

3. **Ontario Colleges and Universities, Award of Excellence 2021**: Recognizing efforts in 'Future Proofing Students', this award was received by Michele O'Brien, Rob Theriault, and Angeline King.

4. **Colleges and Institutes Canada (CiCAN), Indigenous Education Excellence Award**: Awarded to Ernestine Balwin and Greg McGregor, this award highlights Georgian College's commitment to Indigenous education through innovative approaches, dedicated curriculum, holistic support services, and community partnerships.

Impact of Recognition

- **Stimulating Interest and Adoption**: These awards have sparked interest among Deans and faculty, leading to the integration of VR into at least 20 programs, with more in development.
- **Facilitating Grants and Partnerships**: The recognition has been instrumental in pursuing grants, recruiting new team members, and forging educational partnerships.
- **Indigenous Peoples in XR Alliance**: A significant outcome has been the formation of the Indigenous Peoples in XR Alliance, an initiative aimed at preserving indigenous languages and cultures, extending the project's impact.
- **Media Attention**: Coverage by outlets like CBC News [link] has further amplified our project's visibility and influence.

Overall, these awards have been pivotal in catalyzing a broad-based interest in VR at Georgian, showcasing the transformative potential of XR technologies in education.

Leveraging LinkedIn for XR Education Community Engagement

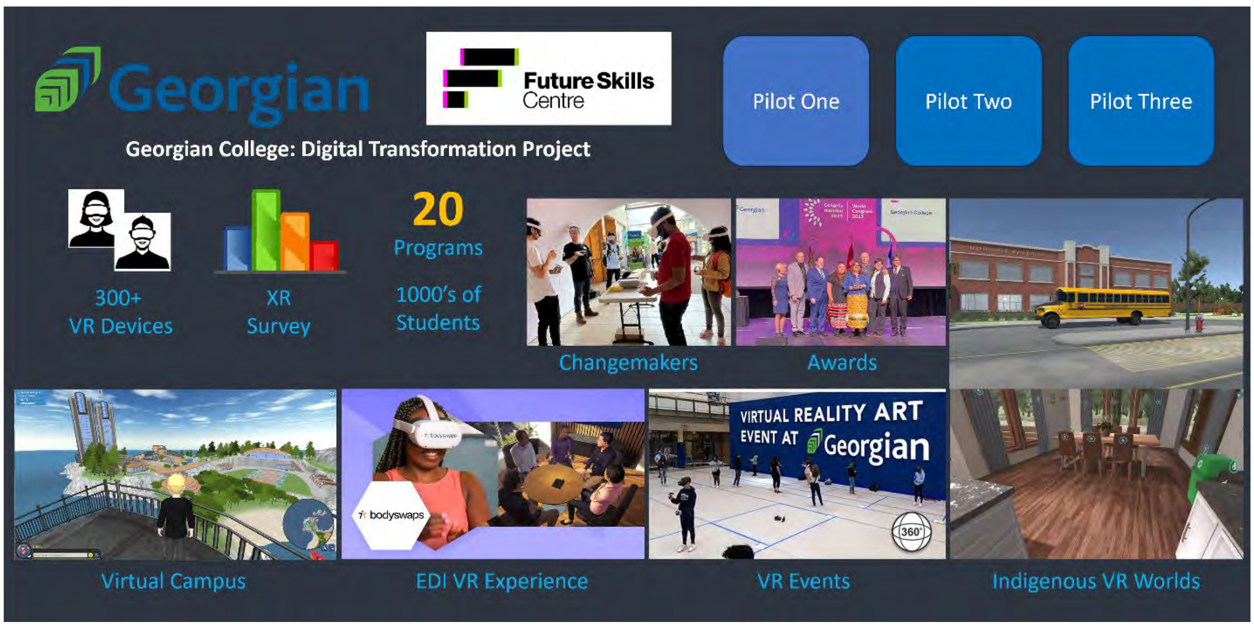
The output from our XR initiatives at Georgian have also had a profound impact in terms of enhancing our presence and influence within the XR education community. LinkedIn has been a strategic platform for maintaining our place as leaders in XR education, allowing us to expand our network, share expertise and challenges, and continue to drive experimentation and innovation in this developing field.

Leveraging LinkedIn for Community Engagement and Expertise:

- **Building a Professional Network**: LinkedIn has been an invaluable tool for staying connected with the XR education community. It enables us to engage with other professionals, educators, and industry leaders, fostering a network of like-minded individuals passionate about XR technology.
- **Showcasing Achievements and Expertise**: Our large and small achievements as well as our challenges, regularly displayed on LinkedIn, support our reputation as subject matter experts in XR. This visibility helps in attracting attention event organizers, XR community leaders and potential collaborators, students, and other institutions interested in exploring XR technologies.
- **Sharing Knowledge and Insights**: Regular updates, articles, and posts about our projects and experiences on LinkedIn keep the community informed and engaged. This continuous sharing of knowledge contributes to the collective learning and advancement of XR in education.
- **Facilitating Collaborations and Opportunities**: The recognition has opened doors for new partnerships and collaborations. Through LinkedIn, we can easily connect with potential partners, share ideas, and explore new opportunities for implementing XR in educational settings.
- **Staying Updated with Industry Trends**: LinkedIn also serves as a platform for us to stay abreast of the latest developments and trends in XR. By following key influencers, companies, and groups in the XR field, we ensure that we are constantly learning and evolving in our approach.

21. Conclusion

Sharing Georgian's journey in exploring and researching XR technologies in this Best Practices Report has been a learning experience of its own. We welcome you to use the information herein to inform or guide your XR journey. As we reflect on our path, filled with both advancements and challenges, it's evident that the exploration of XR in education is an evolving landscape, rich with potential yet complex in its implementation. We humbly recognize that our journey is far from complete and there is much more to discover and understand. In this spirit, we encourage you, our colleagues, and peers in the educational sector, to join us in this ongoing exploration. Let us collaboratively navigate this dynamic field, sharing our experiences and learning from each other, as we all strive to enhance the educational experience through innovative technology. The door is always open for new insights and shared progress in this exciting venture.



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Preparation of this Best Practices Document was completed by Doran Strategic Consulting. www.jamiedoran.com

23. Contributors

Several members of the XR Team contributed to the information collected in this Best Practices report. Much of the detailed information compiled in this report was collected and organized Dr. Jamie Doran and Rob Theriault. Rob and Victor Skierski developed the event logistics, technical procedures, and device-handling protocols used by this project. Research insights and findings were contributed by Dr. Isabelle Deschamps, our faculty members: Sean Madorin, Avinash Thadani, John Pearce, and Rob Harrison, and our data team members: Cassandra Forlani, Jasmeen Kaur JasmeenKaur. Insights gleaned from the Virtual Campus were compiled by Jessica Thomas. Our finance team, Fran Lahartinger and Carol Thibeault contributed to the financial processes of this project and insights gained around purchasing and supply chain. Many support staff and student employees worked on this project and contributed ideas and insights from their connections to the project. Finally, we would like to acknowledge the ideas and feedback we received from the over 2000 students, 400 staff, and more than 5000 members of the public that participated in Pilot 1, 2, or 3 XR experiences. Thank you everyone for helping to make this project a success.

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