



# Differences Between Digital and Classical Field Notebooks for Inclusive Geoscience Programs

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## Abstract

Field notebooks are an instrumental tool for geologists. However, they pose challenges for students with physical disabilities, mainly related to limited fine motor skills or because of the need for assistive mobility devices to navigate field sites. Students with diverse physical abilities cannot always effectively handle the pencil and paper approach to typical field notebooks. A GEOPATH project 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 examined the use of iPads and other mobile technologies to record field observations on projects ranging from stratigraphy to field mapping. These trials occurred in northern Arizona in 2016 and western Ireland in 2017. Throughout each of the projects, several advantages and disadvantages of electronic field notes were observed, ranging from functionality to cost. The benefits included rain resistant notes that were stored and shared in the cloud, the ability to annotate images to immediately add to notes, carrying fewer tools due to available apps, and GPS services to accurately determine exact outcrop locations. Several disadvantages were also noted, such as the cost of the iPad and apps, battery life, sun glare, and the technological competency of users new to utilizing mobile devices. Despite these disadvantages, this novel approach to a classic field task successfully improved student engagement, allowing them to equally participate alongside their peers.

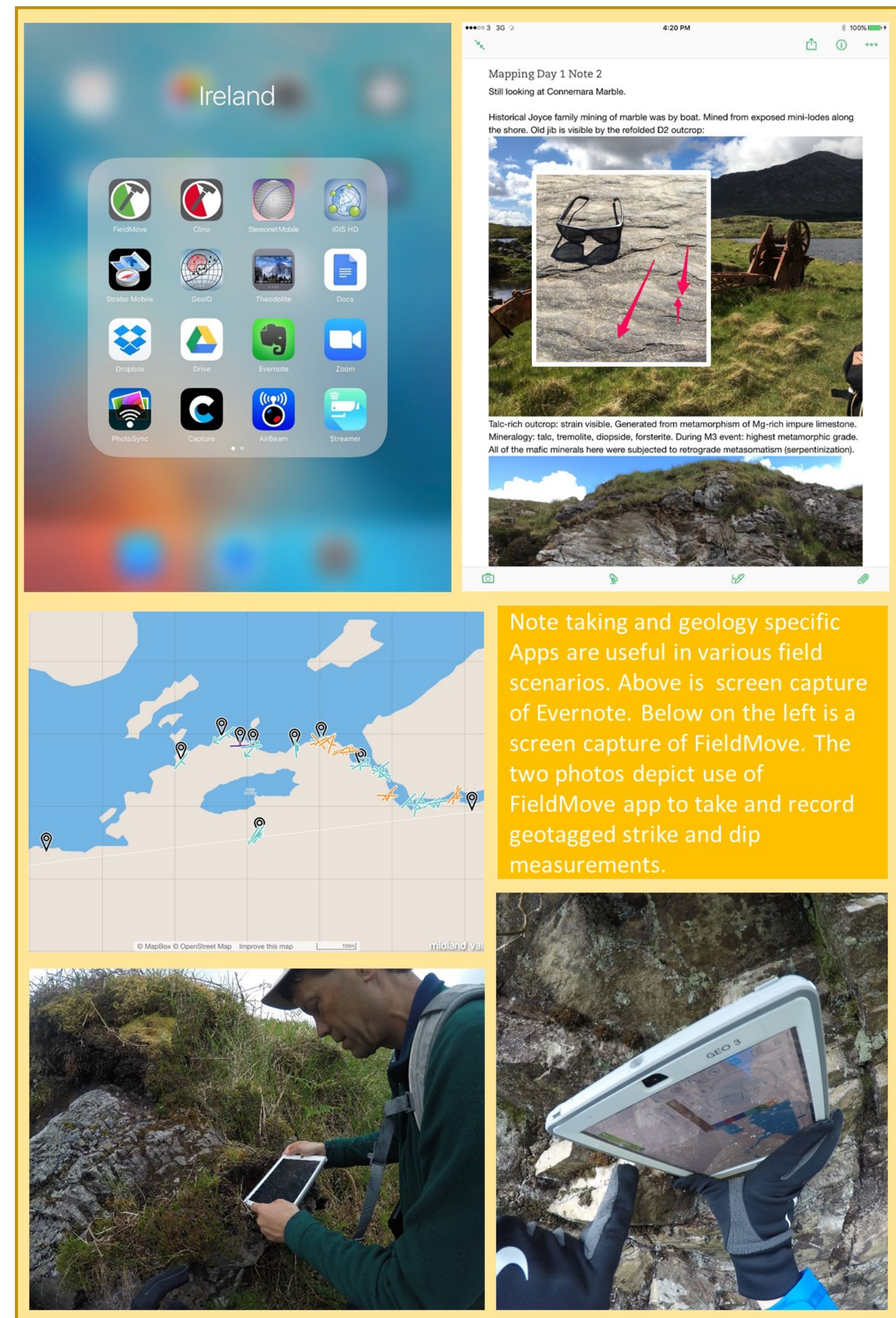
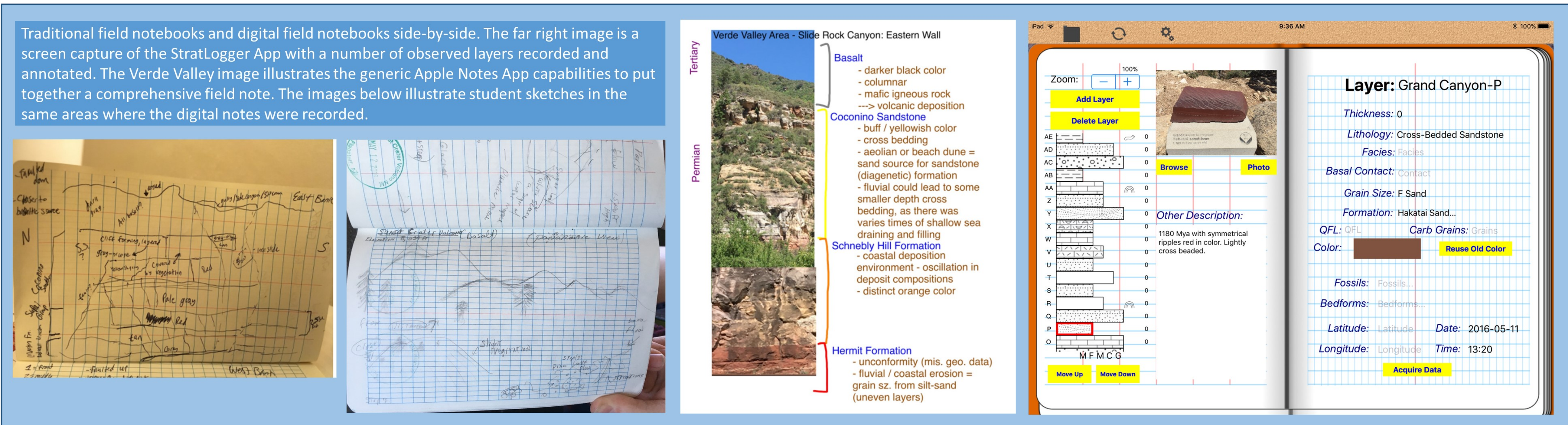
## Introduction

Field research is an important component for all geoscience programs, but for students with physical limitations it can be difficult to record notes using classical field notebooks due to using mobility devices to navigate the difficult terrain 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 compare classical field notebooks to modern digital notebooks to determine its effectiveness at promoting inclusion. During the two years of the project, undergraduates spent 10 days in Arizona in 2016 and 10 days in Western Ireland in 2017 to determine the benefits and limitations of iPads 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. Students participated in several activities to observe their effectiveness of these devices in field exercises – specifically stratigraphy, field mapping, data collection, and note taking.



GEOPATH group photo, Western Ireland 2017, Phoenix Arizona 2016.

Throughout these experiences students worked in groups composed of students with and without physical disabilities to encourage students to work together to understand geological structures and complete various exercises. StratLogger, an application used to create stratigraphic columns, was used to describe the stratigraphy of the Grand Canyon while traversing the Trail of Time. FieldMove, a digital field mapping tool, was used in the Connemara Recess region of Ireland to collect geologic information (i.e. strikes and dips), and to construct a digital field map. Several note taking applications were also used – specifically Evernote and Google docs, and Apple iPad Note app– to assist students with data collection in the field.



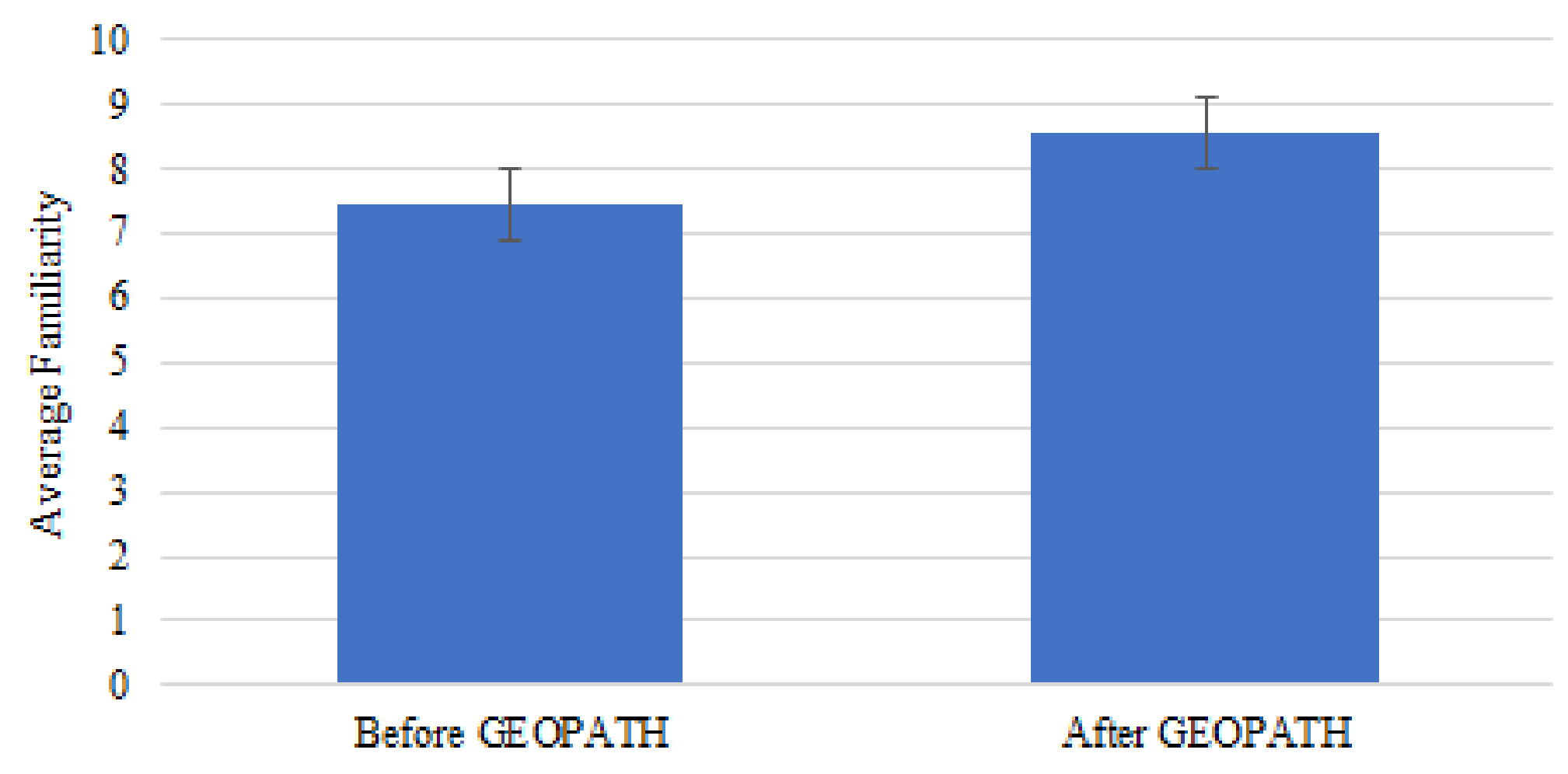
## Digital Vs. Classical Field Notebooks



## Methods

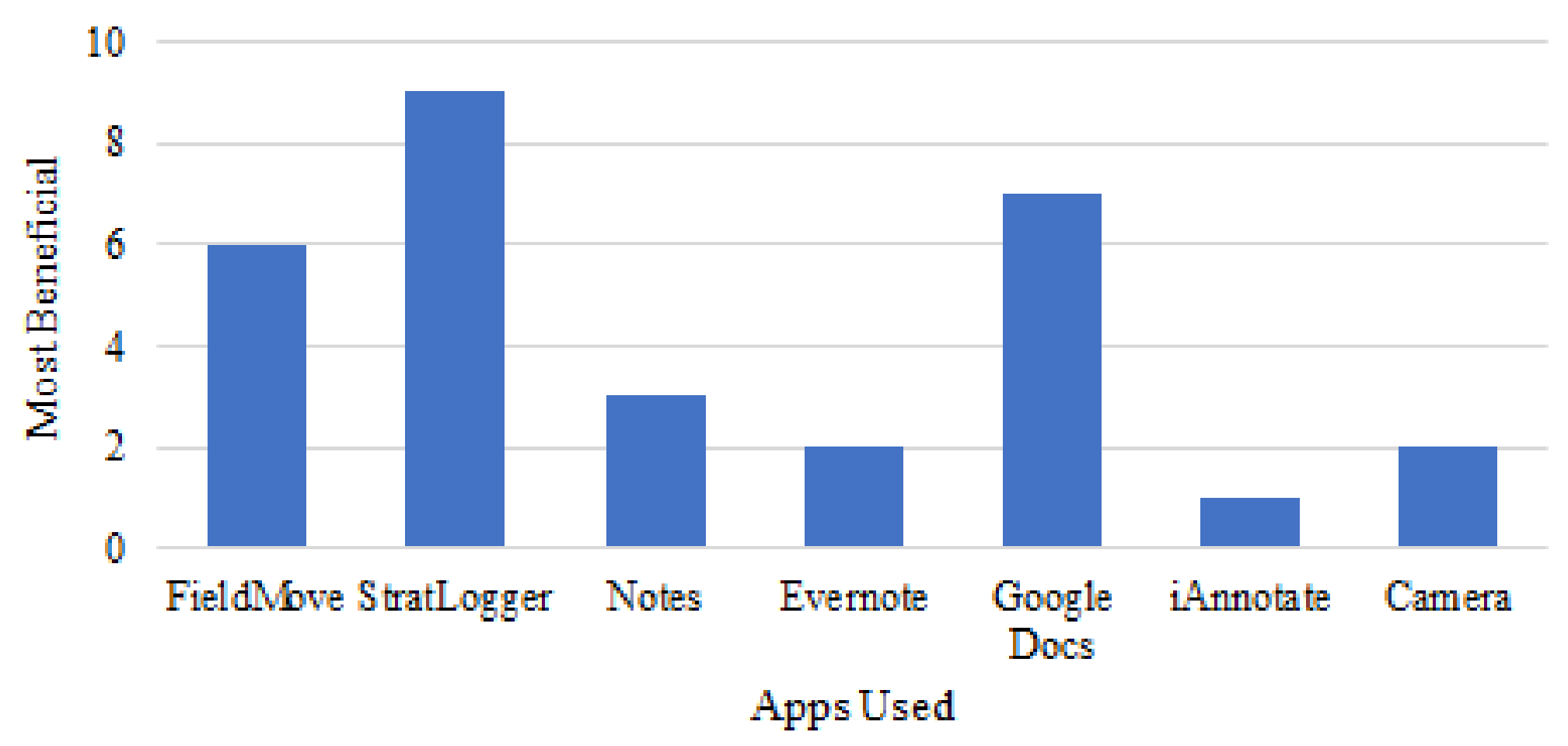
**Methods:** A survey was conducted after the field experiences to better understand the students perspectives on the effectiveness of digital field notebooks, if they believed that they helped promote inclusive field research experiences, limitations of these notebooks, and suggestions to further increase inclusion for all physical ability levels of students in the geosciences. The survey consisted of 17 questions. Familiarity and comfortability questions were rated on a 10 point scale; short answer spaces were provided for responses focused on specific likes/dislikes or advantages/disadvantages; and multiple answers could be chosen for questions asking which apps worked better or worse for specific tasks.

Average iPad Familiarity Before and After Projects



**Graph 1:** Average familiarity with iPad usage prior to and after the GEOPATH project on a scale of 1 to 10. A 13% increase of familiarity prior to GEOPATH 2016 and post GEOPATH 2017 was found (7.4/10 familiarity prior to and 8.5/10 familiarity post GEOPATH experience). This suggests that students are capable of learning and building comfortability with new technology in the field in relatively short periods of time with moderate assistance.

Applications Students Believed were Most Beneficial



**Graph 2:** Student perspectives on the most beneficial apps used during the two years of the GEOPATH project. StratLogger and FieldMove were believed to be the most useful during the project for specific exercises, while Google Docs was more preferred than Evernote for recording notes throughout the project.

Student Perspectives on How Note Taking Apps Promoted or Discouraged Inclusion	
Promoted	Discouraged
Increased students ability to combine their notes and collaborate with others to meet learning goals	Dependence on strong and reliable signal (Wifi or Cellular) to facilitate communication and thus collaboration
Removed physical barriers for students with limited fine motor skills - touch screens, voice dictation, etc.	Intermittently required students to depend on others to take photos, videos, or use other app features due to limited physical access to some outcrops
Allowed images of outcrops to be added and annotated efficiently with group members	Difficult to use if unfamiliar and inexperienced with mobile technologies
Enabled students with limited field experiences to readily look up new terminology	Technologies are expensive and unattainable for low socioeconomic persons and groups
Efficient data collection via Dropbox file sharing, GPS tagging, and crowd sourcing methods	Limited storage capacity of the iPad and note taking apps, especially with free versions of apps and cloud sharing storage sites

**Table 1:** A summary of student responses discussing how note taking apps on the iPad either encouraged or discouraged inclusion for students with physical limitations. Responses were collected via survey through short answers provided by each student and consolidated to five points either by repetition of responses or combining multiple responses into one idea.

## Discussion

Inclusivity of those managing physical barriers and disabilities should be taken into account by those without physical disabilities. Technology can help to promote inclusivity by providing a diversity of methods to incorporate various needs and accommodations. Digital field notebooks are a great first step down the path of inclusion because it provides the basic tools one needs to complete a broad range of geoscience field research tasks such as measuring planar and linear features, mapping, notetaking, sketching, and annotating. Relating to Table 2, there are plenty of negatives that come along with any research tool. However, there are easy ways of mitigating these cons, such as sun glare resistant screen protectors for iPads, online tutorials for iPad and iPad app usage and the use small, lightweight portable chargers or solar chargers into the field.

Technological Pros and Cons of Digital Field Notebooks	
Pros	Cons
Made organizing notes easier and more efficient, as well as legible	Remembering to charge the iPad the night before
Convenient collaboration via WiFi and 4G connectivity	Can cause eye strain form light, may require screen-time breaks
Numerous tools included with iPad's - camera, word processor, GPS, voice recorder, etc.	Sun glare, bulky, overheating, water protection
Facilitated conversations between students and groups with different technological aptitudes	Cumbersome to use without being instructed on proper usage
Customization options for text size, colors, sketching, edits directly on images, etc.	Expensive

**Table 2:** Summary of student responses about the pros and cons relating to iPad use as a digital field notebook. Responses were collected via survey through short answers by each researcher and consolidated by repetition of response or by combination of multiple similar responses into one idea.