Considerations for Adopting Mobile Digital Technologies to Enhance Outdoor Education

NAAEE Virtual Conference 2017

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Our Mission

STROUD™ WATER RESEARCH CENTER

To advance knowledge and stewardship of freshwater systems through global research, education, and watershed restoration

Photo: Marissa Morton
LEED Facility
1800 ACRES EXPERIMENTAL WATERSHED

Moorhead Environmental Complex, 2012
Upham Woods

Upham Woods
Outdoor Learning Center

“These lands are to be used as an outdoor laboratory and camp for youth, such as 4-H clubs and other people cooperating with the University of Wisconsin in the advancement of conservation, of agriculture and rural culture.”

—Elizabeth and Caroline Upham, 1941

For more information, please contact Upham Woods at:
608-254-6461 or uphamwoods@ces.uwex.edu
http://fyi.uwex.edu/uphamwoods/

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Upham Woods
Upham Woods
Tech it Outdoors?

PLUS
Technology that Enhances Outdoor Learning | Eco-Justice Education
An Urban Forest After-School Program | Education with a Human Focus
Learning through Role-Playing | An Intergenerational Empathy Game
Why do we tell stories?
- To educate
- To entertain
- To share ideas
- To remember

What does it take to tell a scientific story?
- Use the data and observations we collect to answer a question.
- Teach others about our discovery by sharing the story of our study, our results, and photos or videos of the process.

What makes a scientific study?
- Answer questions
- Create a hypothesis
- Collect data
- Make observations
- Make measurements
“The exploration of nature should be a critical component of education.”

–David Sobel, 2015
"In order to engage learners, educators must first be able to recognize and navigate in the learner’s own landscape."

- Jan Visser, author of Learners in a Changing Learning Landscape (2008)

“Digital Natives”: The generation of youth who have developed learning strategies shaped around the use of technology.

(Prensky, 2006)
“Many educators believe that the most feasible learning activities of natural science is **outdoor inquiry**, which takes science investigation outside the classroom.” (Liu 2009)
Place-based education provides a way to understand new concepts through making connections with relevant locations.

- “...this approach to education increases academic achievement, helps students develop stronger ties to their community, enhances students’ appreciation for the natural world, and creates a heightened commitment to serving as active, contributing citizens.” (Sobel 2004)

- “Place-based teaching includes all learners as they connect new science-related ideas to community-based experiences. We adopt the view that place-based learning can connect out-of-school learners to their communities.” (Zimmerman 2014)
Liu studied the use of mobile technologies in an outdoor lab setting, with students using mobile computers to enhance their lesson, finding that 49% of students “felt that their opportunity to use a tablet PC throughout the learning activities was a source of motivation.” (2009)

These students described their experience using the mobile technologies as more “personal,” “collaborative,” “hands-on,” and “interesting and interactive” than a typical class lecture. (2009)
“Technology can support reflection and articulation of new knowledge if artifacts are captured for sharing.” (Zimmerman 2014)
How can technology help us see?

GIS DATA LAYERS

Many different types of data can be integrated into a GIS and represented as a map layer.

Examples can include: streets, parcels, zoning, flood zones, client locations, competition, shopping centers, office parks, demographics, etc.

When these layers are drawn on top of one another, undetected spatial trends and relationships often emerge. This allows us to gain insight about relevant characteristics of a location.
| Visible Light | What we can see |
Radio

Infrared

Visible Light

What we can see

Ultra Violet

X-Ray
What we can see

Physical Size

Sand particles

Landscape
What we can see

Physical Size

Microns

Sand particles

Landscape

Galaxy
<table>
<thead>
<tr>
<th></th>
<th>Visible Light</th>
<th>What we can see</th>
<th>Physical Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio</td>
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<tr>
<td>Infrared</td>
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<td>Ultra Violet</td>
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<td>X-Ray</td>
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<tr>
<td>Microns</td>
<td>Sand particles</td>
<td>Landscape</td>
<td>Galaxy</td>
</tr>
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</table>
## What can technology see?

Technology helps us visualize attributes of space:

<table>
<thead>
<tr>
<th>Radio</th>
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</table>

- Radio
- Infrared
- Visible Light
- Ultra Violet
- X-Ray

<table>
<thead>
<tr>
<th>Physical Size</th>
</tr>
</thead>
</table>
Career Scientists
We can all think scientifically about the world around us....
When I grow up
I want to be a
Scientist

When I grow up
I want to be a
Keeper

When I grow up
I want to be a
Dance
Design Considerations

- Memory
- Power
- Portability
- Off-line
- Dedicated device
- Platform neutral
- Digital artifact
Digital Observation Technology Skills (DOTS) kits
Navigator

- Provides direction to study sites
- Locates group geographically using a personal Global Positioning System
- Coordinates data collection with other team members
Navigator
Media Specialist

- Captures photos and videos of the group
- Downloads stills from wildlife cameras
- Shares scientific story with others through images, movies, and writing

Tasks: Germi-Vi, keys, and laptop to upload pictures

Purpose: A handheld camera designed to record images on the go. The media specialist is responsible for recording the team's experience through images and videos.

Tasks: At each viewpoint and while travelling, take pictures and record images that help explain to viewers what the team is doing. Describe things as you see fit.

How-to:
1. Turn on the Germi-Vi by holding down the button on the side labeled ‘mode’ until the green light appears.
2. To record an image, press the button labeled ‘OK’.
3. To record a video, slide the tab forward in the direction of the red ‘REC’.
4. Turn the Germi-Vi off by holding down the ‘power’ button until the green light turns off.
5. Remove the SD card from the trail camera at each location. Use the key that is the same color as the lock to unlock the camera.
6. Insert the SD card into the case.
7. Insert this card into the card reader.
8. Plug the card reader into the iPad.
9. The ‘Media’ tab should open.
10. Scroll which images you would like to download onto the iPad and press ‘on’.
11. Do not delete the images.
12. Return the SD card to the trail camera and replace the cover.

Helpful Hints:
- Before recording images, ensure that there is an SD card in the Germi-Vi.
- Use the solar panel to unlock the Trails Monthly.

http://www.occn.edu/uestaff/extension/connections/ocn.uestaff.edu
Meteorologist

- Collects atmospheric data
  - Temperature
  - Wind speed
  - Relative humidity
- Finds and explores microclimates
Meteorologist
• Uses atmospheric data to make predictions of surface temperatures
• Tests predictions to find the warmest and coldest objects in the study site
Thermal Investigator
• Collaborates with Thermal Investigator to capture interesting thermal differences in the study site visually
• Shares interesting findings with team and facilitates additional inquiry
Thermal Imager
Thermal Imager

98.2°F
2015:07:20
16:35:27
$3.95$

99.2°F
2015:07:20
16:36:04
$3.95$

74.0°F
2015:08:27
14:37:17
$3.95$

71.3°F
2015:08:27
14:37:48
$3.95$
Microbiologist

• Finds and photographs interesting microscopic patterns
• Shares findings with team members through Wi-Fi connection to iPad
Microbiologist
## Research Results

<table>
<thead>
<tr>
<th>Assessment Questions</th>
<th>Pre</th>
<th>Post</th>
<th>Difference</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I know about different types of technologies*</td>
<td>3.81</td>
<td>4.15</td>
<td>0.34</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>I like to be outside</td>
<td>4.39</td>
<td>4.48</td>
<td>0.09</td>
<td>0.236</td>
</tr>
<tr>
<td>I like to use technology*</td>
<td>4.25</td>
<td>4.46</td>
<td>0.21</td>
<td>0.017</td>
</tr>
<tr>
<td>I know how to use different technologies*</td>
<td>3.76</td>
<td>4.11</td>
<td>0.35</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>I like to use technology outside*</td>
<td>3.40</td>
<td>3.99</td>
<td>0.59</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>I can use technology to learn</td>
<td>4.33</td>
<td>4.44</td>
<td>0.11</td>
<td>0.12</td>
</tr>
<tr>
<td>I care about nature</td>
<td>4.57</td>
<td>4.52</td>
<td>-0.04</td>
<td>0.53</td>
</tr>
<tr>
<td>I use technology at home</td>
<td>4.38</td>
<td>4.51</td>
<td>0.13</td>
<td>0.098</td>
</tr>
<tr>
<td>I can use technology to have fun*</td>
<td>4.35</td>
<td>4.54</td>
<td>0.20</td>
<td>0.024</td>
</tr>
<tr>
<td>I like to look at birds*</td>
<td>3.53</td>
<td>3.87</td>
<td>0.34</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>I like to look at plants*</td>
<td>3.57</td>
<td>3.97</td>
<td>0.40</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>I want to learn more about technology</td>
<td>4.15</td>
<td>4.29</td>
<td>0.15</td>
<td>0.123</td>
</tr>
</tbody>
</table>

Students were asked the above questions before and after the EARPOD lesson. Answers were collected on a five-point Likert scale (1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree). The average response was calculated with the total paired student responses (n=136). Differences in the average between pre and post assessment were then calculated. To test for significance, a paired t-test was calculated for each assessment question. *Assessment questions that have significantly different post assessments scores when compared to pre assessments. This means that the measured change in response is due to the EARPOD lesson and not random error.
Increase student’s eagerness to use technology outside by showing them the capabilities of technology

Improve student confidence in scientific observation skills by using technology

Increase student awareness of technology tools available for learning

Increase student knowledge of plant biology and science careers in an exciting way
Teacher Reflections

“The students spent more quality time observing leading to more purposeful writing.”

Mary Roberts 5th grade teacher, Portage Elementary

“The students were able to see and make connections from educational readings to real life situations (Aha moments).”

Amy Luebke 5th Grade Teacher, Lake Delton Elementary

“Scientific thinking allowed them to have better understanding and processing due to practical data.”

Mary Roberts 5th grade teacher, Portage Elementary

“Students understood negative and positive numbers much more completely due to thermometer work.”

Amy Luebke 5th Grade Teacher, Lake Delton Elementary

Wind Speed (mph)

Minimum and Maximum Wind Speeds per Month

<table>
<thead>
<tr>
<th>Month</th>
<th>Max Speed</th>
<th>Min Speed</th>
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<tbody>
<tr>
<td>January</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>February</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>March</td>
<td>4</td>
<td>2</td>
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</tbody>
</table>
Software & Mobile Apps

- Formatted for desktop, optimized for smaller computers and touchscreens, programmed for tablets & smartphones? (different programming considerations & languages)
- Need WiFi or cellular connection or not?
- Ability to store and share data?
- Designed as a learning resource?
- Enhance or distract from the outdoor education experience?
Field Friendly Apps

- WiFi or cellular is not needed.
- Purposely designed and chosen to enhance learning experience.
- Data gathering - pics, video, sounds, learner collected scientific data,…
- Learning tools - identification, healthy data ranges, geospatial features & maps, access to scientific data,…

Fieldfriendlyapps.org by Joy Kacoroski, “Mobile devices and apps can be an appropriate and effective way to connect children to the natural world. Apps provide additional tools to enhance a child’s learning, support efforts to appeal to different learning styles, and can create a multidisciplinary approach to learning. By using apps educators are able to provide a more in depth learning experience for a child so that they can create a greater understanding of the natural world processes.”
Mobile Apps

- Make your own: online templates to make simple apps (e.g. The Fossilator).
- Contract with a programmer for more complex apps (e.g. Water Quality).
- Review and select from available apps (e.g. Audubon Field Guides, Leaf Snap, StoryMe).
Water Quality mobile app

- Data collection tool and learning tool with digital field guide to basic macroinvertebrates, calculate macro PTI, chemical and physical stream data, site profile information, learning pop-ups, and export data.
- Available on Apple and Android tablets and smartphones.
Water Quality mobile app

Site Profile

Chemical and Physical Measurements

Dissolved Oxygen - Concentration (mg/L)

- > 9.0 mg/L
  Supports many, healthy fish populations
  - 11.0

- > 7.0 mg/L
  Fish can grow and are active
  - 10.0
  - 9.0

- 6.0 mg/L
  Supports spawning
  - 8.0
  - 7.0

- 3.0 - 5.0 mg/L
  Stressful
  - 6.0
  - 5.0
  - 4.0

Other measurements:
- Air Temperature
- Water Level
- Weather (Past 48 Hours)
- pH
- E. coli
- Fecal Coliform
- Water Temp - 1 Mile Upstream
- Phosphates
Water Quality mobile app

Chemical and Physical Measurements

Macronvertebrate Digital Field Guide & PTI
Citizen Science

Scientific Data

Participant Engagement

Students as Citizen Scientists

- The National Ecological Observatory Network (NEON)
- eBird
- GLOBE Program
- Digital Earth Watch Network and Picture Posts
- Kestral Watch
- Journey North
- Model My Watershed
- Leaf Pack Network
- Project Budburst
- Habitat Network
- iNaturalist
- Monarch Watch
Toolkit for citizens, conservation practitioners, municipal decision-makers, researchers, educators, & students to collaboratively advance knowledge & stewardship of fresh water.
**Pilot Curricula: Middle School and High School**

Innovative Technology in Science Inquiry

The Innovative Technology in Science Inquiry project engages students in STEM activities through the integrated use of technologies that include modeling, computational thinking, and real-time data acquisition. This comprehensive project will assist teachers in preparing diverse students for STEM careers by engaging them in exciting, inquiry-based science projects.

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<tbody>
<tr>
<td>Middle School Earth Science</td>
<td>Watershed (MS)</td>
</tr>
</tbody>
</table>

- Optional Pre-Activity: Crumpled Paper Watershed
- Part II: How healthy is your watershed? (2016 - 2017)
- Part IV: Can you filter your water?

[https://itsi.portal.concord.org/](https://itsi.portal.concord.org/)
Simulations: Micro Site Storm Model

- Animated model results from the USDA TR-55 runoff model for 24-hour rain storm over a hypothetical small unit of land with a single land cover class and hydrologic soil group.
- Students can vary land cover type, soil type and rainfall to obtain a typical water budget that petitions evapotranspiration, runoff, and infiltration.
Sensors and Apps

- Light, temperature, humidity data collected with low-cost Blue Tooth environmental monitoring device (TI Sensor Tag).
- Students use mobile device to view sensor data then enter it in ITSI portal where the data can be viewed, graphed, and analyzed.
Sensors
Model My Watershed

Results of a 24-hour hypothetical storm event as simulated by SLAMM and TR-55 model algorithms.
Access to Scientific Data

• Model My Watershed users gather & analyze data and model changes in land cover and conservation practices
  • **Data:** USGS NHDplusV2 Stream Network, USGS National Land Cover data layer, USDA Hydrologic Soils data layer, USEPA National Climate Data, ESRI and Google terrain maps, county animal surveys, point source discharges, Stream Reach Assessment Tool water quality data, real-time USGS River Gauge Stations.
  • **Model My Watershed boundaries for analysis:** USGS Subbasin Units (HUC-8, 10, & 12), counties, congressional districts, school districts, PA municipalities, free draw a polygon to study, 1 square Km, or delineate a watershed from any point.
Model My Watershed: Stream Network Overlay
National Land Cover Database
Observation Data - USGS
Design & model scenarios to improve their local watershed by changing land cover (land use) and proposing conservation practices (best management practices)

Site Storm Model a 24 hr. storm event: hybrid of TR-55, SLAMM, FAO, & STEP-L professional models

Create scenarios changing land cover and conservation practices
Design & model scenarios to improve their local watershed by changing land cover (land use) and proposing conservation practices (best management practices).

- **Watershed Multi-Year Model** using Mapshed, customized version of GWLF-E watershed simulation
- **Create scenarios** of proposed conservation practices
MMW: Land Cover Changes (+)
MMW: Multi-year Model - Hydrology
Take Home Ideas

- Carefully review and select technologies and apps to enhance outdoor education.
- Treat technology as any other educational resources.
- Students as citizen scientists using technology for access to data, sharing their data, and making sense of data.
- Use tech to engage 21st Century Learners.
- Use tech to extend learning beyond the classroom to outdoor learning and out of school learning.
2017 NAAEE Strand: Applying Research to Increase our Impact

2017 NAAEE, October 17-21, San Juan, Puerto Rico
● Cutting-edge research that is important and relevant to all environmental educators
● Linking research and practice: applying what we know to what we do
● Strategies for evaluating and improving environmental education programs
● Using research results to influence decision makers and demonstrate the value of EE
● Developing shared outcomes that allow us to better measure our collective impact
● Research and case studies about the benefits and challenges of learning and teaching in outdoor settings and in a culturally relevant context.

This strand has always- and continues to- interrogate the question - What is the role that research plays in our practice as Environmental Educators? For 2017, we invite practitioners and researchers to submit proposals that advance meaningful discourse around science and the environment. To this end, we are seeking submissions that address how our field uses research findings to not just build our programs, but engage stakeholders, communities and citizens across the political spectrum.

We are also seeking proposals that include examples of programs that have undergone robust evaluation and/or empirical research studies that can promote best practices for practitioners as well as advance the community of scholarship contributing to the research-based tradition of our field. Proposals should advance the entire field of environmental education, not simply promote an individual successful program.

Go to https://naaee.org/conference to submit your proposal and volunteer to be a reviewer by April 10.
Thank you!

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wikiwatershed.org

Go to https://naaee.org/conference to submit your EE research to practice presentation proposal and volunteer to be a reviewer.