Student Perspectives on Wireless Communication Technologies to Facilitate Inclusion in Field Activities

THATCHER, Sean, Department of Engineering Sciences and Physics, The City University of New York, College of Staten Island, **VINSON**, Grant, Earth & Environmental Sciences, Michigan State University, **HADDOCK**, Amanda, Geology, Dickinson College, **TODD**, Anna C., Geological Sciences, University of Colorado Boulder, Boulder, **O'BRIEN**, Mathew, Geoscience, University of Calgary, **PRITCHARD**, Caroline E., Earth and Environmental Sciences, Lehigh University, **SULLIVAN**, Betty, Geology, Lake Superior State University, **MILLER**, Leah Z., Department of Physical Sciences, Tarrant County College, **THOMAS**, Christian, Department of Geological Sciences, Ohio University, **KILPACK**, Will, Earth & Space Exploration, Arizona State University, **MORRIS**, Malea, Earth and Environmental Sciences, University of Kentucky, **WHITMEYER**, Steven, Geology & Environmental Science, James Madison University, and **ATCHISON**, Christopher L., School of Education and Department of Geology, University of Cincinnati; sean.thatcher1990@gmail.com

International Association for Geoscience Diversity
www.theiagd.org

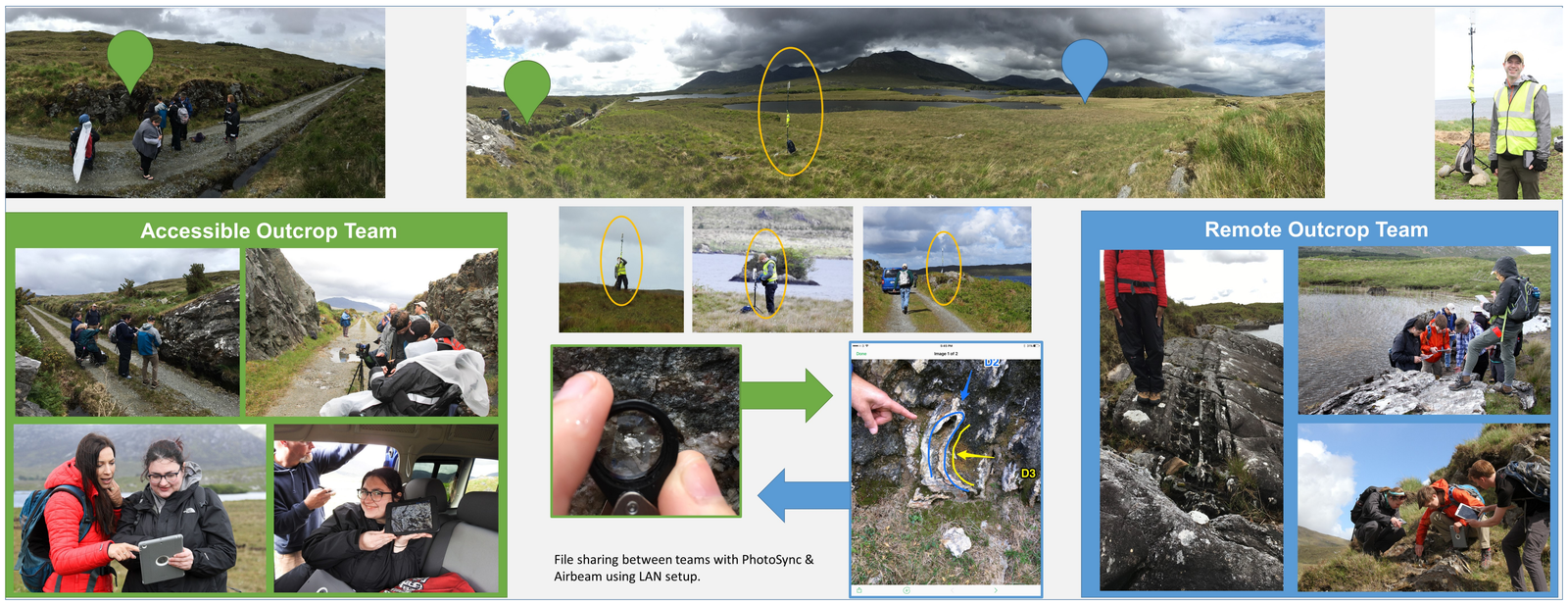
Abstract

Field research for students with physical disabilities can be difficult because of the inaccessibility of most natural field locations. Although a student may have difficulties physically reaching a field location, he or she can still be involved in research initiatives by accessing the field site remotely by utilizing new technologies to participate and record observations. Remotely accessing physically inaccessible field locations can greatly influence future field research initiatives. A two year GEOPATH project in 2016 and 2017 led by a team of researchers associated with the International Association for Geoscience Diversity and funded by the National Science Foundation, brought together a cohort of undergraduates with and without physical disabilities to better understand how new field-based communication technologies can improve inclusion of all students in the natural environment. Although there was limited success with typical communication devices such as walkie-talkies, the most success was found with the implementation of several Local Area Network towers which provided students with the ability to live-stream from one field location to another. In addition, the use of video cameras to record inaccessible field locations, and mobile devices to instantly share and annotate images made remote access an appealing and practical option. These technologies increased inclusion for students with physical disabilities, promoted increased social interaction between students, and emphasized the importance of collaboration, both within and between groups.

Introduction

Field research is an important component for all geoscience programs, but for students with physical limitations it can be difficult due to the natural inaccessibility of many field locations. A two year GEOPATH project in 2016 and 2017 led by a team of researchers associated with the International Association for Geoscience Diversity and funded by the National Science Foundation, brought together a cohort of undergraduates with and without physical disabilities to better understand how new field-based communication technologies can improve inclusion of all students in the natural environment. During the two years of the project, undergraduates spent 10 days in Arizona in 2016 and Western Ireland in 2017 to trial typical field based communication technologies and more modern communication to understand the benefits and limitations for inclusive field research endeavors. Some of the locations visited in Arizona included the Grand Canyon, SP Crater, and Meteor Crater, while in Western Ireland field locations included Killke, Renville Point, and Connemara Recess.

Throughout these experiences students worked in groups composed of physically abled and disabled students to encourage share information from locations that were inaccessible for some group members. While in Arizona the technologies used were those typical of many field research experiences including mobile hotspots on select iPads for students to connect to and walkie talkies, while in Western Ireland LAN - local area networks - were used to allow students to instantly livestream videos from inaccessible locations at the field sites share photographs with other group members.



Results

Methodology: A survey was conducted after the field experiences to better understand the students perspectives on the technologies used, if they believed that they helped promote inclusive field research experiences, limitations of the technologies, and suggestions to further increase inclusion for all physical ability levels of students in the geosciences. Students rated their personal satisfaction with the technologies used, the technologies they believed were most effective, and the field locations that benefitted the most from these technologies on a 1 to 10 scale, and were then asked to briefly describe their rationales to provide a better understanding of their reasoning. The data was then averaged on the scale to visually represent on graphs, while student responses were then organized into tables to emphasize the pros and cons of these technologies and their relationship to inclusion in field research initiatives.

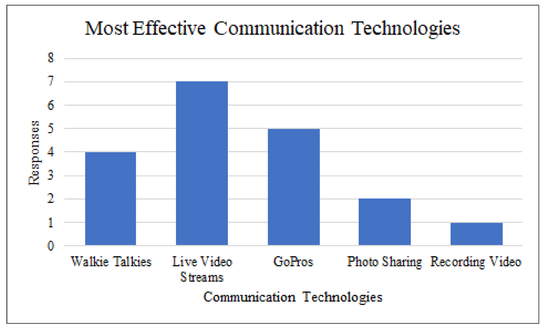


Figure 1: The most effective communication technologies used in the field during the two year period of the GEOPATH project. Live video streams and GoPro recordings were determined to be the most effective in the field, while asynchronous video recordings and photo sharing of features up close to the out crops and photo sharing were also effective during this process - especially during periods of technological issues or poor weather conditions. Walkie talkies were also viewed as effective during these experience, but to a lesser degree than more current field based communication technologies.

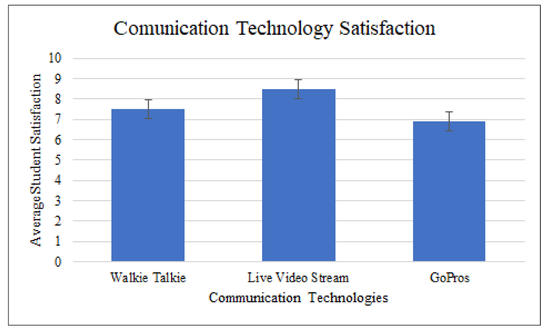


Figure 2: Average satisfaction of the most effective communication technologies based upon student responses from the survey with standard error. Live video streams had the highest average satisfaction on a 1 to 10 sale, followed by walkie talkies, and GoPro video recordings.

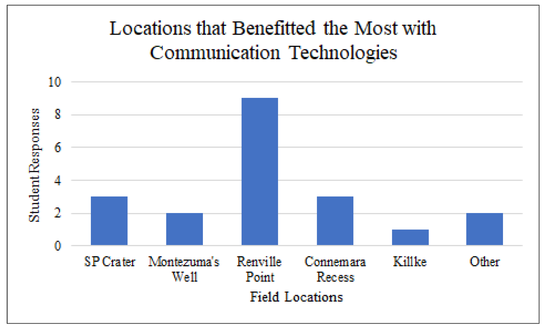


Figure 3: Locations that students believed benefitted the most from utilizing wireless communication technologies. Students believed that the used wireless communication technologies were most beneficial at Renville Point in Ireland, followed the Connemara Recess region in western Ireland, then SP Crater in Arizona. Other locations could include several different locations in either Ireland or Arizona, but responses were not specific.

Technological Pros and Cons

Pros	Cons
Being able to connect with others in real time.	To use these technologies to the fullest potential, a strong WiFi signal is required.
Efficient data collection within the student's physical ability level.	Distance from mobile hotspots/towers, along with limited battery life.
Eliminates physical barriers for physically disabled students.	Steep learning curve if inexperienced with new technologies.
Encourages students to become more active in learning, rather than taking a backseat in educational activities.	Time to troubleshoot inevitable bugs - not connecting to devices, lag times, and other technological issues.

Table 1: A summary of student responses discussing the pros and cons of wireless communication technologies in field research settings. The benefits included increased efficiency, encouraged active involvement amongst students during activities, real time communication, and dismantled exclusive barriers for students with physical limitations. The disadvantages included high costs, difficulties if not familiar with technologies, dependence on a strong WiFi signal, and

Pros and Cons for Inclusion

Pros	Cons
Emotional satisfaction knowing that you were able to participate in something that you would not physically be able to independently.	Training on how to use these technologies is imperative for student engagement.
Encouraged conversations amongst students with different educational levels and backgrounds.	Highly expensive for individual students or departments to buy without funding.
Provided students with the ability to engage in conversations by recording them and to take notes later as a group.	Lag between technologies could make inclusion difficult.

Table 2: A table of student survey responses describing the pros and cons of using wireless communication technologies to promote inclusive practices in field research. Students expressed that it created a positive atmosphere for sharing ideas, a less stressful way to take notes because of the ability to record lengthy conversations to refer to, and satisfaction by being able to work independently. Students also expressed the need for training on how to use the technology is required, high prices could be unattainable for many stu-

Discussion

On a 1 to 10 scale, students experienced an average satisfaction of 8.9 for the two years of the project in regards to utilizing wireless communication technologies in field research to improve inclusion for students with physical disabilities. The high satisfaction amongst students can be observed when comparing the high satisfaction for walkie talkies, live video streams, and GoPros in Figure 2 and the communication technologies used in Figure1. The students determined that these technologies were beneficial in an educational environment because it allowed them to engage in conversations about field locations despite the locations accessibility, created an active learning environment the promoted student participation, and crowdsourced data collection allowed large areas - specifically Killke - to be analyzed in a short amount of time - Table 1. It is also worth noting that live video streams were more preferable than the more commonly used walkie talkies in field research because it allowed students that could not physically access the locations to observe outcrop features in real time alongside their peers, rather than hearing about them. From an inclusion perspective these technologies assisted in bridging educational gaps between lower level undergraduates - freshman and sophomores - and upper level undergraduates - juniors and seniors - and educational backgrounds, provided emotional gratification for students with physical limitations that would not be able to participate in field activities like this without these technologies, promoted interesting conversations about field locations in real time, and eliminated some stress because conversations could be recorded and referred back to when making notes - Table 2. Despite the overwhelmingly positive experience, cons that were identified in this experience related to technology use included a strong WiFi connection, required students to remain in close proximity to mobile WiFi towers, and inexperience with some of the technologies - Table 1. It is also important to recognize several limitations concerning these technologies from an inclusion standpoint such as the costs of equipment, time delays in video streams, and the battery life of devices - Table 2. To combat these issues we recommend that students participate in a workshop prior to field research learn how to utilize these technologies to better understand how they operate, set time aside to compare notes after significant video delays, and the development of technological empathy when troubleshooting issues concerning how to use new technologies in novel ways.