# Increasing Awareness of Geoheritage Sites & Earth Science Literacy Through Teacher Developed EarthCaches

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A Mathematics and Science Partnership of Grand Rapids, Jackson and Kalamazoo Public Schools and Michigan Tech

## EarthCaching in Michigan: Geoheritage Sites & Earth Science Literacy

Creative thinking coupled with effective communication between the public, scientists and decision makers based on a solid understanding of Earth Science is necessary for tackling the many challenges faced by society. Unfortunately there is a broad absence of Earth Science literacy in the general population. Geoheritage and other geologically significant sites have the potential to increase literacy by engaging citizens in geoscience concepts through culturally relevant, place-based examples that evoke emotional attachments in individuals.

### 50 new EarthCaches have been Developed in Four Regional Areas

**City of Houghton**
Urban Areas provide opportunities to connect geoscience concepts to the places we live & are familiar to us

**Michigan National Parks**
The natural beauty of Michigan's Parks create emotional connections to geologically shaped landscapes

**Keweenaw Peninsula**
The historical landscape of the 'Copper County' provides visitors with vivid images of our cultural ties to geology

**Southern Michigan**
The Lower Peninsula's glacial landscape builds awareness of important geoscience features beyond typical rock outcrop examples

### Over 350 community members have visited Michigan geoheritage sites through EarthCaches published on the geocaching Website


EarthCaches are virtual caches located on the geocaching.com webpage and are reviewed by the Geological Society of America (GSA) before being published to ensure the quality of scientific information.

Each EarthCache contains GPS coordinates to a geologically significant place, a scientific explanation of the feature, and an educational 'logging' task.

Visitors use handheld GPS units to locate EarthCaches almost like a treasure hunt where an 'Earth lesson' is the treasure.


## Research Design Overview

### Research Questions

- How does visiting regional EarthCaches & developing an EarthCache as part of a Science Teacher Professional Development improve teachers': geoscience content & skills, scientific inquiry/practices skills and place-based pedagogy?
- Do EarthCaches made by teachers create valuable resources for (formal & informal) earth science education?

### Methods

| Outcome Measured | Mixed Method Design | | | | | | |
|---|---|---|---|---|---|---|---|
| | Pre/Post Visiting EarthCache Survey (n=29) | Site-Specific EarthCache Surveys (n=42) | Post-EarthCache Development Survey (n= 35) | Focus Group (n=29) | Archival analysis of Published EarthCaches (n=42) | Analysis of visitors on geocaching Website (n=307) | Semi-formal Interviews (n= 10*) |
| Earth Science Knowledge | | X | X | X | X | | X |
| Scientific Inquiry Skills | X | X | X | X | X | | X |
| Place-Based Instruction | | X | X | X | X | | X |
| Educational Resources | X | X | X | X | X | X | X |

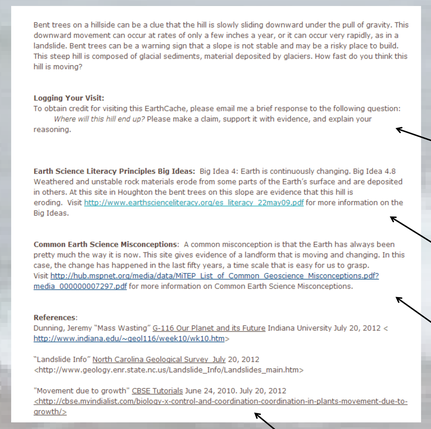
## "MiTEP" Style EarthCaches: How are teacher developed EarthCaches different?


All MiTEP EarthCaches follow GSA & geocaching guidelines

Scientifically oriented questions guide EarthCache Investigations

Includes images & models to help visitors conceptualize geologic concepts

K-12 educators are skilled at explaining complex ideas in everyday language




Logging questions which promote scientific inquiry skills

Focused on Connecting Earth Science Literacy Principles to Local Place- Based Examples

Address Common Misconceptions in Earth Science

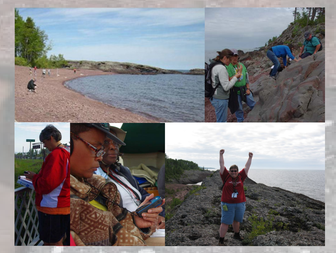
Educators are supported by experts throughout the EarthCache development process

Provides the chance for teachers to participate in the "peer-review" process

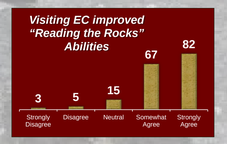
## MiTEP EarthCache Model: Exploring Geoheritage sites during Teacher Professional Development

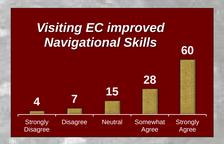
Geologically significant places exist within, or nearby, most communities but may not yet be designated as Geoheritage sites. These special places can be valuable resources used to engage K-12 students in geoscience topics if integrated into existing curriculum. However, many teachers charged with geoscience instruction lack awareness of these sites, pedagogical experience of using place-based examples or a firm background in Earth Science concepts.

### Phase I: Visit EarthCache Sites during Professional Development



In-Service teachers visit Geoheritage sites during Summer Field Institutes by exploring existing EarthCaches. Integrating EarthCaching into professional development activities provides a guided inquiry experience to learn Earth Science concepts and navigation skills.

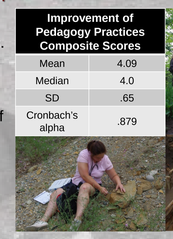


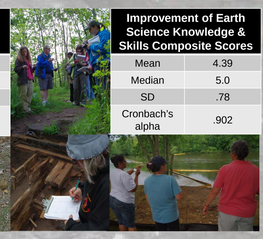




### Phase II: Teachers Develop an EarthCache

Teachers visit geoheritage sites with experts during field courses or National Park internships. Later they develop a "MiTEP" EarthCache that connects to the K-12 curriculum. The experience of developing a "MiTEP" EarthCache deepens teachers' understanding of earth science concepts, engages them in scientific practices and provides authentic pedagogical experience in Place-Based & Inquiry-Based instruction.

| Improvement of Pedagogy Practices Composite Scores | |
|---|---|
| Mean | 4.09 |
| Median | 4.0 |
| SD | .65 |
| Cronbach's alpha | .879 |





| Improvement of Earth Science Knowledge & Skills Composite Scores | |
|---|---|
| Mean | 4.39 |
| Median | 5.0 |
| SD | .78 |
| Cronbach's alpha | .902 |

### Phase III: Using EarthCaches as Classroom Resources

A number of MITEP teachers have adapted EarthCaching to fit into their K-12 classrooms. These experiences allow students to explore concepts through place-based instruction centered around Geoheritage sites instead of textbook examples.


## Results:

Effects on Teacher Participants: 1) improved geoscience knowledge & skills 2) development of place-based pedagogical skills 3) raised awareness of geoheritage sites

EarthCaches as Educational Resources: 1) Integration is limited in formal K-12 schools to those teachers with resources to implement (equipment, class size, class schedule)
2) General public visitors demonstrate increased understanding of geoscience processes & awareness of regional geoheritage locations

### Supporting MiTEP Partners:

Midwest National Parks, American Geological Institute, Grand Valley State University, Western Michigan University, & Grand Rapids Area Pre-college Engineering Program

### Websites for Further Information:

**MiTEP EarthCaches: mitep.mtu.edu**
**Geocaching: www.geocaching.com**
**GSA EarthCaching Program: earthcache.org**

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