Accomplishments

9/1/16-8/1/17

You have the option of selecting "nothing to report" in this section.

What are the major goals of the project?
The goal of this project is to develop and educate a diverse workforce effective in careers directly related to geospatial technologies (GSTs) or that employ spatial tools and skills to visualize, analyze, and communicate with/about spatial data. GSTs are introduced to educators through STEM teaching and learning best practices and support integration of GSTs into community college, high school, and university classrooms. Mesa Community College’s primary role in this effort is to support professional development workshops with technical leadership and educational materials that provide participants hands-on activities utilizing geographic information desktop and online software. MCC’s role contributes to the GEOCACHE project effort to expand and educate the geospatial workforce. The GEOCACHE project builds upon lessons learned about professional development for educators from the POD Project (DRL #0929846, Sample, et al.), that increases the instructor’s abilities to teach with geospatial technologies. Pathways will be created that allow students to obtain competency in GST at a level complementary to their career and/or educational goals.

<2016-2017 EXTENSION-SPECIFIC GOALS?>
For the no cost extension, our goal was to create a self-sustaining environment to support current and future educators’ objectives to integrate GST, specifically geographic information systems (GIS) into the classroom as an instructional toolset. This involved building leadership capacity through support for presenting at and attending GIS education conferences. Additionally, we initiated 1) a state-wide GIS Educator User Conference (AZ GIS EdUC) and 2) a state-wide Educator’s GIS user group (AZ EdG). The intention is to encourage past GEOCACHE participants to assume leadership of these user-oriented forums and encourage, mentor, and inspire other educators to bring GIS to the classroom. These activities will support an independent educational/information resource available to educators throughout the state of Arizona.

What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?

Major Activities:
The AZ GIS EdUC and AZ EdG were fundamental components of this reporting period. Additional efforts included continued support to educators integrating GIS into their classroom in the form of webinars, e newsletters, in-class observations and lesson plan
reviews of those educators currently implementing GST in the classroom.

Monthly email communications not only encouraged participants to continue teaching with GIS but also to share announcements and professional development opportunities, updates to GIS licenses and online functionality, offer assistance, and advertise webinars.

The project supported participants to attend and present at AZ and regional GIS education conferences, and also provided materials to enable teachers to continue to expand GIS lessons in the next academic school year.

The evaluation team observed four classrooms around the state of Arizona this year, two at the community college and two at the high school level. As reported in prior periods, evaluators employed a revised version of the International Society for Technology Education (ISTE) Classroom Observation Tool (ICOT) to capture student experiences in class. High numbers of ISTE standards in practice are desirable. One additional high school teacher was observed by a GEOCACHE team member but the lesson was not evaluated using the ICOT. Details of these observations are provided under Significant Results.

To further support educators, 2 one-hour webinars were held during the reporting period. GEOCACHE staff provided GIS technical demonstrations, participants presented learning from conferences attended, and educators shared successes and challenges with implementing GIS in classrooms. Participants were encouraged to take advantage of further opportunities such as presenting or attending conferences and site visits from GEOCACHE staff. Detailed information about these webinars is reported under Opportunities for Training and Professional Development.

Further activities involved encouraging participants to assume leadership skills that will support a sustainable, supportive environment for increasing their GST skills as well as assisting others who wish to begin using GST as part of their instructional toolset. Supportive environments include the AZ GIS EdUC and the AZ EdG. Corresponding activity during this reporting period included measuring our progress toward encouraging interest in participating in the AZ GIS EdUC and building a self-sustaining AZ EdG.

**Specific Objectives:**

Specific objectives accomplished:

1. The development of a state-wide GIS Educator User Conference (AZ GIS EdUC) that will serve as not only a forum for educators and their students to celebrate successful integration of GST into the classroom through presentations and posters but also provide informational and educational opportunities through panel discussions, workshops, and discussions.

2. The development of a state-wide Educator’s GIS user group (AZ EdG) that will serve as an informational and educational resource for educators who currently use GST
in the classroom and for those who want to learn how to use GST as an instructional tool.

3. Online educational and information sessions related to further developing GST skills, sharing successes and challenges, and building interest in participating in the AZ GIS EdUC and AZ EdG.

4. Ongoing support for educators including monthly email communication, support to attend and present at regional GIS education conferences, and classroom site visits/observations.

**Significant Results:**

In August 2016, individual emails were sent to all 39 GEOCACHE participants who were still teaching in Arizona to inquire a) if they were planning to implement a GIS lesson in the upcoming academic year, b) if they would be willing to submit a lesson plan and be observed, c) what support they would need to continue, d) if they were interested in attending or presenting at regional GIS education conferences, e) if they were interested in planning an AZ GIS EdUC, and f) if they were interested in participating in the AZ EdG. Twenty-nine educators responded, a 74% response rate.

Fifteen educators (51%) indicated they were planning to implement GIS lessons in some form in the upcoming academic year, though some of the plans were tentative and in the idea stage. Seven (24%) noted they did not have time to implement or had too many other responsibilities to be involved (e.g. finishing a doctorate, teaching more courses, lost a course they used to teach in order to take on administrative role). Three were no longer in teaching positions where they could implement GIS, and two were still interested in teaching GIS lessons but felt they needed technical skills refreshed.

Eight respondents indicated interest in attending or presenting at regional GIS education conferences (and all eight ultimately did present; seven were interested in helping to organize the AZ GIS EdUC and participate in the AZ EdG, but several questioned the amount of time and responsibilities involved. Additional supports these educators requested included gaining additional GIS technical skills, site visits/geo mentors, GIS technical/database support help, and GIS lesson ideas.

In response to needs identified on the survey, the GEOCACHE team continued to communicate with participants on a monthly basis to offer support and suggest lesson ideas, the team provided two webinars, and developed the AZ GIS EdUC and AZ EdG (Arizona Educator’s GIS user group).

To identify how GIS lessons continued to be implemented and the quality of lessons, observations were offered to all implementers and scheduled with respondents. The evaluation team observed four classrooms around the state of Arizona this year; two at the community college level and two at the high school level. One high school class was solely
plotting biomes on a world map, with no geospatial question or analysis. The other three classes were learning about ArcGIS and analyzing spatial data, and/or using spatial data to make claims about a topic or question: environmental footprint of the college campus, health problems associated with food deserts and potential solutions, and biodiversity in local areas.

As reported previously, evaluators employed a revised version of the ISTE Classroom Observation Tool (ICOT) to capture student experiences in class; high numbers of ISTE standards in practice are desirable. The average number of ISTE standards observed in these classrooms was 11.5, with a range from 5 to 19. Observed challenges for one educator was presenting the project as a part of an inquiry or question, which may have engaged the students more with the material. This educator asked, and was provided, specific feedback about how to improve her teaching with ArcGIS. Another educator had worked to improve her lesson from last year and was pleased with the quality of the resulting students’ projects. For instance, here is a story map created by a student group: http://arcg.is/2dJFOyb

One additional high school teacher was observed by the PI but was not evaluated using the revised ICOT. This lesson engaged students in an exploration and discussion about methods used to control and mediate interactions between wild species and humans in Connecticut, and to evaluate whether those methods would be appropriate to their local context.

GEOCACHE staff had hoped to be invited to more classrooms to observe lessons. Many requests to visit were extended. Some educators indicated a willingness to be observed at some point in the semester, however, the educators never confirmed actual dates and times for lessons. Anecdotally, a few educators shared with the team that they are using GIS; a geology instructor used Google maps to interpret geologic features and a biology instructor made story maps to use for instructional purposes. She stated she does not have time to have students create their own maps but does want to teach with GIS, and she sees this as a nice compromise.

Initially, educators were required to submit detailed lesson plans prior to being observed. It is possible that other participants are teaching with GIS but did not invite the team to observe because they did not have time to complete detailed lesson plans. The lack of clarity about lessons and dates could also be evidence that educators are still struggling to find ways to meaningfully integrate GIS into their classes. Based on the review of challenges raised during the problems of practice session held at the AZ GIS EdUC and described below, it takes a significant amount of lesson planning and time to meaningfully engage students using GIS to analyze and then communicate with spatial data. It is possible that educators do not have the freedom or time in their curricula, do not have adequate access to technology, or still lack the technical skills to implement lessons with students.
Change takes time, so we are hopeful the activities and supports in the next reporting period will yield better results.

The statewide GIS Educator User Conference and Arizona Educator GIS User Group were both key components of the extension. Several attempts at setting up an initial meeting for the user group were made during webinars. One such webinar was held on February 8 with very little participation. Evaluator participation and team discussion identified that there may be lack of understanding from the education community the purpose and benefits of participating in a user group. A well-defined deliverable or outcome of the meeting or group would also be helpful. Although the goal of a user group is to be run by the users, the lack of experience with this format may require a “lead” for the short term until it gets off the ground.

Since these forums did not have the level of participation desired, it was decided that the GIS Educator User Conference would be the ideal forum for gauging interest in a statewide user group and further defining the purpose and structure of such a group. The following is a summary of the user group and includes a brief summary concerning participants’ interest in a user group.

The first AZ EdUC took place on May 4th and May 5th, 2017 and was hosted by Northern Arizona University. Presentation proposals were solicited and reviewed by a committee of GEOCACHE participants and the NAU PI.

A total of 55 educators attended the AZ GIS EdUC. Of these, 33 attended both days of the conference. Thirteen GEOCACHE participants were originally registered, however, 2 cancelled as a result of family-related issues. Four of the GEOCACHE participants represented Cohort 1; seven represented Cohort 2. This difference in attendance may be based upon time since attending the advanced workshop (Cohort 2 June 2015; Cohort 1 July 2014) or it may be because the focus of cohort 2 was more pedagogical and work was focused in ArcGIS Online, requiring less technical skills. Cohort 1 was more technical and work focused in ArcGIS Desktop, and may have been more technically challenging to the participants. Eight of the GEOCACHE participant attendees presented how they have used GIS in the classroom.

The conference offered workshops, instructor and student presentations, and a career panel. Workshops were both technical and pedagogical in nature. The NAU PI attended a workshop on design based implementation research (DBIR) in order to better understand research-practice partnerships and to learn to facilitate practitioners in identifying problems of practice that would be of interest to study. The strategies learned at the DBIR Workshop were implemented during the AZ GIS EdUC. This session, offered in a carousel brainstorm format, provided educators the opportunity to work together to identify both
benefits and barriers to integrating geospatial technologies into the classroom. In brief, the results of this information session included defining benefits such as

- improved technical skills as well as enhanced problem-solving abilities through the use of logic and measurement
- further-developed cognitive skills through visualization, pattern recognition, critical thinking, and data analysis
- increased student awareness of geospatial careers as well as engagement in the broader community through their application to real-world problems
- support the development of soft skills (team building, collaboration, independence)

Juxtaposed to these benefits, instructors identified possible and real barriers to integration, for example:

- establishing a realistic technical foundation and threshold
- the availability of data
- time
- fitting GST into required curriculum
- administrative support for professional development opportunities in GST
- bandwidth issues
- student motivation
- lack of technical infrastructure
- funding
- assessment tools
- rapid pace of changes in technology

The GEOCACHE team intends to use these identified problems of practice to troubleshoot and respond to issues for future support and sustainability in the next reporting period.

A post-conference survey was completed by 37 attendees. Of those responding, over 50% were secondary educators with the remaining 50% divided equally between elementary and post-secondary educators. Half of the respondees have been teaching more than 12 years with one-third teaching somewhere between 1 and 3 years; the rest having taught between 4 and 12 years.

At the end of each day attendees were asked to rate each activity offered that day in terms of its utility. Sessions were rated on a four-point scale. The most useful session on the first day was a hands-on lab lead by an Esri educational trainer. User presentations and the working lunch were popular; the un-conference brainstorming exercise and career panel were the least popular sessions for the first day.

Key outcomes or other achievements:
What opportunities for training and professional development has the project provided?

Two one-hour webinars were held during the reporting period. The webinar held on December 17, 2016 included a demonstration on developing a workflow for a GIS-based academic partnership and a demonstration on how to create your own apps within the ArcGIS Online Developer environment. Information was also shared concerning funding opportunities for travel and equipment. There were 6 attendees.

A second webinar was held on March 24, 2017. Topics included a demonstration on how to migrate content between ArcGIS Online accounts and information about presenting and/or attending the May 2017 Arizona GIS Educator User Conference. There was also a discussion concerning interest in the Arizona Educator's GIS user group (AzEdG). A GEOCACHE participant presented about his experience attending the Arizona Geographic Information Council annual conference in Prescott, AZ. There were 5 attendees. Four others indicated interest but were not able to attend in person, so they viewed the recorded archive.

Participants were provided the opportunity to learn more about career opportunities in the GST field through a Career Panel discussion at the GIS EdUC in May 2017. Additionally, hands-on workshops were offered at the GIS EdUC that were designed to support further developing the educators’ GST skill set.

Several teachers took advantage of leadership opportunities and attended or presented at regional GIS education conferences. One high school teacher attended the AZ Geographic Information Council’s Education and Training Symposium in Prescott, AZ. He presented what he learned at a webinar for GEOCACHE participants, including Drone2Maps for ArcGIS, Python add-ins for Desktop ArcGIS, understanding and accessing the global demographic and lifestyle data (Living Atlas layers).

Two high school teachers presented how they are using GIS to support authentic projects at the AZ Science Teachers Association Conference in Phoenix, AZ, and one additional high school teacher attended the AZ Geographic Alliance GeoConference in Scottsdale, AZ. One community college instructor has been accepted to present how she used GIS in her pre service education courses at the Esri Education User Conference in San Diego.

How have the results been disseminated to communities of interest?

Eight GEOCACHE participants presented at the Arizona GIS Educator User Conference held at NAU from May 5 through May 6, 2017. Three were cohort one participants and five were cohort two participations. Presentations focused on GST classroom implementation. Examples included how to engage students in authentic problem solving, such as where to place solar panels on a school campus, using PokemonGo games for instruction, teaching AP human geography through GIS, and historical mapping of polio cases to better
understand the nature of science. Additionally, high school students presented how they could create a GIS app to track instances of influenza-like illnesses in partnership with county health organizations.

Representatives of GEOCACHE attended the International Society for Technology in Education conference in June 2017 which included a project poster session.

Representatives of GEOCACHE attended the International Cartographic Conference in June 2017 which included a project poster session.


What do you plan to do during the next reporting period to accomplish the goals?

Several needs were identified at the AZ GIS EdUC to support and sustain GIS education in AZ. Specifically, continued learning of GIS skills, time to collaborate and plan, and a need to develop understanding of the power of GIS for education by the greater education community. There is great interest in and enthusiasm for a centralized information and training hub and a place for educators, professionals, and stakeholders to network, learn, share ideas, and support one another both in person and online. The AZ EdG can provide this support.

MCC will take the lead on providing an infrastructure for the AZ EdG. They will establish a leadership structure, with the goal of the Users taking ownership for sustainability. NAU staff will partner with MCC on this endeavor and assist in organizing and planning a second AZ GIS EdUC and meetings both in person and online where GIS professionals, educators and their students can convene and learn from one another. We will continue to support educators to present at regional GIS education conferences. Regular communications will continue, and we will engage new GIS educators with lesson ideas, tips, and updates to technologies. We will address the identified need to inform, engage and help integrate GIS in education via school site visits across AZ which may involve presentations to administrators and teachers and offer to co-teach lessons. These site visits may be focused on existing GEOCACHE participants or newcomers to the User Group. By the end of the next reporting period, we hope to have an engaged group of educators that will expand and sustain the work that GEOCACHE has begun.

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- **Journals:**
- **Books:**
- **Book Chapters:**
- **Thesis/Dissertations:**
- **Conference Papers and Presentations:** ITSE (June 2017)
- **Other Publications:**
- **Technologies or Techniques:**
- **Patents:**
- **Inventions:**
- **Licenses:**
- **Websites:**
- **Other Products:**

  **Audio or Video Products**
  - Recording of Webinar held on December 17, 2016
    - Technical/Academic Partnership -- Karen
    - Apps in ArcGIS Online – Lori
    - The Arizona Educator GIS User Group (AzEdG) -- Karen
  - Recording of Webinar held on March 24, 2016
    - Migrating data between ArcGIS Online Accounts – Karen
    - The Arizona GIS Educator User Conference – Lori
    - The Arizona Educator GIS User Group (AzEdG) – Karen
    - Report on AGIC Conference, Sept 2016 -- Pradip

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Presentations at the AZ GIS EdUC:

**PARTICIPANTS/ORGANIZATIONS**

*Shereen*
1 person months
Contribution to the project
Co-PI at NAU. Mentored participants. Supported participants by managing and delivering software/data requests. Co-coordinated, planned, and delivered sessions at the AZ GIS Education User Conference.

*Lori*
2 person months.
PI at NAU. Communicated regularly with MCC PIs. Presented at conferences and supported participants to attend and present; worked closely with evaluators to develop survey instruments and track implementation of required elements and communicated completion of requirements to MCC for stipend dispersal. Coordinated, planned, advertised, and delivered sessions at the AZ GIS Education User Conference. Developed and delivered content for webinar. Communicated with and supported participants. Contributed to ATE Annual Survey and annual report.

**Have other collaborators or contacts been involved?** No

**Impacts**
IMPACT - What is the impact of the project? How has it contributed?
The project is significant to pedagogical methods relating to integration of geospatial technologies into the classroom and the professional development strategies that support that integration.
The principles of effective project-based instruction and 21st century skills teaching and assessment were new to many participants. Several noted that the resources provided were invaluable for developing their units and these tools and instruction had an impact on their teaching strategies as evidenced by student survey responses and sample work, classroom observations and lesson plans.
Lessons learned from GEOCACHE are crucial to our new NSF-funded ITEST project, DRL 1513287, Expanding Geospatial Technology Career Development for High School Students through Teacher Professional Development: The Power of Data Project. We are currently conducting a study using design-based research to better understand what elements of PD are essential, in what contexts teachers are able to implement GST-integrated lessons and achieve high levels of student results, and what factors help students develop interest in STEM and GST careers.

What is the impact on Human Resources
As described in Key Outcomes and Other Achievements, several teachers took advantage of additional professional learning opportunities including attending the ATE PI Conference and attending and presenting at the Esri conference, where they interacted not only with educators teaching with GST but also with other GST professionals, thus expanding their awareness of careers in GST.
Several teachers attended GST PD offerings and courses, where they further developed their skills and abilities in GST and in leading others to teach with GST.

What is the impact on society beyond science and technology?
GST can be utilized in many academic fields. Teachers outside of STEM disciplines participated in GEOCACHE PD and have shared it with others. Teachers in many disciplines can utilize the materials GEOCACHE has developed for improving their teaching and exposing more students to GST as a career option.
Attachments

- AZ GIS EdUC program and Google Drive – presentations
  https://drive.google.com/drive/folders/0Bwvqj4Jlh8g6ZHcyVGpPWUlpTFU?usp=sharing
- Nena - Evaluation report?
- Updated Classroom Observations Report – Talbot
- Survey/Data from AZ GIS EdUC - Talbot
- Webinar recordings?