

From Real to Virtual Reality–Using the Geographic Advantage with Emerging Technology to Pivot an International Interdisciplinary Experience

Lynn Moorman, Dawna Cerney, Dianna Gielstra, Ellen Foster & Niccole Villa Cerveny

To cite this article: Lynn Moorman, Dawna Cerney, Dianna Gielstra, Ellen Foster & Niccole Villa Cerveny (2021) From Real to Virtual Reality–Using the Geographic Advantage with Emerging Technology to Pivot an International Interdisciplinary Experience, *The Geography Teacher*, 18:3-4, 107-116, DOI: [10.1080/19338341.2021.1939095](https://doi.org/10.1080/19338341.2021.1939095)

To link to this article: <https://doi.org/10.1080/19338341.2021.1939095>



Published online: 09 Sep 2021.



Submit your article to this journal [↗](#)



Article views: 4



View related articles [↗](#)



View Crossmark data [↗](#)



From Real to Virtual Reality—Using the Geographic Advantage with Emerging Technology to Pivot an International Interdisciplinary Experience

Lynn Moorman^a , Dawna Cerney^b , Dianna Gielstra^c , Ellen Foster^d , and Niccole Villa Cervený^e 

^aDepartment of Earth and Environmental Sciences, Mount Royal University, Calgary, Alberta, Canada; ^bDepartment of Geography and Urban-Regional Studies, Youngstown State University, Youngstown, Ohio, USA; ^cEnvironmental Studies, Prescott College, Prescott, Arizona, USA; ^dDepartment of Teacher Education, University of Mississippi, Oxford, Mississippi, USA; ^eDepartment of Cultural Sciences–Geography, Mesa Community College, Mesa, Arizona, USA

Introduction

GeoCamp Iceland is a local program designed in Iceland to provide “field-based educational experiences dedicated to increasing knowledge through practical and active learning” in subjects related to earth science and renewable energy (Morrill and Waite 2019). Since 2015, NCGE has partnered with GeoCamp Iceland to offer an in-service, field-based, geography professional development program for US educators in Iceland. The course is designed to be interdisciplinary in content; the course objectives are to build capacity in geography, specifically, spatial thinking, geography inquiry, and field methods, while focusing on the topics of geology, renewable energy, history, and culture. Therefore, the partnership is important to the success of the program, not only to facilitate logistics and planning but also to learn from a variety of local experts who can provide an interdisciplinary lens by bringing additional expertise and local perspective to the program topics. NCGE GeoCamp Iceland has been held on site in 2015, 2017, and 2019, with a planned program in 2020 cancelled due to COVID-19 travel restrictions.

As part of a participant’s research project, the value of virtual reality (VR) was recognized to support participant learning in the program and as a means for participants to bring back the experience to their students. VR data collection was conducted during the 2019 program and consisted of capturing 360-degree photos at the course sites (Figure 1). Since the 2019 course, the development of an accessible VR educational platform (GeoEPIC) has been ongoing. With the cancellation of the 2020 NCGE-GeoCamp Iceland program and future travel limitations unknown at the time of writing, the VR education platform and data have been the focus of work as organizers create a virtual experiential learning opportunity. GeoEPIC is being developed as a learning platform, not simply a visualization tool, to support an in-app field experience situated in geographic context and representation and explored through geographic skills while learning about energy, historical, or cultural phenomena. For an example of a historical/comparative government lesson using GeoEPIC, please see Cervený et al. (2021). While not intending to replace an in-person, on-site experience, the app can support

preparatory trip learning activities, enhance learner follow-up reflection, or substitute the site experiences within a trip if the location is inaccessible by enabling virtual exploration of a place. The interdisciplinary focus of the learning model remains whether in-person or in-app; the model and its implementation will be described herein.

Benefits of International Learning Experiences

Frequently cited benefits for participants of international field experiences are increased intercultural sensitivity (Wooldridge, Peet, and Meyer 2018), world view reflection and more global mind-set (Shedrow 2017), dispelling of stereotypes (Cushner and Chang 2015), and enhanced sense of authority and self-efficacy (Cushner 2007). While many learning-abroad opportunities are designed for students, the value of such experiences has long been recognized for teachers. Teachers are required to be culturally sensitive and responsive in increasingly multicultural classrooms while society faces multiple racial and cultural tensions (Cushner and Chang 2015). Even in the field of education, international learning opportunities are typically designed for pre-service teachers, rarely for in-service teachers (He, Lundgren, and Pynes 2017). Teachers have constraints around timing due to teaching commitments, requiring short-term programs, and need to have professional development tied to their subject of practice (Batey and Lupi 2012). For teachers of geography, learning abroad is critically important to facilitate the learning of “sense of place” and to experience geographic phenomena firsthand, whether human or physical in nature. As Keese (2013) stated, “As geographers, many of us believe that learning about the world requires experiencing it firsthand” (18). Experiential learning through mechanisms such as field trips, field schools, and labs is an important mode of learning in geography education, as it creates opportunities for connection, curiosity, and deep learning through affective response (Dewey 2004; Fuller et al. 2006; Hope 2009). NCGE GeoCamp Iceland leaders feel the firsthand experience allows the learner to grasp the nuances of interrelationships among course topics that often cannot be



Figure 1. 360-degree photos were taken to populate the VR platform and create a virtual space for each site of interest.

fully addressed in the classroom setting, and allows participants “to *do geography* and to *be geographers* while in the field” (Morrill and Waite 2019, 8).

Interdisciplinarity and Program Model

Iceland, with its active tectonic, glacial, and bare volcanic landscapes along with strong symbiosis between landscape and human activity, is recognized as a valuable geologic and geographical field location (Björnsson 2017; Muir 1915; Thorarinnsson, Einarsson, and Kjartansson 1959) (Figure 2). In an internationally situated experience, particularly where cultural and physiographic phenomena are both of interest and interplay of natural and human action are of concern, Keese (2013) claims that “understanding places requires an integrated approach, and geography is an integrated discipline” (18). To study any aspect of Iceland’s history, culture, politics, or settlement requires an understanding of the local physical geography. Likewise, studying Iceland’s physical geography in isolation does not make sense without looking at how that geography is constantly creating opportunities and challenges for society. Beyond the inherent interdisciplinarity of geographic exploration of place however, NCGE’s GeoCamp Iceland includes partnering disciplines of geology and environmental science (particularly as applied to renewable energy issues) and history/culture. The on-site characteristics, availability of local expertise to facilitate an interdisciplinary experience, and easy access from the US provide an ideal location for an NCGE international learning experience.

Interdisciplinarity is also important when considering the teacher participants and is an integral part of the program design model (Figure 3). He, Lundgren, and Pynes (2017, 155) point out that “different from preservice teachers who may have limited classroom experiences, in-service teachers bring a wide range of teaching experiences and expertise into study abroad programs.” Although the program is marketed and advertised in primarily geography-focused avenues (NCGE newsletter, email to over 15,000 contacts and social media), discussion from 2019 attendees indicated that a number of participants were made aware of the program through word-of-mouth. This mobilization of personal networks and the broad audience base of NCGE media mean that many NCGE GeoCamp Iceland participants do not have a geography background. In the US and Canada, teachers with limited or no geography background are frequently tapped to teach geography-related content and courses. The gap in educator knowledge creates a demand for professional development opportunities to gain geography

expertise and experience. There are also teachers in core disciplines who can benefit from geography professional development. In many educational jurisdictions, STEM subjects and English/Language Arts (ELA) dominate the required curriculum, and geography is either secondary, integrated into social studies, or invisible. In the US, the federally mandated Every Student Succeeds Act (ESSA) and its predecessor, the 2002–2015 No Child Left Behind Program, require standardized testing for the core areas (ELA, mathematics, social studies, and science) which can then dominate instructional time and student effort, minimizing attention to other subjects. For the core areas, however, tackling content with a geographic lens, spatial thinking, and geoinquiry can support learning through measuring and understanding the spatial and relational context of phenomena. Adding the geographic perspective can simultaneously address the geographic literacy outcomes recommended for graduating students through national standards and frameworks, such as the Geography for Life in the US (Heffron and Downs 2012) and the Canadian Geography Learning framework (VanZant et al. 2018). As indicated, there are many reasons that the NCGE GeoCamp Iceland appeals to teachers coming from different disciplines. In 2019, these participants’ disciplines included mathematics, ELA, geology, sustainable development, marine biology, environmental science, political science, and history.

An interdisciplinary field course also requires specific design considerations. In order to address the wide range of backgrounds of participants, virtual meetings were conducted prior to the on-site course (Lemmons 2015) and are indicated as “preparation” on the model (Figure 3). Three goals of the meetings were as follows:

1. Address logistics but also introduce geographic thinking and concepts in terms of the location and climate of Iceland, the language and customs, and the distribution of sites and phenomena along the itinerary.
2. Educate the participants on entry-level physical and cultural Icelandic geography. This information included attributes and processes of the physical and cultural geography given as a series of separate lessons. The incorporation of these details built a common base of knowledge for participants while providing a geographic framework upon which the information from other discipline lenses could be added.
3. Introduce the participants to each other and to the geography faculty field leaders and provide channels of communication through private groups on social media. Developing rapport and familiarity between participants and leaders, as



Figure 2. Iceland's location northwest of continental Europe, site of NCGE's GeoCamp.

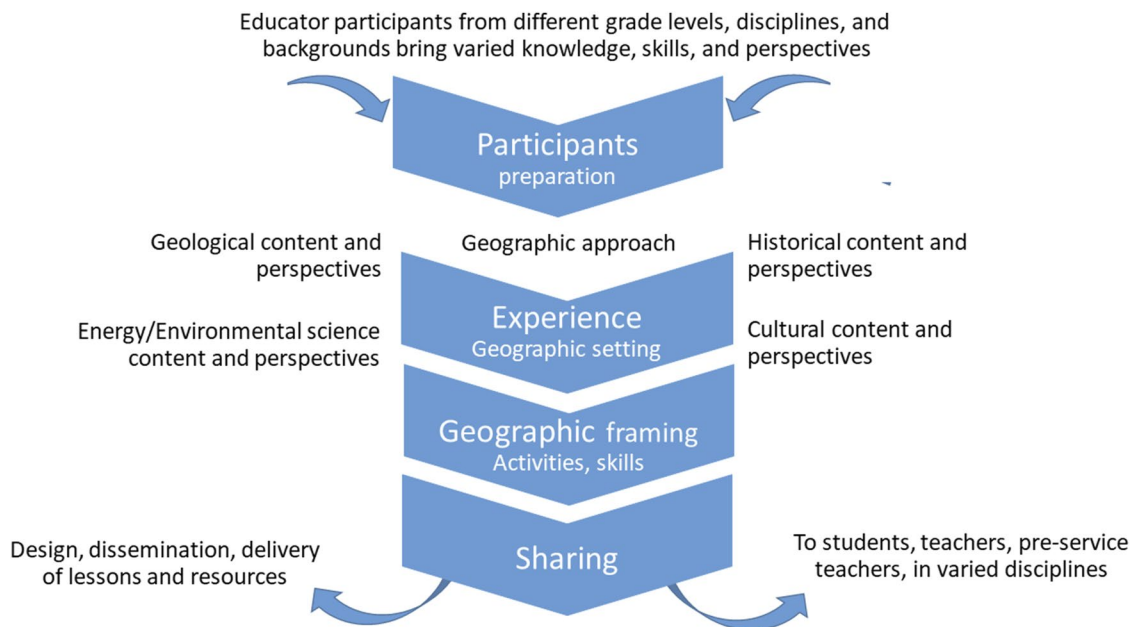


Figure 3. Model of interdisciplinary program delivery, with participants coming from different disciplines; a geographic approach with delivery from experts in geography and different disciplines; geographic framing through activities, reflection, and geoinquiry; and dissemination of learning to audiences in diverse disciplines.

well as among participants, allowed for an easier transition into the actual onsite course and may support efforts for future academic collaboration both in the field and after the field course is complete,

The virtual meetings were recorded and were accompanied with presentation slides and other geographic materials, all of which the teacher participants could adopt for their own classroom use following the course.

Ensuring a valuable interdisciplinary experience demanded an iterative and collaborative approach to program design and delivery. NCGE leaders developed a list of sites and experiences that were important to include from their perspective, and GeoCamp Iceland refined the list with local knowledge and availability of expertise. Once participants were on the ground, the daily activities included any preparation required, visits to sites with explanations from experts, geographic and reflection activities, and preparation for further visits. The main disciplines of

expertise of local GeoCamp guides include geology, renewable energy, and Icelandic history and culture. They, with other local experts, provided partnering discipline and site-specific expertise, describing, for example, glacial history of the Jökulsárlón glacial lagoon, Westman Islands volcanology, geology of the Katla GeoPark, rescue services at the Icelandic Association for Search and Rescue, Icelandic history at Settler's Museum (Figure 4), and geothermal energy at various sites (Figure 5). NCGE leaders then framed the learning in spatial terms, including geographic knowledge dissemination and activities. These activities focused on geographic investigation of the sites, such as capturing a sense of place, studying spatial characteristics and patterns by looking at variability, comparing sites, using maps as a key information portal and reflection tool, considering place-dependence of processes and, finally, asking geographic questions and facilitating analysis by following the geoinquiry process (ask a geographic question, act on geographic knowledge, acquire geographic information, organize geographic data, analyze geographic information) (Morrill and Waite 2019). Examples of compelling questions include: Is Iceland a safe place to live? What is a good location for a geothermal power plant? How can energy build or ruin a place? How can society exist and even thrive amid so much

destructive power? Table 1 provides examples of partnering disciplines, example questions, and topical links for typical questions. Participants needed to draw upon their geographic knowledge and skills as well as knowledge from other disciplines to address the questions. The goal of this interdisciplinary approach was to provide the affective experience, geographic perspective, and disciplinary content to help shape the educators' personal practical theories that inform their pedagogical practice (Levin, He, and Allen 2013). It was hoped that through the repeated process of accepting content from another discipline (e.g., geology, history) with a geographic lens and practicing geographic perspectives to answer complex interdisciplinary questions, their pedagogical practice would include more geographic content, skills, and approaches. The success of the interdisciplinary approach for meeting the goals of the NCGE GeoCamp Iceland course is evident in the responses from the 2017 cohort participants, who identified the degree to which geographic perspectives and inquiry would be integrated into their teaching (Figure 6).

Reflection is recognized as a key component of an international educational experience to process and secure learning from experience and transform experience to pedagogical beliefs



Figure 4. Guide Ólafur Jón Arnbjörnsson from GeoCamp Iceland provides expertise in Icelandic settlement and environmental adaptation at Hafnir, Reykjanes, Iceland (photo courtesy of E. Foster).



Figure 5. Participant educators in NCGE's GeoCamp Iceland engage with local experts to learn about geothermal energy at Svartsengi Power Station (photo courtesy of Ólafur Arnbjörnsson).

Table 1. Example questions and partnering disciplines in NCGE GeoCamp Iceland.

Partnering discipline	Guiding questions	Subject links
Energy and Sustainable Development	What is a good location for a geothermal power plant? How can energy build or bust a place?	Plate tectonics, geothermal processes, building design and safety, location to market, transportation, ancillary industries Energy depends on availability and development of technology relative to extracting, using and transporting
Economics and Economic Development	What areas are best suited to farming? What communication/transportation networks are necessary for the spatial organization of towns/cities in Iceland? Who decides fishing quotas and how are they distributed? Is it better for Iceland to tax gasoline-powered vehicles or to subsidize individuals' purchase of hydrogen-powered vehicles?	Landscapes, resources, climate, geographic irony, and hazards (e.g., flooding) Settlement patterns, economic development, vulnerability, independence Natural resources, power, geopolitics, uneven economic development Geopolitical relations, international trade, economic development, changing ideas about energy, sustainability
Political Science	Is Iceland a typical island nation? Is Iceland part of Europe? In what ways are Iceland's geopolitical relationships changing?	Isolation, proximity/distance to other places, spheres of influence, geopolitical change over time, language/culture groups, colonization, tourism, out-migration and in-migration Proximity/distance, spheres of influence, geopolitical change over time, language/culture groups, colonization, tourism, out-migration and in-migration Arctic region, European region, global, security issues, climate change
Geology/Environmental Science	How can a society exist amid so much destructive power? Is Iceland a safe place to live? What is the source of Iceland's geothermal energy?	Physical hazards of being on a plate boundary, safety, warning systems, volunteer corps, building design and other mitigation strategies, risk and risk perception Plate tectonics, Earth structure
History	Why did Iceland's early settlement survive and Greenland's collapse? How did democracy evolve and work in ancient Iceland?	Adaptation, vulnerability, climate, culture Power and authority, legitimacy and stability, democratization, internal and external forces, geomorphology

and practices (He, Lundgren, and Pynes 2017; Trilokekar and Kukar 2011). Not only do the participants in the NCGE GeoCamp Iceland partake in daily reflection activities such as journaling, peer sharing, and sketch mapping, the program requires that each teacher design inquiry-based fieldwork or classroom activities based on their learning experiences once back home, bringing geographic thinking and skills to bear in their own context. A special issue of *The Geography Teacher* was dedicated to articles of participants' work resulting from the 2017 program, including Butzow (2019), Law (2019), and Parra (2019).

Challenges Noted

After conducting the course three times, two challenges around interdisciplinarity became clear. The first challenge concerned

the wide diversity in participant backgrounds and geographic knowledge. While this was an intentional and successful design of the program, providing a wide range of perspectives and ideas from various backgrounds and disciplines, the diversity of participant experience meant the range of geographic knowledge and skills was vast and was seen by the leaders as a challenge to progressing the whole group through the curriculum effectively. The second challenge relates to facilitating the mobilization of the learning from the field back to the classroom. As described by an educator on a different field course, "this makes me wish I could bring my students here—I wish I could pull each and every one of them across the Atlantic, into this fjord, up this mountain, and have them stand in the very awe that I am experiencing. Of course, this is unfeasible. And I will have to settle into finding ways to deliver this magical experience to them,

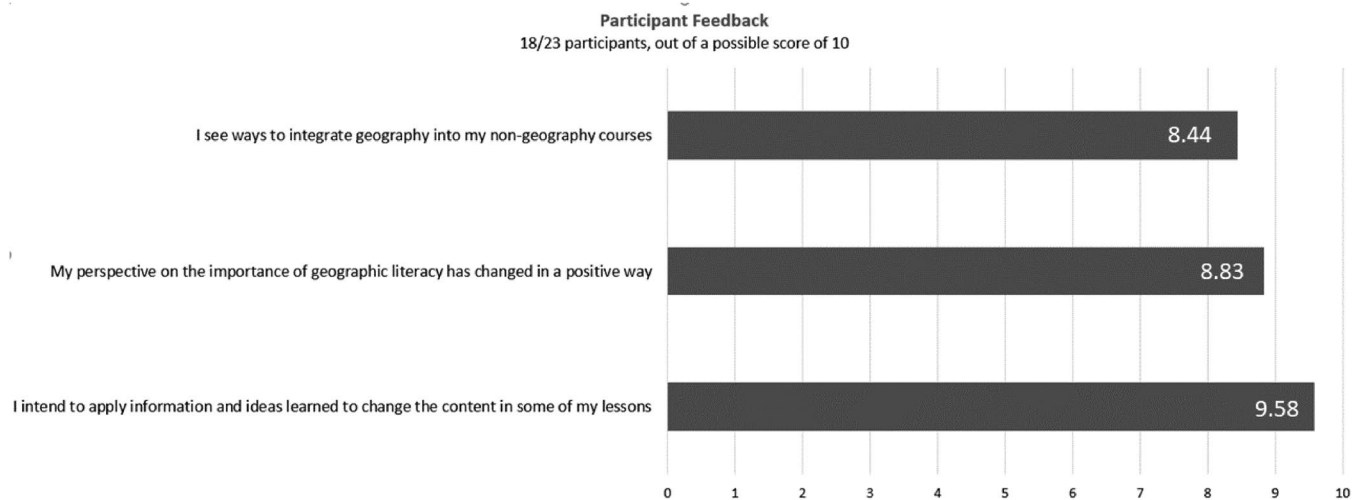


Figure 6. Participant feedback on the impact of the field course and potential of using their NCGE GeoCamp Iceland learning in their future teaching.

instead.” (Miller 2020). Considering these two challenges, the NCGE leaders recognized a significant need for a resource to support the participants’ learning while in the field and to help secure and share it once back home. To address this need, a team with specializations in VR, geomorphology, biogeography, spatial thinking, and geographic education have worked together to contribute their disciplinary methods and insights to create a holistic learning solution in VR. GeoEPIC was created to provide access to the field school environment from anywhere: a VR, interdisciplinary solution designed through the foundations and synthesis of geography, geovisualization, and educational principles and best practices.

The VR application also allows educators to create their own experiences to share with students and embed in their curriculum, thereby sharing and extending their own field experience. This supports Miller’s (2020) desire to bring the experience back to her own classroom and students, while also creating connections and resources and building upon the field experience. “As a result of study abroad, teachers develop new ideas and innovative collaborations to internationalize the existing curriculum. ... While it is important to standardize the quality of curriculum activities students experience in K-12 settings, we believe it is equally important to create space where teacher innovations are encouraged” (He, Lundgren, and Pynes 2017, 155).

About VR

The goal of any technology is to extend our normal human capacities. VR environments “capitalize upon natural aspects of human perception by extending visual information in three spatial dimensions” (Wann and Mon-Williams 1996, 833) and facilitate the sense of user presence and interaction in that environment. In this VR platform, which can be accessed through mobile device, computer, or headset (Figure 7), activity takes place within a virtual world and emulates the in-person field experience in three ways. First, there is a geographical setting seen in three dimensions (3-D) that can be a fictional world (through illustration) or a dynamic real-world environment (through photography). For GeoEPIC, the actual Icelandic field



Figure 7. VR content can be accessed through a mobile device or computer, but a headset provides a more immersive experience. Navigating through the virtual landscape is enabled with the hand controls.

sites were photographed using 360-degree cameras, capturing the complexity of elements and environments that make up real-world scenes. Second, the area can be explored by controlling the viewer position and perspective. The virtual visitor can experience not only similar perspectives and views that an actual visitor would but also views beyond the reach of an actual visitor. The viewer also has the benefit of visiting many sites in a day, exploring each for as long as desired, and being able to rely on seeing the sites and phenomena. This was not always the case in the in-person course as weather and logistics occasionally

disrupted the planned itinerary. Third, the viewer has additional information at their fingertips and can self-explore, guided by navigation icons and content found in the “zones of interest.” In GeoEPIC, learners can access embedded expert or ancillary content of political, cultural, and environmental topics for each site, which serves as discipline specific or expert knowledge that would be imparted at the actual site. This content can include text, sound, graphics, GIS layers, and even tools that can help the viewer analyze aspects of the landscape, such as measurement tools (Figure 8).

The Role of VR in International Educational Field Experiences

There are three main reasons to incorporate VR into an in-person field experience like NCGE’s GeoCamp Iceland, and all serve as the rationale for developing GeoEPIC as a VR resource. The first reason is to assist in-person learning with additional perspectives and resources, the second is to help secure learning once home, and the third is to share the experience with others. The VR serves to facilitate learning through self-directed navigation of resources containing supporting knowledge and concepts and providing complementary spatial perspectives and data to help see the bigger picture, a new picture, or greater detail of an area (Ragan, Bowman, and Huber 2012). These benefits can also serve remote learners to help bring a form of international field experience to those who cannot access it otherwise, for reasons of cost, safety, health, or conservation. The learning model followed in our VR for the interdisciplinary context is the same as demonstrated for the on-site learning, including bringing content of both geography and the partner discipline together

through expert knowledge sharing, using geographic skills to explore the content, and applying a geoinquiry to engage deeply in all aspects of the content.

In addition to experiential learning (Dewey 2004; Hope 2009), situated learning and cognition is also important (Brown, Collins, and Duguid 1989; Lave 1988), especially in learning abroad, as the context of place helps to inform the meaning of what is learned and secure the ability to apply that learning in the real world. These philosophies speak to the embodied and personal experience, but research indicates similar benefits are realized through 3-D VR applications and when complementing in-person with VR experiences (Carver 1996; Markowitz et al. 2018; Martin and Ertzberger 2013; Welsh and France 2012), including enhanced spatial knowledge representation and increased motivation/engagement (Dalgarno and Lee 2010; Ragan, Bowman, and Huber 2012).

A characteristic of situated cognition that is important to the interdisciplinary nature of the NCGE GeoCamp and GeoEPIC is that the student feels immersed in the location and thus in the geographic elements and characteristics of place (Figure 9) (Carver 1996; Gautam et al. 2018). Being present in person accomplishes this, while in VR, it is the fidelity of the representation (realism), other sensory experiences (sound, smell), the ability to interact with the environment or other people, and the complexity of the situation and problem at hand that contribute to the quality of the “presence” or immersion felt by the participant (Schott and Marshal 2018). A feeling of being embedded in the environment facilitates a constructivist approach to learning, whereby students make personal connections to the material to make it more meaningful, practical, and personally relevant (Gautam et al. 2018; Huang 2002; Vygotsky 1978).



Figure 8. In GeoEPIC, learners can access embedded ancillary content that can include text, sound, graphics, and tools to help the viewer contextualize and analyze aspects of the landscape. In this case, the height of a geyser can be both viewed relative to the landscape and measured.



Figure 9. An important aspect to a field experience, whether on-site or in VR, is to feel immersed in the location. Here NCGE GeoCamp participants explore the geology of columnar basalt at Reynisfjara, Mýrdalshreppur, Iceland (photo courtesy of D. Gielstra).

An interdisciplinary example for the NCGE GeoCamp Iceland using the GeoEPIC VR is the lesson included in this issue (Cervený et al. 2021), “Where is our Booth? Clan Organization at the Alþingi, Þingvellir, Iceland in Virtual Reality.” Partnering disciplines include history and political science, and objectives are aligned with AP Human Geography, AP Government and Politics: Comparative, and AP World History: Modern. The lesson begins with tasks that build the student’s understanding of location and place, absolute versus relative location, assessments of travel, location and resources, the political importance associated with spatial attributes, and understanding democracy in the context of religious upheaval in Iceland’s earliest commonwealth council. Interactive lessons and role-play allow the audience to participate in preparing for such an event, collect data, make choices around resources and site

location, and determine the outcomes of those choices based on the logic of space and place (Figure 10). The gamification of the lesson is accomplished through an immersive, place-based experience. We have a ranking/scoring metric that allows students to reflect on their choices, debate the choice, and make a claim to a booth. The experience offers a feel of attendance at the council setting and effectively allows the students participation in an early democracy. Feedback includes scoring on their choice of location for their booth at Þingvellir, which is dependent on their resources, needs, and priorities from each of their farm locations, all based on a historical Icelandic saga. Initial feedback from educators indicate that the use of the VR is appealing; it allows access to a place the students cannot go and one where the physical landscape is important to understanding political and cultural history of the area.



Figure 10. Using GeoEPIC, participants are immersed in the Icelandic landscape and can interact with the images and maps. The scene is of Þingvellir, site of the Icelandic Alþingi, ancient parliament. Students can acquire information from the indicated sites and must choose which would best suit their needs for a booth at the parliament.

It would be difficult for any VR to replace an on-site international learning experience. According to He, Lundgren, and Pynes (2017), there are two competencies to the international learning experience for teachers as participants: the academic competence, in which the content and skills are learned, and the cultural competence, where beliefs underlying pedagogic practice are evolving, cultural sensitivity and world views are shaped, and intentional collaboration with the host country educators are not only important but critical. The role of the VR is to support the academic competence, at any point through the learning (pre-, during, and post-trip) which enhances the comfort of participants and thus make a better experience to develop cultural competence when access to the location is feasible. In times where access is not feasible, the VR provides an excellent proxy to the real environment, and can ensure that geographic-specific or interdisciplinary studies can continue where data are available.

Conclusions

NCGE's GeoCamp Iceland was designed to help educators in different disciplines learn more about geography, geographic perspectives, and geoliteracy through an in-person 10-day international field school in Iceland. The program is interdisciplinary in its approach, as participant educators and local experts come from different disciplines and connect through the language of geography and the act of geoinquiry to explore complex guiding questions. Contributing disciplines important to this place are geology, renewable energy, history, and culture. Outcomes and deliverables of the participants enhance the interdisciplinary nature, as participants are expected to produce classroom resource materials and lessons for dissemination and create knowledge mobilization initiatives to share their experiences and integrate their geography learning into their discipline through

teaching and building sharable resources. A VR application, GeoEPIC, was designed to address the following needs of NCGE's GeoCamp Iceland: (1) to support educators in developing learning resources following their on-site experience, (2) to help secure learning following a field experience, and (3) to aid in learning while on-site, a need determined by trip leaders to address gaps created by the wide variety of background and knowledge of participants. GeoEPIC is based on the same theoretical foundation that drives on-site field experiences, situated cognition, and authentic and experiential learning, with a constructivist approach facilitating user-driven choices and feedback. The pedagogy is informed by the interdisciplinary content of the sites, and driven by the geoinquiry process, to promote nonlinear deep-learning educational experiences that develop critical thinking and interdisciplinary connections. Given the current lack of access to in-person group field experiences, GeoEPIC provides a model for continuing the benefits of international field experiences through a personal access point, be it smartphone, desktop, or immersive headset. Future work will include creating more experiences and sites in Iceland; developing lesson plans, activities, and assessments; as well as testing impact and outcomes to add to an emerging body of literature on immersive VR environments for educational applications in geography.

Notes on Contributors

Lynn Moorman is a Professor of Geography at Mount Royal University and conducts research in the areas of geography education, geospatial literacy, citizen science, GIScience, and the role of geospatial technologies and visualizations in the construction of people's geographic skills and knowledge. Her work includes remote sensing curricula for industry, government, school boards, and recently, Arctic communities. She is a Governor of the Royal Canadian Geographical Society.

Dawna Cerney is a Professor of Geography at Youngstown State University. As a biogeographer, her research interests include ecological landscape level change, resilience theory, conservation and sustainability strategies, and applied geography. Dawna is a co-leader for NCGE's Iceland field course.

Dianna Gielstra is a Course Designer and Instructor of the Master's of Science in Environmental Studies at Prescott College in Arizona. Her research interests are in human impacts in the environment, geography, successional changes in riparian environments, landscape ecology, forest ecology, and the use of technologies to engage K–12 learners in science education.

Ellen J. Foster serves as Professor of Secondary Social Studies Education at the University of Mississippi—School of Education Teacher Education Department. As President of the National Council for Geographic Education in 2016, Ellen promoted geo-literacy and interdisciplinary instruction of geography at all levels. Ellen co-led international field courses in Iceland with NCGE in 2017 and 2019 and continues to work with GeoCamp Iceland to promote professional development opportunities for educators.

Niccole Villa Cervený is a Professor of Geography and Sustainability at Mesa Community College in Arizona. Her research interests are in geomorphology, landscape evolution, Native American rock art conservation, and sustainable heritage management.

ORCID

Lynn Moorman  <http://orcid.org/0000-0001-6554-1615>

Dawna Cerney  <http://orcid.org/0000-0001-9068-4394>

Dianna Gielstra  <http://orcid.org/0000-0003-3300-4035>

Ellen Foster  <http://orcid.org/0000-0003-3165-8190>

Niccole Cervený  <http://orcid.org/0000-0001-5014-0202>

References

- Batey, J. J., and M. H. Lupi. 2012. Reflections on student interns' cultural awareness developed through a short-term international internship. *Teacher Education Quarterly* 39 (3):25–44.
- Björnsson, H. 2017. *The glaciers of Iceland: A historical, cultural and scientific overview*, Vol. 2, 613. Paris, France: Atlantis Press.
- Brown, J. S., A. Collins, and P. Duguid. 1989. Situated cognition and the culture of learning. *Educational Researcher* 18 (1):32–42. doi:10.3102/0013189X018001032
- Butzow, D. 2019. Using sense of place in the classroom. *The Geography Teacher* 16 (1):10–4. doi: 10.1080/19338341.2018.1559215
- Carver, R. 1996. Theory for practice: A framework for thinking about experiential education. *Journal of Experiential Education* 19 (1):8–13.
- Cervený, N., D. Gielstra, J. Gielstra, L. Moorman, D. Cerney, and E. J. Foster. 2021. Where is our booth? Clan organization at the Alþingi, Þingvellir, Iceland in Virtual Reality. *The Geography Teacher*. doi: 10.1080/19338341.2021.1931919
- Cushner, K. 2007. The role of experience in the making of internationally-minded teachers. *Teacher Education Quarterly* 34 (1):27–39.
- Cushner, K., and S. Chang. 2015. Developing intercultural competence through overseas student teaching: Checking our assumptions. *Intercultural Education* 26 (3):165–78.
- Dalgarno, B., and M. J. W. Lee. 2010. What are the learning affordances of 3-D virtual environments? *British Journal of Educational Technology* 41 (1):10–32.
- Dewey, J. 2004. *Democracy and education*. Mineola, NY: Dover Publications Inc.
- Fuller, I., S. Edmondson, D. France, D. Higgitt, and I. Ratinen. 2006. International perspectives on the effectiveness of geography fieldwork for learning. *Journal of Geography in Higher Education* 30 (1): 89–101.
- Gautam, A., D. Williams, K. Terry, K. Robinson, and P. Newbill. 2018. Mirror worlds: Examining the affordances of a next generation immersive learning environment. *TechTrends* 62 (1):119–25. doi:10.1007/s11528-017-0233-x
- He, Y., K. Lundgren, and P. Pynes. 2017. Impact of short-term study abroad program: Inservice teachers' development of intercultural competence and pedagogical beliefs. *Teaching and Teacher Education* 66:147–57.
- Heffron, S. G., and R. M. Downs, eds. 2012. *Geography for life: National geography standards*. 2nd ed. Washington, DC: National Council for Geographic Education, National Standards.
- Hope, M. 2009. The importance of direct experience: A philosophical defence of fieldwork in human geography. *Journal of Geography in Higher Education* 33 (2):169–82. doi: 10.1080/03098260802276698
- Huang, H. M. 2002. Toward constructivism for adult learners in online learning environments. *British Journal of Educational Technology* 33 (1):27–37. doi:10.1111/1467-8535.00236
- Keese, J. R. 2013. Study abroad: Geography does it better. *Yearbook of the Association of Pacific Coast Geographers* 75 (1):15–27.
- Lave, J. 1988. *Cognition in practice: Mind mathematics and culture in everyday life*. New York, NY: Cambridge University Press.
- Law, T. 2019. Exploring how Iceland's physical geography impacts daily life and energy use. *The Geography Teacher* 16 (1):29–30.
- Lemmons, K. 2015. Short-term study abroad: Culture and the path of least resistance. *Journal of Geography in Higher Education* 39 (4):543–53.
- Levin, B. B., Y. He, and M. Allen. 2013. Teacher beliefs in action: A cross-sectional, longitudinal follow-up study of teachers' personal practical theories. *The Teacher Educator* 48 (3):201–17.
- Markowitz, D. M., R. Laha, B. P. Perone, R. D. Pea, and J. N. Bailenson. 2018. Immersive virtual reality field trips facilitate learning about climate change. *Frontiers in Psychology* 9:2364. doi:10.3389/fpsyg.2018.02364.
- Martin, F., and J. Ertzberger. 2013. Here and now mobile learning: An experimental study on the use of mobile technology. *Computers & Education* 68:76–85. doi:10.1016/j.compedu.2013.04.021
- Miller, A. 2020. Wandering the Viking ruins at Brattahlíð. Lindblad expedition blog. <https://www.expeditions.com/blog/viking-ruins-of-brattahlid/>
- Morrill, R. W., and J. L. Waite. 2019. NCGE GeoCamp Iceland: Exploring Iceland's changing landscapes and diverse environments. *The Geography Teacher* 16 (1):6–9. doi: 10.1080/19338341.2018.1559217
- Muir, T. S. 1915. The physical geography of Iceland. *Scottish Geographical Magazine* 31 (5):254–257. doi:10.1080/14702541508554844
- Parra, J. 2019. Energy: Types, evaluation, conservation. *The Geography Teacher* 16 (1):15–26. doi:10.1080/19338341.2018.1560349
- Ragan, E. D., D. A. Bowman, and K. J. Huber. 2012. Supporting cognitive processing with spatial information presentations in virtual environments. *Virtual Reality* 16 (4):301–314. doi:10.1007/s10055-012-0211-8
- Schott, C., and S. Marshal. 2018. Virtual reality and situated experiential education: A conceptualization and exploratory trial. *Journal of Computer Assisted Learning* 34 (6):843–852.
- Shedrow, S. 2017. Cross-cultural student teaching: Examining the meaning-making of one white, female, middle-class, preservice teacher. *Journal of International Students* 7 (2):270–190.
- Thorarinsson, S., T. Einarsson, and T. Kjartansson. 1959. On the geology and geomorphology of Iceland. *Geografiska Annaler* 41 (2-3):135–169. doi:10.1080/20014422.1959.11904385.
- Trilokekar, R. D., and P. Kukar. 2011. Disorienting experiences during study abroad: Reflections of pre-service teacher candidates. *Teaching and Teacher Education* 27 (7):1141e1150–1150.
- Wann, J., and M. Mon-Williams. 1996. What does virtual reality NEED?: Human factors issues in the design of three-dimensional computer environments. *International Journal of Human-Computer Studies* 44 (6):829–847. doi:10.1006/ijhc.1996.0035
- Welsh, K., and D. France. 2012. Smartphones and fieldwork. *Geography* 97 (1):47–51.
- Wooldridge, D. G., S. Peet, and L. L. Meyer. 2018. Transforming professionals through short-term study-abroad experiences. *Delta Kappa Gamma Bulletin* 84 (4):31–36.
- VanZant, P., C. Wyatt-Anderson, A. Kitchen, L. Moorman, J. Ruest, J. Trites, and K. Wallace. 2018. The Canadian geography learning framework. <https://sites.google.com/rcgs.org/learningframework/homeaccueil?authuser=0>
- Vygotsky, L. S. 1978. *Mind in society: The development of higher mental process*. Cambridge MA: Harvard University Press.