Habitat Tracker: Engaging Students with Scientific Inquiry Through Technology and Curriculum Support

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ABSTRACT
This poster presents preliminary results from the second year of a three-year project designed to help elementary students learn about scientific inquiry and become active participants in their own science education. Florida State University has developed a set of technologies (an iPad application and website) integrated with a standards-based nature of science and scientific inquiry curriculum called Habitat Tracker. Preliminary analysis of the students’ task engagement shows that this project has the potential to support student engagement during field trips to natural wildlife centers. Current results will inform future iterations of the project, and improve support for science teachers integrating museum field trips and classroom activities.

Keywords
Engagement, collaboration, scientific inquiry, field trips, digital journaling, educational technology, curriculum.

INTRODUCTION
In 2007 the National Research Council (NRC) released a report that addressed questions about how children learn science, how elementary science should be taught, and the types of research needed to understand these questions. Identifying four strands of science proficiency that work as both learning goals and a curriculum design framework, Duschl, Schweingruber, and Shouse (2007) argue that “students who are proficient in science: 1) know, use, and interpret scientific explanations of the natural world; 2) generate and evaluate scientific evidence and explanations; 3) understand the nature and development of scientific knowledge; and 4) participate productively in scientific practices and discourse” (p. 2).

These proficiencies are in line with recent science reform documents and updated national and state elementary science education standards that promote inquiry-based instruction as an effective way to help students learn about the nature of science, scientific inquiry methods, and the meaning of scientific inquiry (American Association for the Advancement of Science, 1993, 2000; Collins, 1998). Although a lack of clarity and agreement regarding a strict definition of classroom inquiry still exists, inquiry-based instruction is generally understood to involve students “‘doing’ science to learn about the world” (Abrams, Southerland, & Evans, 2008, p. xvi). In light of these recommendations, researchers have called for schools to institute a new kind of science classroom and a pedagogy that supports students conducting their own investigations, and integrates the use of technological tools into the curriculum (Linn, Davis, & Bell, 2004; Reiser, et al. 2001).

Field trips to science centers and museums can be a good fit for this pedagogical model, providing a context for hands-on scientific inquiry. Unfortunately, studies of school field trips to science museums find that it is difficult for teachers to integrate these trips into school curricula. While teachers generally desire such integration, few consider connection to curriculum when evaluating field trip success (Kisiel, 2005). There is little in-class preparation before a field trip, and follow-up activities tend to be trip-related (Cox-Petersen & Pfaffinger, 1998; Griffin & Symington, 1997; Storksdieck, 2001). The discrepancy between the teachers’ self-reported goal of field trip curriculum fit and a general lack of trip-curriculum integration in the classroom points to a clear need to provide teachers with better support for linking field trips to an inquiry-based curriculum.

The Habitat Tracker project (http://tracker.cci.fsu.edu/) is addressing this need by using online and mobile technologies to engage fourth and fifth grade students with their own science education, integrating field trips to a wildlife center with a standards-based, scientific inquiry curriculum. Using an iPad application and website, students interact with digital journals, collaboration and analysis tools, and a shared online observations database to develop, refine, and answer scientific research questions.
BACKGROUND AND PURPOSE OF STUDY

Habitat Tracker draws on decades of science education research and over a decade of research on mobile computing in museums to investigate an intervention that combines the educational benefits of journaling with interactive technologies that allow students to collect data and produce collaborative analyses using a shared online database. The Habitat Tracker curriculum takes students through a tripartite process in which they a) spend time in the classroom learning about the nature of science, the elements of scientific investigation, and the nature of scientific inquiry; b) write in their journals and collect three types of observation data (animal, habitat, and weather observations) during a field trip to the Tallahassee Museum, an outdoor natural wildlife center in Tallahassee, FL (http://www.tallahassemuseum.org/); and c) return to the classroom to analyze their data and present their findings.

The system includes two connected technologies:

1. The Habitat Tracker Digital Journal, an interactive iPad application that students use to record qualitative observations in their journals about the wildlife habitats they visit, and to contribute quantitative animal, habitat, and weather observations to a shared database that can be accessed by other students online; and

2. The Habitat Tracker Website, where students conduct research by accessing content about museum wildlife; read, edit, and share their journal entries; collaborate with students in other classes and schools through a discussion board and journal comments, and analyze the growing database of animal, habitat, and weather observations made by students at the museum.

Before the field trip, students use the website to browse multimedia content about the habitats they will visit, write in digital journals about what they are learning and their research questions, and collaborate with students in other classrooms and other schools on discussion boards. At the museum, students work in small groups using the iPad application to write journal entries and collect observation data about ten natural habitats at the Tallahassee Museum: deer, turkey, otters, red wolves, bobcats, panthers, alligators, black bears, grey foxes, and skunks. After the field trip, students use the website’s analysis tools to refine and answer their questions and present their findings.

The Habitat Tracker project straddles the science education and museum informatics research traditions. Writing is used in science education to help students develop science literacy and scientific inquiry skills through reflection and revision and the dissemination of scientific knowledge (Hand, Prain, Lawrence, & Yore, 1999). In museums, interactive technologies and mobile computing have been introduced to improve educational experiences and to provide information and support self-directed inquiry on field trips (Economou & Meintani, 2011; Proctor, 2011; Tallon & Walker, 2008; cf. Rogers & Price, 2009).

The NRC report suggests a number of potential research agendas, including focusing on learning across the four strands of science proficiency, with a special emphasis on the third and fourth strands (Duschl, Schweingruber, & Shouse, 2007). Habitat Tracker’s focus on engaging students in collaborative, hands-on scientific inquiry addresses that need, while its educational modules and interactive technologies provide technology and curriculum support for the integration of field trips with nature of science and scientific inquiry curricula. This study, therefore, can help shed light on whether encouraging students to become active participants in collaboratively gathering and analyzing scientific data before, during, and after field trips to a wildlife center helps them become better engaged with the nature and practice of science.

METHODS

Twenty-five teachers from twelve schools were recruited for the 2011-2012 academic year through professional development workshops held during Summer 2011 that were designed to help teachers learn how to implement Habitat Tracker in their classrooms, demonstrate inquiry-based activities, and explain how incorporating project activities into the curriculum can help improve student learning and meet standards for science education.

Data Collection and Analysis

This poster reports preliminary findings from two types of data reflecting student engagement that were collected from September 2011 through January 2012:

1. Researchers’ direct observations of the students in the classrooms and at the museum, and

2. Observations and journal entries entered by the students before, during, and after the field trips.

Data analysis is on-going; student engagement is being measured through a quantitative analysis of the observations made during the field trips, and a qualitative analysis of the students’ journal entries and the researchers’ direct observations of the students in the classrooms and at the museum. The codebooks for qualitative analyses are being developed through an iterative process using open and axial coding to uncover common themes (for direct observations of students, each class represents a unit of analysis while individual posts and comments represent the units of analysis for journals). Analysis of the animal, habitat, and weather observation databases includes counts of the types of observations the students are making as well as an analysis of the types of inquiry students are able to conduct using the system’s online analysis tools.
FINDINGS
Preliminary findings indicate that the Habitat Tracker curriculum and technologies have the potential to support and encourage student engagement as active participants in their own science education.

Student Engagement at the Museum
In the 2011-2012 academic year, 1,170 students from twenty-five classrooms in twelve schools participated in field trips to the museum (Table 1). Working in groups of two or three, they made 2,083 total observations—844 observations of items they found in the animals’ habitats, 751 observations of the animals’ location and activities, and 488 observations of weather data (Table 2). At this stage in the project, participating students entered observations for only one habitat—the bobcat habitat.

The habitat and animal observations represent 0.72 and 0.64 observations per student, respectively. As the students were working in groups, observation rates per student greater than 0.50 indicate that students were very enthusiastic in these activities. The 0.42 weather observation rate is respectable, but suggests that the students were less involved in this activity. This may be partly due to order effects (while students were told that they could make observations in any order, the tasks were presented in the iPad application as “make a habitat observation, an animal observation, and a weather observation” and the per-student observation rates mirror this habitat-animal-weather order). It is also possible the students were running out of time, especially if they were highly engaged with the other tasks.

The students wrote 646 journal entries in small groups at the museum, a per-student rate of 0.54 (Table 3). Content analysis of the journal entries is in progress but, generally, the students used the journals for narratives such as notes about aspects of the animals’ activities and précis of what they had learned, for instance:

Bobcats seem to like the shade on a hot day. Bobcats are very pretty creatures to look at. I wouldn’t [sic] mess with them during their rest because they may injur [sic] me or hurt me severely. Bobcats have short tails. They seem to pace back and forth across their habitat. I named my favorite one Rufus because I used to have a cat named Rufus and they look just alike.

<table>
<thead>
<tr>
<th>Observations</th>
<th>n</th>
<th>n / student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat</td>
<td>844</td>
<td>0.72</td>
</tr>
<tr>
<td>Animal</td>
<td>751</td>
<td>0.64</td>
</tr>
<tr>
<td>Weather</td>
<td>488</td>
<td>0.42</td>
</tr>
<tr>
<td>Total</td>
<td>2,083</td>
<td>1.78</td>
</tr>
</tbody>
</table>

Table 2. Student observations made at the museum.

Students also used journal entries to pose questions based on their observations, such as “How do bobcats sleep and stay on thin branches?” or “How do bobcats climb?” While the students generally worked well together as observed during the field trips, they typically did not interact with each other by commenting on each other’s journal entries (as evidenced by the 0.10 per-student comment rate).

Preliminary analysis of the direct observations of the students by the researchers has identified a number of behaviors that suggest engagement. The students appeared to be very serious about their tasks—many were observed talking to each other about what they were seeing and working through the iPad application systematically. A number of the students were observed saying that they had been to the museum on other occasions but had never observed the habitats so closely before. Several students became so involved with the observations that they began looking beyond the habitats and pointing out objects and animals (e.g., white squirrels) in other parts of the museum.

Student Engagement in the Classroom
Direct observations of the participating students confirmed the difficulty of integrating field trips with classroom work. Although all the participating teachers were enthusiastic about the project during the summer workshops, once the school year began it became very clear that they were having trouble integrating Habitat Tracker with their curricula. Very few teachers, for instance, had sufficient time to perform the pre- and post-trip nature of science and inquiry activities that they had learned during the summer workshops. Journal entries were almost exclusively written during the field trip, but not before or after. On the other hand, when the researchers visited the classrooms to model the pre- and post-trip activities in person, the students were observed to be extremely active and engaged participants. For example, students worked hard on creating research questions and discussing the types of questions that could be answered by a trip to the museum and enthusiastically talked about their own sightings of animals in the wild.

<table>
<thead>
<tr>
<th>Participants</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schools</td>
<td>12</td>
</tr>
<tr>
<td>Classrooms</td>
<td>25</td>
</tr>
<tr>
<td>Students</td>
<td>1,170</td>
</tr>
</tbody>
</table>

Table 1. Participating schools and students.

<table>
<thead>
<tr>
<th>Journal Entries</th>
<th>n</th>
<th>n / student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posts</td>
<td>626</td>
<td>0.54</td>
</tr>
<tr>
<td>Comments</td>
<td>122</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Table 3. Student journal entries made at the museum.
DISCUSSION AND IMPLICATIONS
The results of this research will help improve support for science teachers integrating museum field trips and classroom activities. The fact that student engagement in the classroom was lower than engagement in the museum is a challenge for future research. For the next stage of the project (2012-2013), the researchers are focusing on more targeted teacher support to create dedicated environments in which the students participate across all segments of the program and interact with each other within classes and across schools. Four teachers from 2011-2012 have been recruited to participate in this next stage. During the summer they will work with the project team to identify the types of support that they need (and the types that do not help). The researchers are currently creating three weeklong modules that include more explicit lesson plans and support for the teachers, including paper-based and electronic materials. The three modules (before the field trip, the field trip and related activities, and after the field trip) will run during consecutive weeks, and should reach approximately 250 students during Fall 2012.

CONCLUSIONS
Preliminary findings show that the Habitat Tracker technologies have the potential to increase student engagement with scientific inquiry during field trips to a wildlife center by helping them become actively involved in their own science education. Participating students made over two thousand observations and wrote over six hundred journal entries. Student groups worked systematically to complete the observation worksheets on the iPad and were very engaged throughout the process. The researchers used this phase of the project to identify problems that will inform future research, focusing on the types of support teachers need to integrate field trips with classroom work.

ACKNOWLEDGMENTS
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REFERENCES


