



Large TLEF Project – Final Report

Report Completion Date: (2019/**/**)

1. PROJECT OVERVIEW

1.1. General Information

Project Title:	Flexible Learning in Geography: Environment and Sustainability Major		
Principal Investigator:	Loch Brown		
Report Submitted By:	Loch Brown		
Project Initiation Date:	September 2013	Project Completion Date:	April 2017

1.2. Project Summary

In 2013, with the help of funding from the Flexible Learning Initiative, the Department of Geography began a process of curriculum review and renewal of their largest undergraduate program, *Environment and Sustainability*. The goal of the Flexible Learning in Geography Project was to improve student learning through transforming program content and delivery, at both course and program levels, to better reflect twenty-first century environmental issues, learning environments, and pedagogical approaches. There were four key areas of project activity pursued by the team. 1) Curriculum review, integration, and renewal in the E&S program; 2) Course review and renewal in light of emerging educational technologies and pedagogical best practices; 3) Exploration, innovation and deployment of emerging technologies (and open education) to support undergraduate education in the related fields of geography and environmental studies; 4) Evaluation and dissemination of project experience, and formulation of best practices when it comes to the use of emerging technologies in environmental and geographic undergraduate education.

This project initially began with the aim of transforming seven existing courses and developing three new (or significantly revised) courses using technology and innovative pedagogy to apply flexible and blended learning concepts within and across these courses. However, it became apparent early on that how students’ experience the E&S curriculum was not well understood and that many of the pedagogical approaches we initially sought to adopt in our geography courses were untested and unproven with regards to enhancing student learning, particularly within a multi-disciplinary and non-linear program such as ours. As a result, the project team created learning objectives for the program which were ratified by the department, a systematic review and mapping of the program curriculum was carried out, and key principles for guiding both program level and course level review and renewal were developed (these guiding principles proved essential in directing all future project activities). From here we embarked on sweeping changes to core courses, implemented several new program level initiatives, and initiated a process of curriculum redesign. We also realized that there was a marked lack of openly available educational materials and technological tools that could support the learning approaches and activities we wanted to implement. In response to this challenge, we developed a range of open educational resources (OER) that would be used in our courses but also made available to other instructors and students at UBC and beyond. Recognizing the importance of capturing, evaluating, and sharing our experiences, we set out to identify and explore a series of research questions related to core project activities as well as develop and disseminate best practices concerning the use of new and emerging educational technologies.



Finally, it is worth noting that the project actively involved undergraduate and graduate students in all stages and activities, both to enhance student input and engagement in program and course design as well as to build into the project itself authentic learning opportunities for our students. Many of the open educational and digital resources that emerged from this project were developed by teams of undergraduate and graduate students. The team members and outcomes of the project are highlighted in the remainder of this document. Many of the activities and projects started as part of this initiative are still active today.

1.3. Team Members*

Name	Title/Affiliation	Responsibilities/Roles
Loch Brown	Faculty	Project Lead and course (co-)lead on GEOG 211, 310, 316, 319, 318, 410, & 446
Arthur Gill Green	Teaching & Learning Fellow	Postdoctoral Fellow, Course co-lead on GEOG 319
Derek Turner	Teaching & Learning Fellow	Postdoctoral Fellow, Course co-lead on GEOG 319
Heather Dorries	Teaching & Learning Fellow	Postdoctoral Fellow
Simon Donner	Faculty - Geography	Course Lead: GEOG 312
Graeme Wynn	Faculty - Geography	Course Lead: GEOG 327
Brett Eaton	Faculty - Geography	Course Lead: GEOG 103
Alec Blair	Faculty - Geography	Course co-Lead: GEOG 311
Andreas Christen	Faculty(former) - Geography	Course co-Lead: GEOG 311
Sally Hermansen	Faculty - Geography	Course Lead: GEOB 270
Michelle Koppes	Faculty - Geography	Course Lead: GEOB 308
Karen Bakker	Faculty - Geography	Course co-Lead: GEOG 310
Jennifer Williams	Faculty - Geography	Course co-Lead: GEOG 310
Jeanie Suparman	Undergraduate RA	Tech Team
Shavonne Yu	Undergraduate RA	Tech Team
Christine Kim	Undergraduate RA	Tech Team
Jaiyi Chen	Undergraduate RA	Virtual Reality Fieldtrips
Gowtham Mohan	Undergraduate RA	Tech Team
Jason Ngan	Unity Developer	Tech Team
Gillian Der	Undergraduate RA	Content development
Cecilia Jaques	Undergraduate RA	Content Team
Mila Mezei	Undergraduate RA	Camosun Bog Fieldtrip / OER development
Sarah Rowland	Undergraduate RA	Canadian Open Education Resources Research
Mielle Michauz	Undergraduate RA	Textbook Cost Research
Alison Fung	Undergraduate RA	Natural Hazards Open Textbook
Elyssa Liu	Undergraduate RA	Annotated Bibliographies
Yuqing Shen	Undergraduate RA	Mobile App development
Caledonia Thomson	Undergraduate RA	Mobile App development
Hyunsoo Kanyamuna	Trail Six Collaborator	VP Academic: Geography Student Association
Nicole Rich	Trail Six Collaborator	Trail Six Project Manager: GSA
Joseph Lee	Graduate RA	Research Assistant: Spatial Visualization and GIS
Leonora King	Graduate RA	Research Assistant: Natural Hazards Textbook
Seth Wynes	Graduate RA	Research Assistant: SHIRC Connections Grant
Alice Henry	Graduate RA	Research Assistant: Skill Module Development
Harold Eyster	Graduate RA	Research Assistant: VR and Education Research
Anya Leenman	Graduate RA	Research Assistant: Photoscan workshop
Lucy MacKenzie	Graduate RA	Research Assistant: Photoscan workshop
Miriam Katz	Graduate RA	Research Assistant: Flexible Learning Project
Jen Moss	Faculty – Creative Writing	Collaboration on digital media writing component
Saeed Dyantakar	Collaborator	UBC Studios – Acting Director



Chris Spencer	Collaborator	UBC Studios
Kirk K.	Collaborator	UBC Studios
Matt Hall	Collaborator	UBC Studios
Craig Carpenter	Collaborator	UBC Studios
Asia Schmok	Collaborator	UBC Studios
Oksana Bartosh	Consultant	Independent, Curriculum
Peter Kao	VR Consultants	Metanaut, Unity Project Management /
Andrew Lee	VR Consultants	Metanaut, Unity Project Management /
Novak Rogic	CTLT	Manager, Web Strategy, CTLT
Ido Roll	CTLT	Senior Manager, Research and Evaluation
Julie Walchli	Faculty of Arts	Director, Arts Co-op
Amir Entezaral mahdi	ARTS ISIT	Technical Lead, ARTS - ISIT
Bret Peterson	Geography	Digital Media Production and Support
Andrea Han	CTLT	Associate Director, Curriculum and Course Services
Lucas Wright	CTLT	Educational Consultant: Learning Technologies
Angela Lam	ARTS ISIT	Manager, Arts Learning Centre Operations
Leah Macfadyen	ARTS ISIT	Program Director, Evaluation and Learning Analytics
Jason Myers	CTLT	Project Manager and Instructional Designer
Jeff Miller	CTLT	Senior Associate Director, CTLT

* There were numerous additional staff, faculty, and community members involved directly and indirectly in supporting this project. We would like to acknowledge their valuable contribution without which this project would not have been successful. If you were formally part of the project and your name is not found above, please accept our apologies and contact the PI at loch.brown@geog.ubc.ca who will add your name to the team list.

1.4. Student Impact: Course transformations*

Course	Section	Academic Year	Term (Summer/Fall/Winter)
GEOB 103	101/201	2013-ongoing	Winter
GEOG 211	101	2015-ongoing	Fall
GEOB 270	101	2015-ongoing	Fall
GEOB 308	101	2016-ongoing	Fall
GEOG 310	101/201	2013-ongoing	Fall/Winter
GEOG 311	201	2013-ongoing	Winter
GEOG 312	101	2013 - ongoing	Winter
GEOG 316	201	2015-ongoing	Winter
GEOG 318	201	2015-ongoing	Winter
GEOG 319	201	2015-ongoing	Winter
GEOG 327	101	2013	Winter
GEOB 370	201	2016	Winter
GEOG 379b	201	2014/2015	Winter
GEOG 410	101	2016-ongoing	Fall
GEOG 446(A)	201	2015 & 2016	Winter

* How these courses are taught in any given year depends on the faculty/sessional teaching.



2. PRODUCTS & ACHIEVEMENTS

2.1. Products and Achievements

Product(s)/Achievement(s):	Location:
Open Geography: Project Website, Community Hub, and Dissemination Platform	https://open.geog.ubc.ca
Guiding Principles for Course and Program Renewal	https://open.geog.ubc.ca/flexible-learning-project-guiding-principles/
Stanley Park Virtual Field Trip	Available upon request. While the virtual field trip and all the assets are openly licensed, due to the size of the files involved, we do not currently have a platform for publicly sharing these materials.
FieldPress (Technology Assisted Field Trips Platform)	<p>Overview: https://open.geog.ubc.ca/resources/fieldpress/ Prepackaged beta plugin: https://github.com/open-geography/FieldPressPlugin/tree/master/pluginreleases Latest version of the plugin code: https://github.com/open-geography/FieldPressPlugin</p> <p>User manual: https://drive.google.com/file/d/0B669N2eac2L1Z21wWUpXtIFYLVU/view Demo Website: FieldPress.ca is a demonstration website for displaying and testing the capabilities of the FieldPress plugin for WordPress.</p>
Camosun Bog Technology Assisted Field Trip	This field trip was designed to be used with FieldPress (see above), however, the content, in the form of a google doc, has been made publicly available and can be found at: https://docs.google.com/document/d/11e6ToJ1WWHGwoTLg_RihgqYh0phFgAZBvWEZxloGeCs/edit?usp=sharing
Sea to Sky Natural Hazards Virtual Field Trip	Due to software licensing, this is currently only available to UBC Faculty and Students at https://blogs.ubc.ca/fieldtrips/ . However, all the content of the virtual field trip is available upon request; please contact Dr Loch Brown.
Quaternary and Applied Geomorphology VR/AR Field Trip of Lower Mainland	Please contact Dr Michelle Koppes if you are interested in this fieldtrip
Public Reading List: Emerging Issues in Higher Education	https://www.mendeley.com/groups/7186151/flexible-learning-project-ubc-geography/papers/
Annotated Bibliography Series	<p>Annotated Bibliography 1: Virtual Field Trips Annotated Bibliography 2: Learning Analytics Annotated Bibliography 3: Social Media in the Classroom Annotated Bibliography 4: Flexible Labour in the Academic Context Annotated Bibliography 5: Flexible Learning Annotated Bibliography 6: Open Science</p>
Openly-licensed Natural Hazards Textbook	This textbook is currently in the review process. Link will be published once the textbook has been published.
Open Education Modules for QGIS	<p>Overview: https://open.geog.ubc.ca/resources/qgis/ Module 1 (Draft): https://open.geog.ubc.ca/virtual-and-augmented-reality-technology-assisted-fieldtrips-student-based-approaches-to-using-new-technologies/</p>



	<i>Other resources available upon request.</i>
Trail Six Website: Open Undergraduate Journal of Geography	https://trailsix.geog.ubc.ca/
SOTL talk: How Flexible is Flexible Learning?	https://open.geog.ubc.ca/how-flexible-is-flexible-learning/
SOTL talk: Open Education Resources for GIScience?	https://open.geog.ubc.ca/open-educational-resources-for-giscience/
SOTL talk: The Why, When, and Where of Virtual Reality in Education	https://open.geog.ubc.ca/the-why-when-and-where-of-virtual-reality-in-education/
SOTL talk: Best Practices for Developing OER Ancillary Resources for Open Textbooks	https://open.geog.ubc.ca/best-practices-for-developing-oer-ancillary-resources-for-open-textbooks/
Working Paper Abstracts	https://open.geog.ubc.ca/research/presentations/
SOTL project research overview: Virtual and Augmented Reality Technology-Assisted Field Trips: Student-Based Approaches to Using New Technologies	https://open.geog.ubc.ca/virtual-and-augmented-reality-technology-assisted-fieldtrips-student-based-approaches-to-using-new-technologies/
Showcasing Student Work in the Environment and Sustainability Program: Website to support authentic learning	https://environment.geog.ubc.ca/
Student Authored Resource: Complex Environmental Problems - Case Studies	https://environment.geog.ubc.ca/complex-case-studies/
Student Authored Resource: Infographics on Key Environmental Issues	https://environment.geog.ubc.ca/infographics/
Course Specific Resources	Please contact the PI (loch.brown@geog.ubc.ca) if you are interested in course assignments and resources developed for the above listed courses.

2.2. Item(s) Not Met

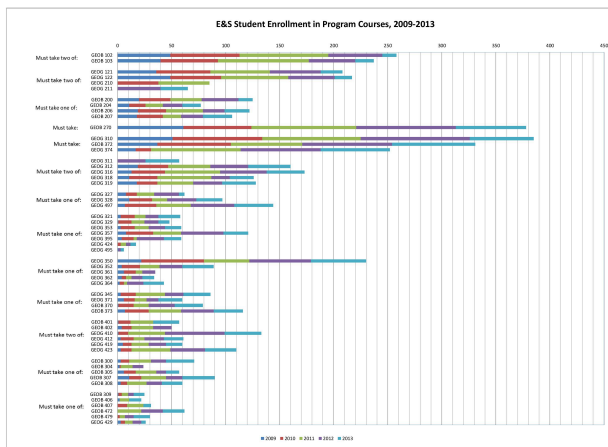
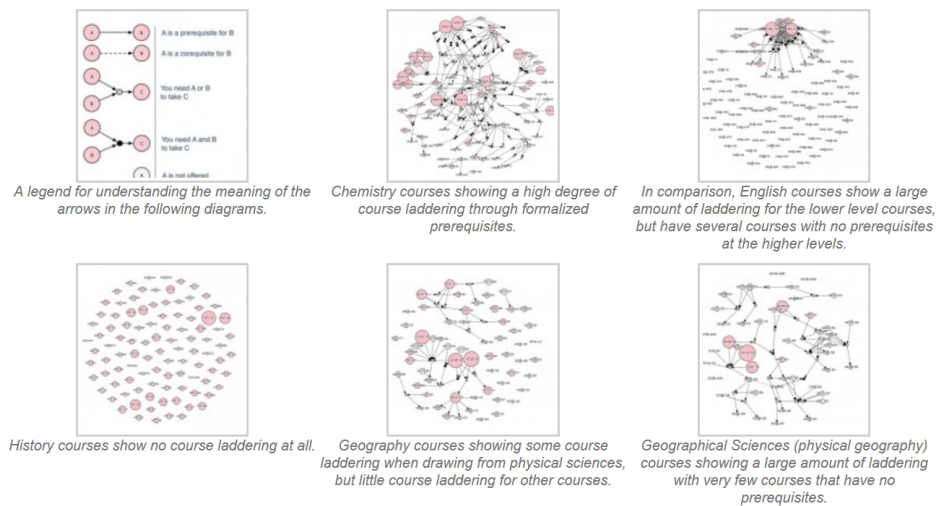
Item(s) Not Met:	Reason:
Dissemination of research through targeted journal publications	The early departure of the teaching and learning fellows (tenure track appointment) and parental leave taken by the project lead.
Delay in the publication of the Open Textbook on Natural Hazards	See above. The textbook has now proceeded to editorial review.
Delay in the completion of Openly licensed QGIS modules	See above. The former TLF, Arthur Green, has continued to work on these modules. These modules will be used in a new undergraduate <i>Earth and Environmental Science</i> program at the University of Central Asia, which is currently being developed by the Department of Geography and the Department of Earth, Ocean and Atmospheric Science
Dissemination of select Open Education Resources	Delays in the effective dissemination of some resources have resulted from a lack of appropriate platforms for disseminating the material or the need for further development or editing.

3. PROJECT EVALUATION

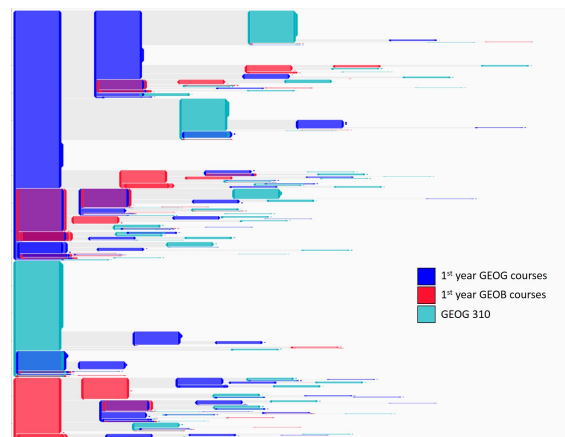
3.1. Project Outcomes

Project outcomes are challenging to summarize succinctly given the wide range of activities undertaken by the project team at the course, program, university, and disciplinary (ie. Environmental Studies and Geography) levels. However, key identifiable outcomes of the project that are beneficial to faculty and students are as follows:

- E&S Program Development:** Major program level outcomes include curriculum review and mapping that formed the basis for the implementation of significant changes to the E&S program, including the addition of two new courses (GEOG 313 & GEOG 314), the restructuring of degree requirements, and the creation of an E&S minor degree program. Other program level outcomes included: the implementation of eportfolios across multiple courses, creation of a “Trail Six” Undergraduate Journal of Geography website, and the creation of website to showcase undergraduate research. The project also contributed to advancements in the field of learning analytics through the innovative use of medical patient tracking software to map and analyse student pathways through undergraduate degree programs (Please see <https://open.geog.ubc.ca/student-enrollment-pathways-in-non-linear-university-programs/>).



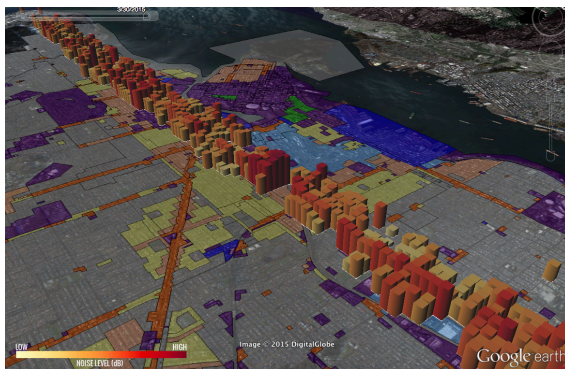
Student enrollments in courses organized according to program requirements. What this shows is that GEOG 350, though not a required course, is essentially taken by all E&S students; it deserves careful consideration.



Student enrollment pathways comparing 1st year Geography (GEOG) and Geographical Sciences (GEOB) courses and GEOG 310 (required course) from 2004 to 2014. This analysis shows that ~17% of students take GEOG 310 without having taken a first year GEOG or GEOB course.

1. **Open Educational Resources:** The creation of open educational resources (OER) available to other instructors and students at UBC and beyond that include (see section 2.1):
 - a. Open textbook on introduction to Natural Hazards
 - b. A virtual reality environmental fieldtrip of Stanley Park
 - c. Software platform for mobile technology assisted field trips
 - d. Annotated bibliography series on SOTL related topics of interest
 - e. Student generated environmental reference resources
 - f. QGIS learning modules.
 - g. Skills modules, Course Assignments, and Guides/Manuals

2. **Course Transformations:** The project resulted in a wide range of changes to core courses within the program (see section 1.4 above). These included: virtual fieldtrips, technology assisted field trips, open textbook resources, peer assessment, clicker questions, pre-class online reading questions, pre-class online assignments, online case studies and associated learning activities, course websites, paperless exams, two-stage exams, team based learning, open data assignments, the use of discussion forums, and different authentic learning and public scholarship oriented course assessments.



Urban noise mapping assignment in GEOG 311: Urban Environments. Students collect noise data along urban corridors using mobile apps, then using data visualization compare noise levels against demographic data, seen here as a colored map layer.



An example of a virtual fieldtrip for GEOG 316: Natural Hazards using interactive 360 photospheres. This is a high accessibility (creation and consumption), high flexibility, and lower interaction example of VR and AR content. The location is in Lion's Bay, BC. You can move the angle by using your mouse and click on the interactive elements or use Google Cardboard for a more immersive experience.

Course	Project Supported Faculty in achieving the following:
GEOG 103: Our Changing Environment: Water and Landscapes	<ul style="list-style-type: none"> • Course re-design: flipped classroom approach adopted and a suite of pedagogical strategies to engage students in the subject area. • Course changes included online pre-class reading questions, in class clicker questions, in class TA lecture assistance, flexible presentations, and online assessments.
GEOB 270: Geographic Information Science	<ul style="list-style-type: none"> • New online course environment • Online lab submission through Connect



<p>GEOG 211: State of the Earth*</p>	<ul style="list-style-type: none"> • New online course environment • Online pre-class reading quizzes and assessment using Gravity Forms • Development of in-class questions for use with iclickers • Online discussion forums for course content and FAQs using PulsePress • Staged final team project, including producing an infographic designed to contribute to public scholarship • Developed and implemented an online e-portfolio component to the course assessment (part of the Faculty of Arts initiative).
<p>GEOB 308: Quaternary and Applied Geomorphology</p>	<ul style="list-style-type: none"> • Quizzes for TED-Ed videos (ed.ted.com) • VR/AR geology field trips based on the in person and self-guided trip Michelle Koppes currently runs.
<p>GEOG 310: Environment and Sustainability</p>	<ul style="list-style-type: none"> • Online weekly pre-class reading quizzes in Connect • In-class questions for use with iclickers • New online course environment • Development of a staged team term project built around applied case studies on complex and contentious environmental challenges across North America and which engages students in public scholarship. • Development of an annotated bibliography assignment and associated supporting materials. • Development of an ePortfolio as a way of structuring and reflecting on learning and assessment in the course.
<p>GEOG 311: Urban Environments</p>	<ul style="list-style-type: none"> • Development of new course labs designed to apply course learning to real life urban environmental issues. • Development of two field-based “lab” activities that involve students in the collection and visualization of primary data on the urban environment. • Development of an augmented reality fieldtrip of Camosun bog (and other bogs from around the world).
<p>GEOG 312: Climate Change: Science and Society</p>	<ul style="list-style-type: none"> • Development of a Climate Summit Simulation to engage students in the process of climate change policy formation that ran in parallel to the course. • Creation of an online collaboration environment and repository of background and multi-media materials.
<p>GEOG 316: Geographic of Natural Hazards</p>	<ul style="list-style-type: none"> • New online course environment • a virtual reality fieldtrip of natural hazards along the Sea to Sky highway • Transition to a zero cost course for students: <ul style="list-style-type: none"> ○ Development of an open textbook that addressed physical processes covered in the first half of the course. ○ Additional reading content that could be made available through internet/library • Reading quizzes developed on course website using Gravity Forms • Online discussion forum and related activities established using PulsePress • Online final project report and infographic designed to engage students in public scholarship



	<ul style="list-style-type: none"> • Implementation of a two-stage exam
<p>GEOG 318: Sustainability in a Changing Environment</p>	<ul style="list-style-type: none"> • Design an Op-ed based assignment to engage students in public debates • Designed a written summary and critique assignment of course readings designed to practice critical thinking and academic writing skills. • Use of audio recorded student led group discussions in order to able to convene an 80 student discussion based seminar course. • New online course environment • Development of case study based learning module to support learning on the topic of biodiversity
<p>GEOG 319: Environmental Impact Assessment</p>	<ul style="list-style-type: none"> • New online course environment • Pre-class online quizzes developed in Connect • Design of a flexible final project delivered in multi-media format (video or powerpoint) • Use of discussion forums using PulsePress
<p>GEOG 327: Creating Canada</p>	<ul style="list-style-type: none"> • Complete revision to the structure of <i>GEOG 327</i> built around principles of critical inquiry based learning and flexible pedagogies as applied to the existing course theme. • Development of podcasts, online forums, and a student course guide.
<p>GEOB 370: Advanced Geographic Information Science</p>	<ul style="list-style-type: none"> • New online course environment • Development of two Open QGIS learning modules (A. Green & E. Liu) • Use of online discussion forums (PulsePress) • Development of pre-class online quizzes in Connect • Bringing in principles of Open Science and Public Scholarship through: <ul style="list-style-type: none"> ○ Re-designed labs to be based around the use of open data. ○ final group project using open data to analyze the ALR in BC as a form of student public scholarship <p>(http://environment.geog.ubc.ca/giscience/)</p>
<p>GEOG 379b: Field School in Human and Environmental Geography</p>	<ul style="list-style-type: none"> • Collaborated on the <i>Human and Environmental Geography Experiential Learning Initiative</i> led by Siobhan McPhee to develop a new field course for the Human Geography and Environment and Sustainability programs. • Designed and developed a regionally focused interdisciplinary geographic field course to fill an identified gap in experiential learning within the E&S program.
<p>GEOG 410: Environment and Sustainability</p>	<ul style="list-style-type: none"> • Redesigned the course content and approach: notably a medium size (50 students) seminar course made possible using a team based discussion format using audio recordings and written summaries for student reporting. • Student led course approach: students identify environmental problems to research as a class. • New online course environment • Development of case study based learning modules to support learning of core course topics

GEOG 446: Agriculture and Environment	<ul style="list-style-type: none">• Developed a new online course environment• Community engagement: Community based learning projects (2016/2017 collaborators were UBC SEEDS and the UBC botanical gardens)• Public Scholarship: public presentations of research (2016/2017 presented at the <i>Biodiversity Showcase March 2017</i>).• Due to the course structure, the students decide as a group what topics to be explored during the second half of semester. As a result, I designed 4 new seminars for GEOG 446 this year.
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3. **Capacity Building:** A large focus of the project was in capturing learning and building capacity, at both the Departmental and University level, to implement new pedagogies and work with new and emerging technologies. The Flexible Learning Project, with departmental support and the assistance of external funding (BCcampus), created a *Virtual and Augmented Reality Teaching and Learning Lab*. Equipment was purchased and a dedicated lab space was established in Geography for a) supporting the innovation and development of virtual and augmented reality educational resources by both faculty and students and b) geography students to engage in virtual reality based educational activities. This lab space is connected to existing computer labs to facilitate its use in teaching.

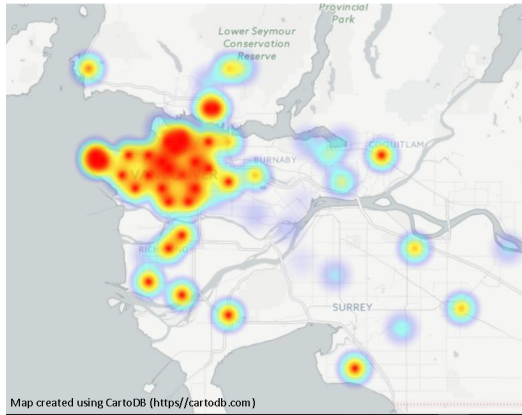
In addition to these, the project team participated in a wide range of formal and informal collaborative efforts with groups across campus and beyond, including: Faculty of Arts (e-portfolio project), UBC Studios [& the creation of the Emerging Media Lab], BC Campus (open education), Geological Association of Canada (VR/AR), Douglas College, UBC Learning Technology Innovation Committee, Metanuats, and offering informal support and advice to faculty across campus. Learning gained from the Flexible Learning in Geography project has spawned and/or contributed to a number of ongoing collaborative efforts and further external project funding opportunities, including the Department of Geography's current role in co-leading the development an undergraduate program in *Environmental and Earth Sciences* for the newly formed University of Central Asia funded by the Agha Khan Development Network.

3.2. Findings

The following presents an overview of initial findings relating to research conducted around three key project themes. Work on program and curriculum mapping and analysis resulted in a number of applied changes already discussed and not included in this section.

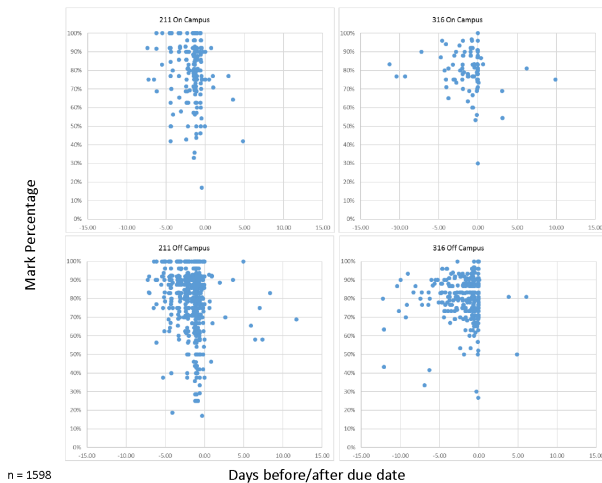
The Spaces and Places of *Flexible Learning* and does this impact learning? Flexible learning encompasses a wide variety of teaching philosophies and strategies centered on providing students with more responsibility, opportunity and choice in how, what, where and when they learn (Collis and Moonen, 2011; Arfield et al., 2013). As geographers, we were naturally curious about the where and when aspects of flexible learning, but found that both of these issues were not adequately addressed in the existing literature on flexible learning. The lack of evidence-based research on the impact flexible learning initiatives have on student flexibility and how this affects their learning is especially troubling given the amount of resources currently being devoted to introducing these approaches in institutions around the world. To investigate this, we used a combination of tracked IP addresses, time stamps, student surveys and focus groups to examine the places (e.g. home, campus, transport, or cafes) and spaces (e.g. distances

to university and spatial clustering of students) where students completed ‘flexible’ online assignments and how increased flexibility impacted their performance on these assessments.

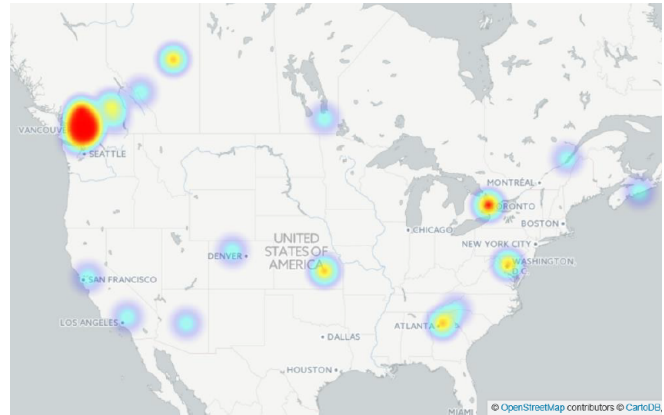


Above: Heat map of assignment submissions from lower mainland, n = 1556, showing 36.6% of students completed assignments on campus and the remainder off campus

Below: Assignment grade compared to when and where it was submitted



n = 1598

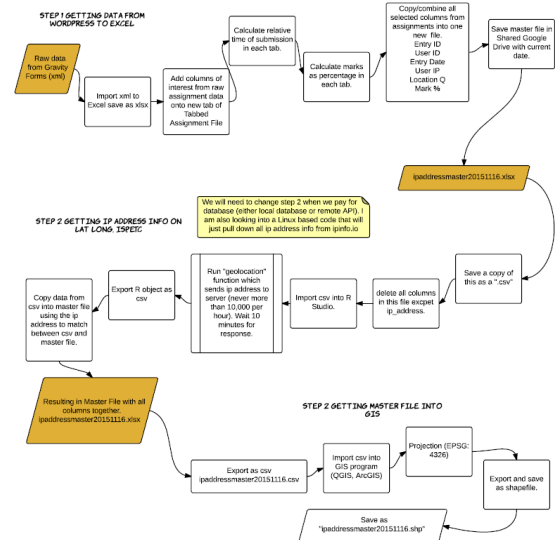


Above: Heat map of assignment submissions from North America, n = 1556

Below: Workflow for determining geolocation of assignments submitted through wordpress

WORK FLOW FOR GEOLOCATION

Giff, Derek, Ekisa on 17 Nov 2015

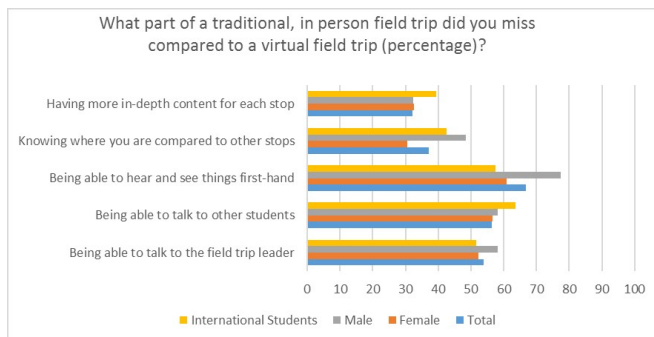


Overall, we found that increasing the flexibility of assessments resulted in a measurable change in where students completed their work compared to their predicted behaviour and that this increase in spatial and temporal flexibility had no significant effect on their performance or on the number of late assignments. These results that students respond to having more choice in where, when and how they work, allowing them to alter their study habits to better fit external demands on their time and space, and that the benefits of this appear to have no clear negative impacts on student learning.

Emerging Technology and “Flexible” Field Trips: Experiential learning gained through field trips has long been recognized as an effective way for students from a wide range of disciplines to gain hands-on experience in applying concepts and building new skills (Orion, 1993; Scare, 1997). Unfortunately, the resource intensive nature of field trips in conjunction with growing operational and budgetary constraints among higher education institutions have worked to severely limit the time most students get to spend in the field (McGuinness and Simm, 2005). Even where traditional field trips are available, many students find themselves unable to participate (e.g. disabled students, distant education students), which strongly suggests the need for more flexible field experiences (Atchison and Feig, 2011; Gilley et al., 2015). One

solution to these problems has been to develop “flexible” field trips, be they real, virtual, or blended, that students can experience on their own time and schedule. Such technology-assisted field trips are being adopted by institutions across North America, leading to the innovation of exciting new tools designed to overcome the limitations of traditional field trips (e.g. Stainfield et al., 2000). While this generates new and exciting opportunities for engaging students, the success of “flexible” field trips as measured by student learning hinges on informed design that applies sound pedagogical practice when leveraging new or existing technologies. In moving this debate forward, this research offers a preliminary assessment of the effectiveness of flexible field trips run by the UBC Geography program and suggests best practice in the design and delivery of blended field trips. Students responded well to both virtual and augmented reality field trips, though in both cases they

As part of the assessment for this field trip, we asked students for feedback on what parts of a traditional trip they missed on the virtual trip, how well the various components of the virtual trip helped replicate a traditional field trip and what advantages they found with the virtual version. Overall, the student response was positive, especially considering that this was a first attempt and there were a few technical problems. Students generally responded favourably to questions on scales of 1-5 about how much the field trip helped them learn about local natural hazards (4.0), how easy it was to navigate between stops (4.4) and how well the virtual field trip simulated a ‘real’ field trip (3.2). Interestingly, female students found minor technical issues somewhat or very distracting more commonly (33%) than male students (3%). Of the 66 respondents to the survey, roughly 50-65% of students identified one or more of “being able to talk to an instructor”, “being able to talk to other students” and “knowing where they were compared to other stops” as the things they missed most about not going on a traditional field trip.



Easy to complete from home, not too time consuming compared to a normal field trip
 I could do it on my own time and pace
 I didn't have to leave my house
 I'm super busy and this made it possible to have an engaging learning experience that was time sensitive
 Less stress
 Environmentally friendly

Left: What student's missed from a traditional fieldtrip when taking a virtual field trip.

Above: Student comments concerning what aspects of virtual fieldtrips they liked.

We also asked several qualitative questions about what they liked about the trip and what they would like to see changed. Besides students expressing overall enthusiasm about the delivery of images, video and audio content using novel technologies, the most common comments were that they appreciated the increased flexibility of the virtual field trip. Several of these comments aligned closely with our project's guiding principles. For example, one student commented that they were “able to learn about places that we may not feasibly been able to visit on our own time.” Many students enjoyed being able to do it at home and being able to re-visit sites multiple times at their own pace. One student expanded on this by saying that they are “busy and this made it possible to have an engaging learning experience that was time sensitive. Also, I'm a visual learner and I find that it's not often that students get to experience multi-media assignments.”



Both of these quantitative and qualitative data seem to justify spending the time and resources to incorporate more virtual and augmented reality field trips into the UBC Geography curriculum. These trips should not, however, be designed to replace traditional field trips entirely, especially those with small enough enrollment to allow valuable student-instructor and student-student interactions. Instead, they offer a potential way to increase the amount of field experiences undergraduate students get beyond existing options, or as a last resort in giving students time in the field if programs continue to be cut. With time, it seems inevitable that high quality, more immersive 3D augmented and virtual field trips will become more prevalent in higher education classrooms. Perhaps one day these technologies will enhance, or even replace, existing lecture formats. In the meantime, the goal should be to develop and test various formats to ensure they are maximizing the value to students, and can be shared openly between various educators and institutions around the world.

Open Education, Geography and Science: The open science movement responds to an urgent need to rethink the production and dissemination of scientific research in contemporary society. Open science emphasizes engaging with open source software, open data, open access publishing, and open notebook methods in order to increase public participation in and the transparency, public understanding, and policy impact of scientific research. While the open science movement has the potential to change ways in which research is undertaken, it also has significant meaning for pedagogic strategies. The movement towards open science impacts not just research, but also teaching and learning strategies in geography and allied disciplines. Research modalities affect research-based teaching strategies and institutional action - particularly in contexts that promote student involvement in research as a core learning strategy. We examined teaching in a time of disruption in higher education through an overview of open science issues in geography, the creation and deployment of open education resources, and a case study of the application of open science principles for teaching geographic information science. Our work overviewed how geographic research has been impacted by the open movement (e.g. open science). It then critically examined the potential possibilities and challenges open science poses for pedagogic practices in geography (e.g. open pedagogy and open educational resources). It concluded by examining the implementation of open science pedagogy through a case study. The case study involves an undergraduate course of over one hundred students working in teams to conduct open science, geographic information science research on British Columbia's Agricultural Land Reserve.

3.3. Data Collection and Evaluation Methods

We employed a wide range of data collection and evaluation methods in our efforts to answer research questions related to core project themes. The following section highlights key data collection and evaluation methods activities undertaken by the team.

Annotated Bibliographies: We set out to review the current state of knowledge in a number of key areas of research interest. With the help of RAs, we identified key words in these subject areas and searched academic journals, compiling a series of annotated bibliographies on: Virtual Field Trips, Learning Analytics, Social Media in the Classroom, Flexible Labour in the Academic Context, Flexible Learning, Open Science and Education.

Program/Curriculum Analysis: Data for our curriculum analysis included a data series of all students who majored in Environment and Sustainability since the inception of the program. This was anonymous data pulled from the central university databases that included a range of demographic information as well as



course enrollment information allowing us to track the “pathway” students take through the degree program. Surveys of competencies sought by key industry, civil society, and government employers who hire geography students was conducted with the help of Arts Co-op. Alumni surveys were conducted asking students to highlight program strengths and weaknesses. Data from surveys conducted with current students was incorporated along with current and historical data on program course offerings, program schedules, and prerequisites. This data was combined and analyzed using statistical software, social networking software (*Gephi*, *NodeXL*) as well as data visualization software (*Eventflow*, *Tableau Public*).

Where does learning occur: We recorded IP addresses of students accessing specific online assignments and course media in an effort to better understand where and what types of environments these students were learning in. We recorded when (time of day and how long before the deadline) work was submitted. We also included voluntary questionnaires in student assignments asking them to identify the type of environment they were in at the time they submitted their work. We then compared when and where students submitted their work with grades achieved (please see section 3.2). A number of problems arose with collecting of spatial data from IP addresses which limited the usefulness of this methodological approach. However, this did result in an in-depth look at the potentials and pitfalls of this methodology which was presented at a conference.

Virtual Fieldtrips: Data to better understand students learning experience when taking virtual fieldtrips a series of student surveys were conducted, with some questions asked during the fieldtrip and others after the fieldtrip had ended. These were qualitative questions asking students to provide their perception of virtual fieldtrips. We also collected data on the performance of students who completed the survey so that learning could be compared against a control group of students who take a live fieldtrip to the same locations. We have not completed the collection or analysis of this data.

3.4. Dissemination (Presentations, Workshops, and Exhibits)

Dyanatkar S, L Brown, et al. (2016) “Stanley Park VR/AR Demo - VR/AR - Enriched Community of Practice”, VR/AR Global Summit Pre-Event, The Cube, Vancouver, Sept 29th.

Green A, L Brown, and D Turner (2016) “EdTech Demo – FieldPress Demonstration Workshop”, BCcampus, Vancouver, Aug 29th.

Brown L (2016) “Using Virtual and Augmented Reality to Enhance Student Learning: Lessons from Geography”. *Virtual/Augmented Reality Showcase*, ArtsISIT, Sept 27th.

Brown L, A Green and D Turner (2016) “Using VR and AR in education: lessons from the Flexible Learning Project in Geography”. *Digital Media Community of Practice*, UBC (with UBCO), May 10th.

Brown L, A Green, D Turner, E Liu, M Katz, K Shen (2016) UBC Geography Flexible Learning Project” TLEF Showcase, Poster Presentation, Earth Sciences Building, UBC, May 5

Brown L, A Green, D Turner (2016) “Enhancing Learning In and Out of the Classroom: Using Virtual Reality in Higher Education”, *CTLT Spring Institute*, UBC, Vancouver, May 3rd.

Green A, S Hermansen, L Brown, and D Turner (2016) “The Pedagogy of Open Science: The ‘Open Turn’ and Research, Teaching, and Learning”, *CTLT Spring Institute*, UBC, Vancouver, May 2nd.



Brown L, A Green, D Turner (2016) "Student Led Technology Assisted Field Trips: Challenges, prospects, and best practices". *American Association of Geographers (AAG) Annual Meeting*, San Francisco, U.S., March/April 2016.

Turner D, L Brown, and A Green (2016) "Where in the World is Geographic Education? An examination of the spaces and places of learning". *American Association of Geographers (AAG) Annual Meeting*, San Francisco, U.S., March/April 2016.

Green A, S Hermansen, L Brown, and D Turner (2016) "The Pedagogy of Open Science: Impacts of the 'Open Turn' on Geographic Research, Teaching, and Learning". *American Association of Geographers (AAG) Annual Meeting*, San Francisco, U.S., March/April, 2016.

Brown L, A Green, M Katz, Y Shen, and D Turner (2016) "Expanding the classroom: The Why, When and How of using Virtual Reality in Education". *Festival of Learning*, BCcampus, Vancouver, June 2016.

Turner D, L Brown, A Green, and M Katz (2016) "How Flexible is Flexible Learning?". *Festival of Learning*, BCcampus, Vancouver, June 2016.

Brown L, D Turner, A Green (2015) "Flexible Field Trips: Exploring Best Practices in Emerging Student-Led Technology Assisted Field Trips". Symposium, Scholarly Teaching & Learning in Post-Secondary Education, Vancouver, November 2015.

Green A, L Brown, D Turner (2015) "Where in the world is flexible learning? An examination of the spaces and places of learning. Symposium, Scholarly Teaching & Learning in Post-Secondary Education, Vancouver, November 2015.

Turner D, L Brown, A Green (2015) "Using backchannel technology to enhance large lectures". Symposium, Scholarly Teaching & Learning in Post-Secondary Education, Vancouver, November 2015.

Brown L (2015) "Problem Based Learning in Geography Higher Education: Theory and Practice". *American Association of Geographers (AAG) Annual Meeting*, Chicago, U.S., April 2015.

Brown L, H Dorries (2014) "UBC Geography Flexible Learning Project" Flexible Learning Open House, Poster Presentation, UBC, June 10

An array of additional informal presentations at various events across campus communicated the project's goals and progress to the UBC teaching and learning community.

4. TEACHING PRACTICES

Teaching Practices have changed, in some cases dramatically, among key faculty in the E&S program as a result of this project. The use of pre-class learning materials, activities, and quizzes to promote focused engagement with the readings prior to lectures or seminars have been adopted across many of the core courses, and have allowed instructors to better gauge student understanding of the key concepts and content being explored. We have also seen the use of more interactive teaching techniques and technologies in large enrollment classes as a result of the project. The use of small group discussion, often supported by class surveying tools such as iclickers, has allowed for more feedback and greater engagement of students in large enrollment courses. The project has also led to a move toward more formative modes of course assessment (multi-staged



projects, team based learning, authentic learning assignments, debates, panels, reading responses, and even two stage exams). Public scholarship and more authentic learning opportunities have also been implemented across a number of courses. These include getting students to work with open data on real world policy issues (ex. Agricultural Land Reserve) or work on public resources (ex wikis) or to disseminate their research (ex writing Op-eds). As a result of the project, a number of courses have also switched to the use of open educational resources, both existing and newly created by the project team, or resources that are freely available to students through the library. That said, we still do use commercial textbooks or other paid resources when and where these significantly enhance learning. Faculty involved in the project have learned how to use virtual and augmented reality to develop simulations or technology assisted field trips as a way of engaging students in field work related experiences and exercises. The informal and formal dissemination of our experience with these teaching approaches has been ongoing within the department, the university, and the wider geography/environmental studies community. Formal dissemination includes workshops and the creation of the virtual and augmented reality lab. Informal dissemination has occurred through sharing project activities with networks on and off campus. The impact of such informal networks on shifting the culture of teaching is hard to measure, and yet anecdotally we have seen our experiences and successes inspire others to adopt similar approaches.

5. PROJECT SUSTAINMENT

Despite the changes to teaching practices among many of the core faculty in the E&S program, there is a very real risk that this could stagnate or that faculty could even fall back into poor teaching habits. This risk stems in large part from the lack of time, resources, or discipline specific support available to individual faculty for ongoing review and renewal of their teaching. The department has sought to institutionalize its commitment to undergraduate teaching innovation and renewal in the E&S program through:

1. A half-time staff position in Geography was created to support the use of media, narrative, and visualizations in teaching and research.
2. The virtual and augmented reality lab was expanded to incorporate additional media technologies for use in research and teaching. We have secured a larger space and funding for equipment.
3. A new hire was made in the teaching faculty stream.
4. A coordinated curriculum review process, which has culminated in significant curriculum changes to the E&S major as well as the creation of an E&S minor (in process).
5. Creation of a committee to establish a five year vision for the E&S program.

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