Statement of intended use of the monetary award: This study investigates the potential use of GIS as a means for teaching environmental study to secondary school students. As a prior settlement, a syllabus for five 90-minute classes for the 8th grade has been already established under the topic of “Studying the Environment of Eighteenmile Creek in Buffalo.” The collection of data relating to research question about the effectiveness of “learning-with-GIS” approach in environmental education was designed. The items being requested from the award in order to conduct this research are:

1) Human subject costs: For the purpose of this study, 20-30 students will be recruited from a secondary school. Students will be observed four times a week for a period of one month and all classroom activities and talks will be videotaped. The researcher chooses to pool the human subject fees and use this money to purchase incentives for human subjects (mugs, ribbons, gift cards, etc.) Each student will be awarded $20 incentive for the participation in the study, for a total of $400 - $600 for the 20-30 students.

2) Transcription fees: Transcriptions of the in-depth interviews and classroom observation will be made for further analysis following Pilkington (1999)’s DISCOUNT scheme. Approximately, 20 tapes (90min) will be used for these purposes. Each 90-minute tape will be transcribed into 15 pages, for a total of 300 pages. Transcription fees will result in a total of $600

3) Website development cost: For this study, a corresponding project website, “Environmental Education with GIS within Community” was developed so that students and instructors can easily download and share the information and curriculum. As the next phase of the project, the website will be expanded and data and maps are also available through this website. The cost for this item was not yet determined.
Figure 1. A conceptual framework of research: This three dimensional model for the successful environmental education shows the integration of (1) contents of environmental education, (2) scales, and (3) methods using both acquisition and participation metaphors with GIS.

Figure 2. Study area Note that the blue–lined stream shows the course of the Eighteenmile Creek and a black–lined area is a sub–basin which is selected as a study area. The inset in the upper left corner is the New York State map and the inset in the lower right corner showing the Buffalo River–Eighteenmile Creek Watershed.
Figure 3. A sample curriculum about the topic of road-stream crossings. This figure shows how to integrate both the acquisition metaphor and the participation metaphor. In this study, an environmental curriculum was emphasized which amalgamates social science and natural science with real-world problems through GIS.

### Acquisition metaphor
- **Students are expected to**...
  - learn the concept of ‘stream-road crossing’
  - understand the potential hazard of road-stream crossing
  - learn the skills of searching through Internet and using GIS basic functions

### Participation metaphor
- **Students are expected to**...
  - learn how to find other factors to affect high risk crossing
  - search for a practical solution for reasonable watershed management

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### Figure 4. Screen shot of the project website
A website, “Environment Education with GIS within Community” (http://www.acsu.buffalo.edu/~boaehun/env_edu/) has been developed so that students and instructors can easily download and share the information and curriculum. Each tab has an explanation about specific piece of puzzle and useful links. At the next phase of the website development, data and maps are also available from this website.

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#### Table: Sample Curriculum

<table>
<thead>
<tr>
<th>Question</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is road-stream crossing?</td>
<td>- using GIS, find out the total number of road-stream crossings.</td>
</tr>
<tr>
<td></td>
<td>- write down the impacts from road-stream crossings.</td>
</tr>
<tr>
<td>3. Find the “High risk road-stream crossings” using GIS.</td>
<td>- how does the slope affect road-stream crossing?</td>
</tr>
<tr>
<td></td>
<td>- find other factors which can affect road-stream crossings.</td>
</tr>
<tr>
<td>&lt;Legend&gt;</td>
<td>- <strong>Legend</strong></td>
</tr>
<tr>
<td>Stream</td>
<td>- Stream</td>
</tr>
<tr>
<td>Road</td>
<td>- Road</td>
</tr>
<tr>
<td>Stream-road crossing</td>
<td>- Stream-road crossing</td>
</tr>
<tr>
<td>Sub-basin</td>
<td>- Sub-basin</td>
</tr>
<tr>
<td>&lt;Slope (%)&gt;</td>
<td>- 0-1</td>
</tr>
<tr>
<td></td>
<td>- 1-5</td>
</tr>
<tr>
<td></td>
<td>- 5-10</td>
</tr>
<tr>
<td></td>
<td>- 10-20</td>
</tr>
</tbody>
</table>

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**Introduction: Sharing geographic information for survival**

When considering the past, present and future of geographic information systems (GIS), it is utmost importance of building a technology that facilitates open sharing of geographic information freely and easily so that the various users can employ the power of thinking geographically to solve the world's pressing problems. It is a vision. With facing up to reality, it would take the billions of dollars of geographic data, geographic processing capability, and user expertise as an essential prerequisite (ESRI 2000). However, it might be worthwhile- for survival, in other words to solve the world’s urgent problems.

**Environmental education for life**

One of the most formidable and ever more intractable challenges facing human beings today is existing together with the other living creatures on Earth. To meet this challenge, many authors ascertained that education, both formal and informal is the most fundamental countermeasure- even though it would take a long time to see the visible results as education inherently is accomplished by long term efforts - and the best way (Westing 1988). Even though it would be time-consuming, however it is not easily deniable that the only way we can affect the nature of human beings is education. In spite of its urgent need, however, environmental education is mostly absent in our classroom or not provided in an appropriate and effective way.

**Integrating GIS with environmental education into K-12**

The old adage, “Tell me, and I’ll forget. Show me, and I may not remember. Involve me, and I’ll understand.” is supported by many researchers. It is so true to environmental education, where it is crucial for learners to participate to their own community based on the cognitive knowledge building about their own environment. Therefore, to achieve the successful environmental education, involving learners to their real world environmental problem solving is the key and is only possible when the learner’s belief system is changed through the process of learning.

As a method of involving students, GIS have been favorably received as innovative and exciting tools (Kerski, 2000; Sui, 1995; Audet, 1994; Palladino and Goodchild, 1993; Walsh, 1988). Using GIS, children, citizens-in-training can access to the geographical data, participate in the decision making process and empower their rights as a method to cope with the challenges, which keep them marginalized.


In this sense, the research will investigate the effectiveness of “learning-with-GIS” approach in environmental education through classroom observation, field notes, in-depth interview with teachers and students, and document collection. All classroom activities and talks will be videotaped. Data will be organized and analyzed by the discourse analysis following Pilkington (1999)’s DISCOUNT scheme.

To do this, a syllabus for five 90-minute classes for the 8th grade has been established under the topic of “Studying the Environment of Eighteenmile Creek in Buffalo.” Also, a corresponding project website, “Environmental Education with GIS within Community” ([http://www.acsu.buffalo.edu/~boaechun/env_edu/](http://www.acsu.buffalo.edu/~boaechun/env_edu/)) was developed so that students and instructors can easily download and share the information and curriculum.
Using this curriculum, students will collect information from maps, remotely sensed images, reference books, and websites. The students will also manipulate data, utilize the GIS tools and study “real problems.”

Providing Open Access to Geographic Information to the public, even kids

We can best empower children when we provide the access to geographic information and support them to solve the real world problem as a community member. Children, citizens-in-training (Matthews et al. 1999, 135) will make important decision for their surrounding world in their near future. To be a more informed decision-maker, they are required not only to know the scientific facts but also to understand the social phenomena, which shape the society through the interaction between various stakeholders- in other words, namely a “geographically informed person”¹. “All voices are reasonably equally heard” (Cunningham et al 2003, 203) and this statement should include children as future adults, too.

< Cited references>


¹ Someone who understands that geography is the study of people, places, and environments from a spatial perspective, some one who appreciates the interdependent world in which we all live (Geography Education Standards Project, 1994: p27-29).