GeoEPIC: Innovating a Solution to Implement Virtual Field Experiences for Education in the Time of COVID-19 and the Post-Pandemic Era

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The spring of 2020 marked the start of many countries closing their borders to travel due to the COVID-19 pandemic. These closures disrupted travel and learning opportunities for K- 16 education. International field trips and study abroad programs were some of the first canceled opportunities with domestic field trips becoming more complicated to implement safely. With termination of these experiences, students lost cooperative and collaborative opportunities for place-based, field-based education. To address these losses of situated learning opportunities for students, a digital learning platform was developed to increase access to educators and students to free virtual field-based experiences. The platform is enhanced to allow teachers easy adoption of resources with supporting workshops to help educators in creating and delivering this rich education content through authentic, virtual landscapes.

Keywords: instructional technologies, virtual reality, place-based education, experiential learning, field-based education, and virtual field trips

INTRODUCTION

In spring of 2020 COVID-19 spread globally and marked the beginning of countries closing their borders. As the pandemic worsened, these closures disrupted travel for higher education domestic and study abroad programs as well as field trips for K-16 institutions. In the Spring of 2020, "UNESCO estimated that 86 percent of the world's student population" participated in remote learning (DeWitt, 2021, para. 1). Blankenberger and Williams (2020) described how the pandemic has "rocked" higher education specifically and applied Gaus' ecological approach to describe impacts to systems of education and government (Gaus, 1947). Catastrophic events act as agents of change to these systems. The subsequent disturbance generates chaos and mass disruption that encourages the population to challenge the system's effectiveness (Anderson et al., 2021; Blankenberger and Williams, 2020)

As attitudes towards institutional systems shift, associated ideals and policies change within these systems until a new equilibrium is found. DiNapoli (2020, para. 4), stated, "pre-pandemic conditions in education were rife with inequity" and exposed long-held racial and economic inequities that have impacted educational opportunity caused by childhood poverty, experienced acutely by Black, Latino/a, and Tribal children in K-16 education. To cope with the necessity of remote learning, distance learning and expanded learning, technologies were provided, including supplemental resources for students to take home. Nationally, in the United States there is a projected revenue shortfall in the range of $230 billion to $305 billion (DiNapoli, 2020). Higher education sector impacts include lags in enrollment and recruitment as college students delay a year resulting in a 15% drop in student recruitment in 2020 (American Council of Education, n.d.; Aucejo et al., 2020). Trips for academic research were delayed and funding was subsequently impacted (Corlett et al., 2020, Petrov et al, 2020). Course delivery had to be redesigned post haste (American Council of Education, n.d), and concerns are mounting for "learning loss" amidst questions of how to approach online accountability and assessment (DeWitt, 2021). Recognition of the pedagogical uncertainty these disruptions bring require innovative approaches to teaching.

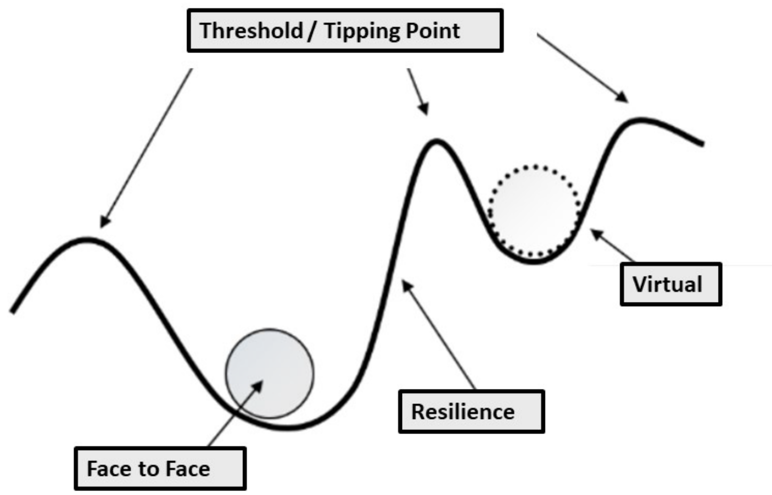
For field work or field trips, place-based experiences are important to create "meaningful experiences" for learners (Dean, 2020; Rotzien et al., 2021; Semken et al., 2017); these opportunities help students connect theory introduced in the classroom to features and situations in the environment (Semken et al., 2017; Semken & Freeman, 2008). Experiential learning offers engagement with the landscape that sparks curiosity and reflection. Direct student involvement in lessons and fieldwork permits students to explore the geographic concept of place through their interaction with physical features and landscapes (Mogk, 2004; Mogk & Goodwin, 2012; Rotzien, 2021). Decreased opportunities to learn skills with investigation of subject matter through field work include: data collection techniques, map reading analysis, and problem solving (Hope, 2009, Kent et.al.,1997; Rotzien, 2021). Impacts of COVID-19 on field-based, place-based learning is perhaps the ultimate example of "learning loss" as "learning by doing" is an important pedagogical tool which encourages deep learning through improved understanding and enjoyment (Dummer, et al., 2008, Hope, 2009).

Challenges inherent during a field course allows students to construct knowledge rather than "acquire" knowledge (Duffy and Cunningam, 1996). Additionally, field work produces independence of thought as work activities provide ownership of information and of place (Stokes et al., 2012; Thompson, 2010). Students are invested in learning as they produce knowledge in their field studies (Wheeler et al., 2011). Without an in-person field experience, students lose the potential to collaborate with both teachers and peers; and with that loss, the benefit of the Socratic Method, the give and take of cooperative, argumentative dialogue is lost. The technique is frequently used to challenge assumptions students might have about the world around them.

A CALL TO INNOVATE

To address these losses in opportunities for students to engage in face-to-face learning, collaboration, and building student skills, it is necessary to produce virtual field lessons. Larsen et al. (2021) describe the need to hack online and hybrid learning environments to bring field geography to students and educators to cope with scenarios associated with the "Coronapause, Coronacene, and the Anthropause" (Rutz et al., 2020). The pandemic is a disruptive event, or threshold, that requires a new way to experience field opportunities (See Figure1). Larsen et al.'s (2021) "hacking" requires a transfer of on-ground lessons in field-based education into the online environment. Virtual trips focused on topics in field-based education are a proxy of the on-ground site visit with an authentic experience reconstructed within visual environments enriched with auditory soundscapes mimicking what Larsen et al. (2021) referred to as "the great outdoors from the great indoors." Fieldwork is an important component for the learner, "an upward spiral toward a more holistic and sophisticated understanding of the planet" (Larsen et al., 2021). To translate this "learning" spiral from on-ground to online environments, designers of virtual field-based experiences need to create a landscape for learners to discover education content. The student becomes an explorer in the visual environment which is layered and embedded with educational content to foster that learning progression.

FIGURE 1
ADAPTATION FROM FACE TO FACE FIELD LEARNING TO VIRTUAL FIELD LEARNING OPPORTUNITIES WITH INNOVATIVE TECHNOLOGY



Adapted from Holling, 1973

Therein lies the difficulty; the true challenges for educators are the time and costs to recreate these on-ground experiences to virtual experiences. According to the Center for Budget and Policy Priorities (2020), estimated shortfalls in state education budgets are projected at 25% in Fiscal Year 2021 with further gaps predicted in fiscal year 2022 (Huang et al., 2020). With the stressors of the pandemic on schools and teachers, as well as a constriction of resources as costs mount with compensatory measures to make on-ground learning safe for students, combined with adjustments to make curriculum in remote learning effective, there are limited resources and time for teachers and institutions to manifest and support these lessons online. Moreover, not all teachers are comfortable with technical aspects of creating these experiences tailored to the student needs. Finally, online field experiences alone do not supplement effective teaching and learning, and field lessons must be tied to curriculum and standards to ensure an efficacious transfer of topics from real world to the classroom and to promote academic rigor.

Prior to the pandemic, advanced technologies lowered costs for data capture required to create online field trips (Cliffe, 2017). Moreover, the online field proxies eliminated the costs for teachers and learners to reach the real-world sites (Cliffe, 2017). Affordable technologies used to collect data to create virtual field trips include GoPro cameras, iPhone12 Pro cameras, open-source software and tools, Geographic Information Systems (GIS) and Global Positioning Systems (GPS). Tablets and smartphones are game changers in lowering accessibility costs. Chen et al. (2013) discussed mobile devices for hosting the learning opportunities that are found within real-world environments. Further, these devices are accessible for synchronous and asynchronous learning, the latter type used more often by schools at the start of the pandemic as an emergency response to decrease transmission of COVID-19.

Lessons crafted for in-person remote field sites become impractical because of social distancing requirements and travel (Rotzien, 2021). Sites can also be inaccessible for individuals with physical limitations (both teacher and student). To close those physical and psychological distances of limited access to remote sites, a flexible solution is needed that also overcomes the challenges associated with current and future field-based, experiential online learning. In terms of equity, remote virtual field trip options offer as much opportunity for class exploration of the site as does the back-yard experience or the local site in the town, county, or even state.

To offer the virtual experience to a class, the capture of high-quality data and imagery is necessary to embed into virtual field lessons of real-world sites. Digital collection of physical objects requires site visitation by the designer of these virtual experiences. In-situ data collection of 360° photographs (photo spheres), close-up imagery of physical and biotic features, field notes, and potentially data collection for samples can help bridge from in person field trips and fieldwork to virtual field trips and field work (Kitchen, 2021).

To address the consequential lack of experiential learning, whether during the pandemic or at any time. The solution designed must address the patchwork of funding available to schools with an eye on improving equity and access to these virtual field trips and their creation. To keep costs low for schools and educators, and to reduce the need for technological support, the solution must be simple and have ease of use.

AN INNOVATIVE SOLUTION

One solution to address ease of use, access and equity is a digital learning platform to host lessons with associated virtual reality field trips. To reduce the need for technological support that might be required for educators to navigate additional downloads of "third party" executable files to devices, the digital learning platform needs to be straight-forward and uncomplicated in design and effortless to use. The platform should accommodate educators uncomfortable with technologies and make the educator more confident in leading their students through virtual field experiences, no matter their level of expertise with computers and education.

Focused on these challenges, we developed such a digital learning platform, and call the proof-of-concept instructional technology GeoEPIC. The GeoEPIC platform is a browser-based (cloud-based) digital learning platform accessed through a URL https://geoepic.app from any browser on any device (desktop, smart phone, tablet, laptop computer, or a virtual reality headset) that has Internet connection. All of these technologies have the capability to view immersive 2D and 3D environments. GeoEPIC is constructed to provide teachers with all the elements needed to teach a virtual field experience: lesson, mapping tools (See Figure 2), pedagogy, standards, and the 360°photo sphere (See Figure 3 A and 3 B) just to name a few. GeoEPIC also enables teachers to create their own resources, publish these resources, and contribute to a crowd-sourced solution with lesson inventory shared with the education community widely.

GeoEPIC is a proof-of-concept that virtual reality content can be incorporated into education curriculum for ease of use and blended with other tools to increase student's access to the world around them. To showcase the collaborative capability of the platform, we designed a Learning-Based Game into the virtual reality visual experience with a soundscape to allow learners a deeper exploration of the content. A scoring tool is provided for use by educators and students to assess, analyze and reflect on their geographic choices in the lessons, to increase skills that involve critical thinking, bargaining and collaboration between groups, and collaborative problem solving. By deconstructing the various components needed to support the learning experience, we could support educator efforts to build on the 5 E's: Engage, Explain, Explore, Elaborate and Evaluate (Wysession, 2020). The example lesson featured showcases the use of Socratic discussion to drive exploration of questions from basic geography, natural resources to more refined questions of cultural heritage. We use the landscape site features to tether icons of information for the learner. The entire visual landscape operates as a "memory palace" to build "spatial intelligence" with the goal that students might have better recall of the information if tethered to spatial attributes in the digital, immersive environment (Krokos, 2019). "Memory palaces are a spatial mnemonic to help remember information by organizing it spatially and associating it with salient features in that environment." (Krokos, 2019). A method of loci technique was applied using icons to represent historical, site-specific features of this mental environment against a 3D image (See Figure 4).

FIGURE 2
THE GEOEPIC PLATFORM SHOWCASING AN INTERACTIVE MAP EMBEDDED WITHIN THE LESSON

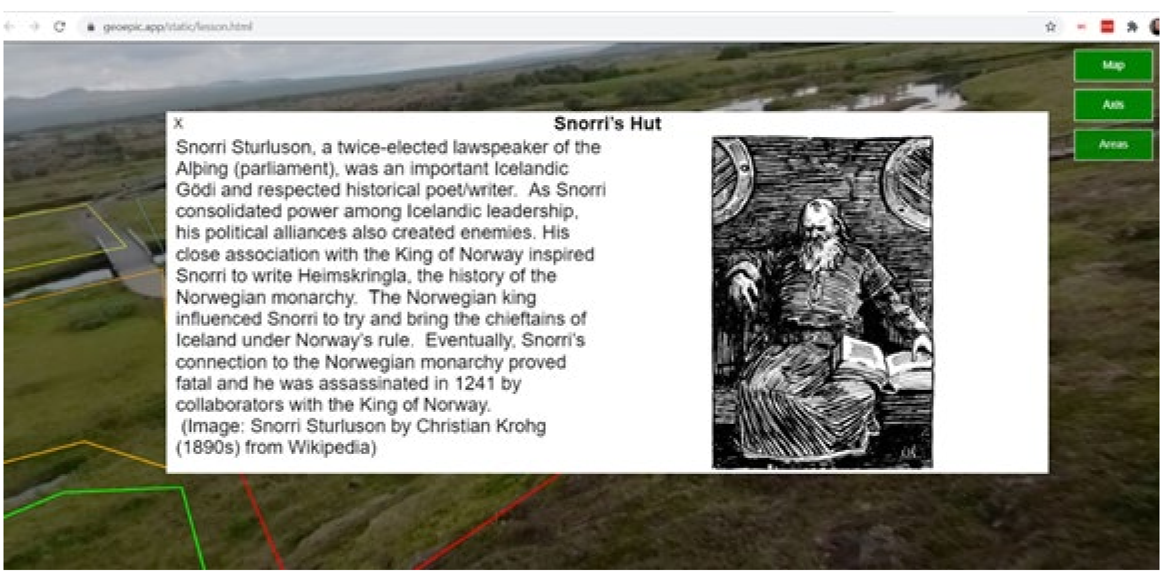
FIGURE 3 A AND 3 B
GOPRO FUSION FRONT AND BACK IMAGES OF A 360 ° PHOTO SPHERE SHOWING KIRKJUFELL MOUNTAIN, SNÆFELLSNES PENINSULA, ICELAND

3 A FRONT IMAGE	3 B BACK IMAGE
	

FIGURE 4
METHOD OF LOCI TECHNIQUE USED TO TETHER BOOTH ICON TO A HISTORIC SITE

Figure 5 shows a sample from a lesson developed to help learners explore Advanced Placement (AP) comparative government and geography. The booth placement of Snorri Sturlison's hut, a documented historical location on the landscape in Thingvellir National Park, Iceland, is embedded with education content. Students can click the booth, and information about Snorri and his influence on Icelandic politics and governance are provided.

FIGURE 5
THE EMBEDDED EDUCATION CONTENT LINKED TO THE ICON

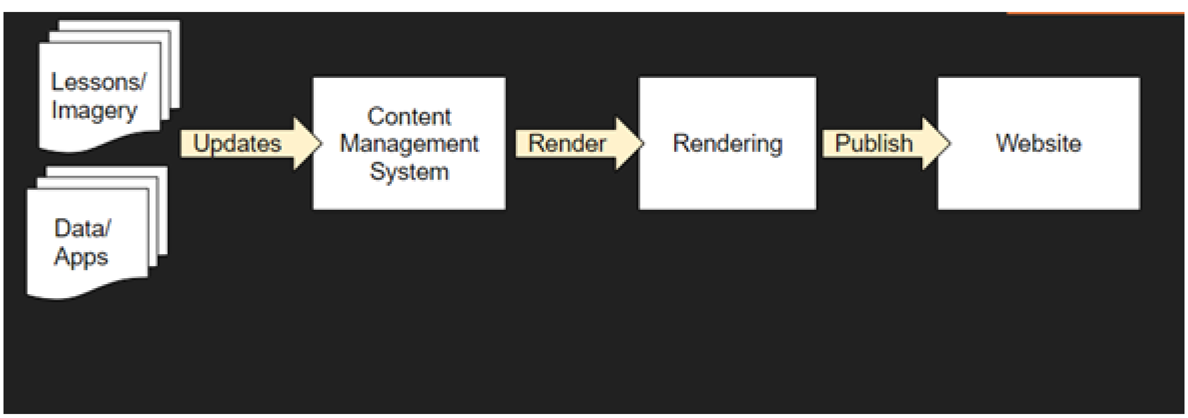


Careful attention was paid to the content embedded in the platform sample lesson to strike a balance between designing materials for teachers, but not give the student all the information. The goal is active learning and engagement that is student driven with adapted lessons designed to promote student interests, understanding, and abilities (National Academies of Science, Engineering, and Medicine, n.d.). Student comprehension of the content is influenced by their exploration and inquiry, those being the guiding tenets of science education. "Inquiry into authentic questions generated from student experiences is the central strategy for teaching science" (National Academies of Science, Engineering, and Medicine, n.d., p.31). Some of the topics covered include base geographic concepts: location, place (both the physical and cultural attributes), pattern and dispersion, spatial interaction, size and scale, spatial diffusion, and the relationships with humans and the environment. We demonstrate that the field geography experience can be brought to life for learners able to participate using Virtual Reality embedded with mnemonic devices, a strong accompanying lesson, and associated tools familiar to geographers. GeoEPIC shows that a learning platform designed to these components can support an immersive experience and meets the learner where they are.

THE NEXT STEP

A primary goal for year 2021-2022 is to allow educators access to the content management system of the GeoEPIC platform. Some progress has been made toward this goal using open-source software leveraged in the platform. Lesson content parts featuring multimedia such as: imagery, virtual reality, GIS tools, and interactive maps are published under the Wiki-commons license to allow educators a space to freely develop and share lessons. Kitchen (2021) highlighted challenges educators may have with even the simplest of technologies to transform their classrooms with virtual field experiences, and that without educator training and resources, adoption of these technologies may be limited. In March 2021, a workshop for teachers was hosted by the Arizona Geographic Alliance that we called GeoDay Iceland. Educators were trained on using the GeoEPIC platform and field lessons for classroom use. Subsequent tutorials and workshops will follow as education support for a standard protocol for GeoEPIC users. The new version of the content management system will allow for creation and the publication of the content to the GeoEPIC website (See Figure 6).

FIGURE 6
CONTENT MANAGEMENT SYSTEM SHOWING THE STEPS FOR LESSON PUBLICATION



Using the content management system, teachers can develop drafts of their content and allow other contributors to revise and check their work before publication. The system will allow for the upload and management of photos and text content (videos must be hosted externally on YouTube or other such websites). Photo spheres and other VR applications are linked into the lesson plans and are hosted separately from a web server.

CONCLUSION

As the GeoEPIC platform launches, additional workshop opportunities are planned. User testing through these workshops is intended to provide insight into what works well for educators in developing and implementing virtual field experiences in the classroom (lesson creation and lesson use), highlight areas in which teachers may need more support (areas for technology support/content support) (Kitchen, 2021), and identify how they want that support provided. Follow-up studies on the platform's effectiveness for building field-based, place-based lessons and the impact and efficacy for both educators and students are needed. The over-arching goals of such a study are to understand how to increase opportunities for experiential learning, how to increase capacity for educators to teach interdisciplinary concepts in science and culture using geoinquiry, and how to crowd-source more content and more lessons through a community of practice. Post-pandemic, a field short course designed to train teachers on science concepts, data collection, and lesson building can build that sense of place and historicity to enliven and enhance their classroom experience.

Sometimes the most elegant solution is the deceptively simple innovation. GeoEPIC platform is designed for ease of use and low, or no-cost, to educators and education institutions, or whomever might find value in these immersive field experiences. The browser-based access creates an ease of use, and with only a few clicks needed to move through the lesson, removes complications of navigating outside resources and any technology issues educators or students might encounter. Technology can be fun, but it changes rapidly over time, and asking our teachers to constantly keep up with these changes reduces time and energy better spent developing strong lessons with rich education content that is tied to standards. We, as an academic community, must understand the true value is the education content and the immersive experience offering students the "sense of place" to connect theory to real-world features. More of these free and accessible opportunities are needed to support educators and students and to make field-based learning more equitable and inclusive. If we work together to populate education resources and tools, and help teachers build their own, we can come together as an academic community to form creative-commons for virtual field trips and field-based experiences.

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