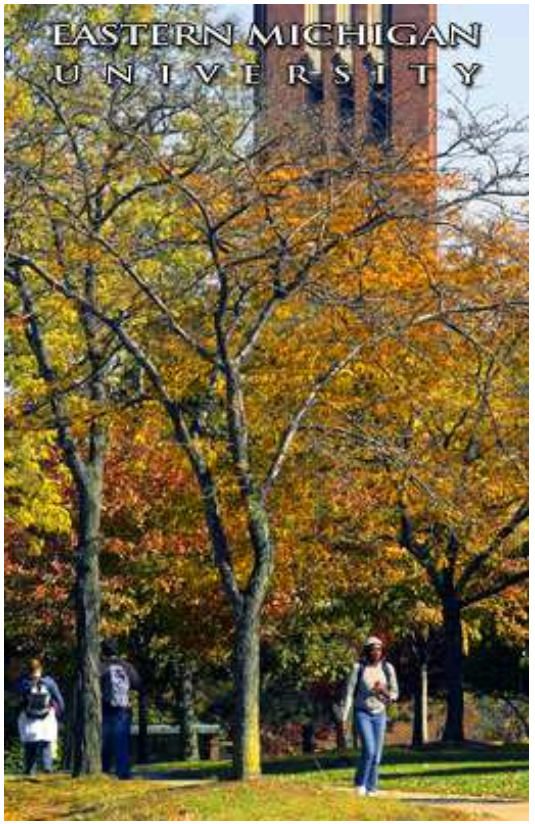
GIS/T Resources & Applications for Career Education (GRACE) – NSF ITEST Project



Michigan Earth Science Teacher Association

The GRACE Community Meeting

EMU Student Center, September 15, 2014

Presented by: Yichun Xie, Institute for Geospatial Research & Education

The Presentation Outline

1. **WHAT IS The GRACE Project**
2. **The Project Goals**
3. **Why Integrate GIS/T in STEM Curricula – for Teachers**
4. **The Benefits and Commitments for Teacher Participation**
5. **Why Integrate GIS/T in STEM Learning – for Students**
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7. **The Benefits and Commitments for Student Participation**

1. WHAT IS The GRACE Project

Collaborative Project: GIS/T Resources and Applications for Career Education (GRACE) is a SPrEaD (Successful Project Expansion and Dissemination) project building upon an earlier successful ITEST project: Mayor's Youth Technology Corps (MYTC–NSF DRL-0737589). MYTC developed a model of *purposeful applications of technology (geographic information system and technology (GIS/T) -based education for STEM careers in the workplace* that enabled youth in economically disadvantaged communities to have opportunities for determining their own futures. GRACE will take the MYTC model to a large number of students and teachers in grades 8-12 across the State of Michigan by following a three-stage learning process from ***Explorers*** to ***Investigators*** and to ***Interns***.

Two Awards: Award #1433712: Eastern Michigan University

Award # 1433640: Michigan Virtual University

Collaborative Organizations:

- National Science Foundation
- EMU Institute for Geospatial Research & Education (IGRE)
- Michigan Virtual University (MVU)
- Michigan Mathematics and Science Centers Network (MMSCN)
- Michigan Communities Association of Mapping Professionals (MiCAMP)
- Michigan Earth Science Teacher Association (MESTA)
- Environmental Systems Research Institute (ESRI)

Institutional Roles:

- EMU is one of the largest teacher preparation institutions in Michigan and has a history of working with K-12 in a multitude of GIS/T projects.
- MVU has a proven record of growth both for teacher professional development and online courses for secondary students.
- MMSCN is a collaboration of 33 regional centers and most of which are located within Intermediate Schools Districts.
- MiCAMP is a well-established state-wide GIS/T professional organization, the broadest source of volunteer mentoring and internship opportunities in Michigan.
- MESTA has a large group of enthusiastic teachers for integrating GIS/T into science curricula.

2. The Project Goals

Goal 1: Establish a three-stage process that encourages a large number of middle and high school students and teachers to engage in learning through GIS/T experiences across the State of Michigan.

The GRACE project, following this process, has three objectives:

(1) deploy an online delivery mechanism and introduce GIS/T lesson modules in STEM and social studies and apply the Science and Engineering Practices (NGSS Lead States, 2013) to enough teachers to help 5,000 students achieve ***Explorer*** level;

(2) collaborate with MMSCN, MESTA, and MDE to recruit 40 schools and 120 teachers to adapt and package in-depth GIS/T-based lesson modules in STEM and social studies classrooms using blended and online PD and encourage 2,500 students as ***Investigators*** to explore STEM questions and challenges (NRC, 2012) and master comprehensive GIS/T skills; and

(3) Engage ***Interns*** in workforce experiences by identifying employable GIS/T skill-sets in cooperation with MiCAMP, providing certified ESRI virtual campus GIS/T training to 500 selected students, and employing 300 of them as GRACE interns to work on GIS/T applications at sponsoring MiCAMP member organizations.

The ***Explorer*** level introduces students to GIS/T through ArcGIS Online Portal and through demonstrations developed with online GIS/T tools to build students' basic understanding of GIS/T as well as pique student curiosity.

The ***Investigator*** level leverages students' curiosity and interest and prepares them to work with GIS/T lesson modules that are designed to enhance the science and engineering practices and align with the Next Generation Science Standards.

The ***Intern*** level provides students with professional GIS/T training and with opportunities to gain work experiences in local organizations as *Interns*. Students apply the skills they've acquired through the first two phases, working within their communities to gain job skills and solve authentic problems. The professional development activities for teachers are tightly integrated with this progressive learning process so that adequate instructional and technical mentoring and support will be provided to support students at each level.

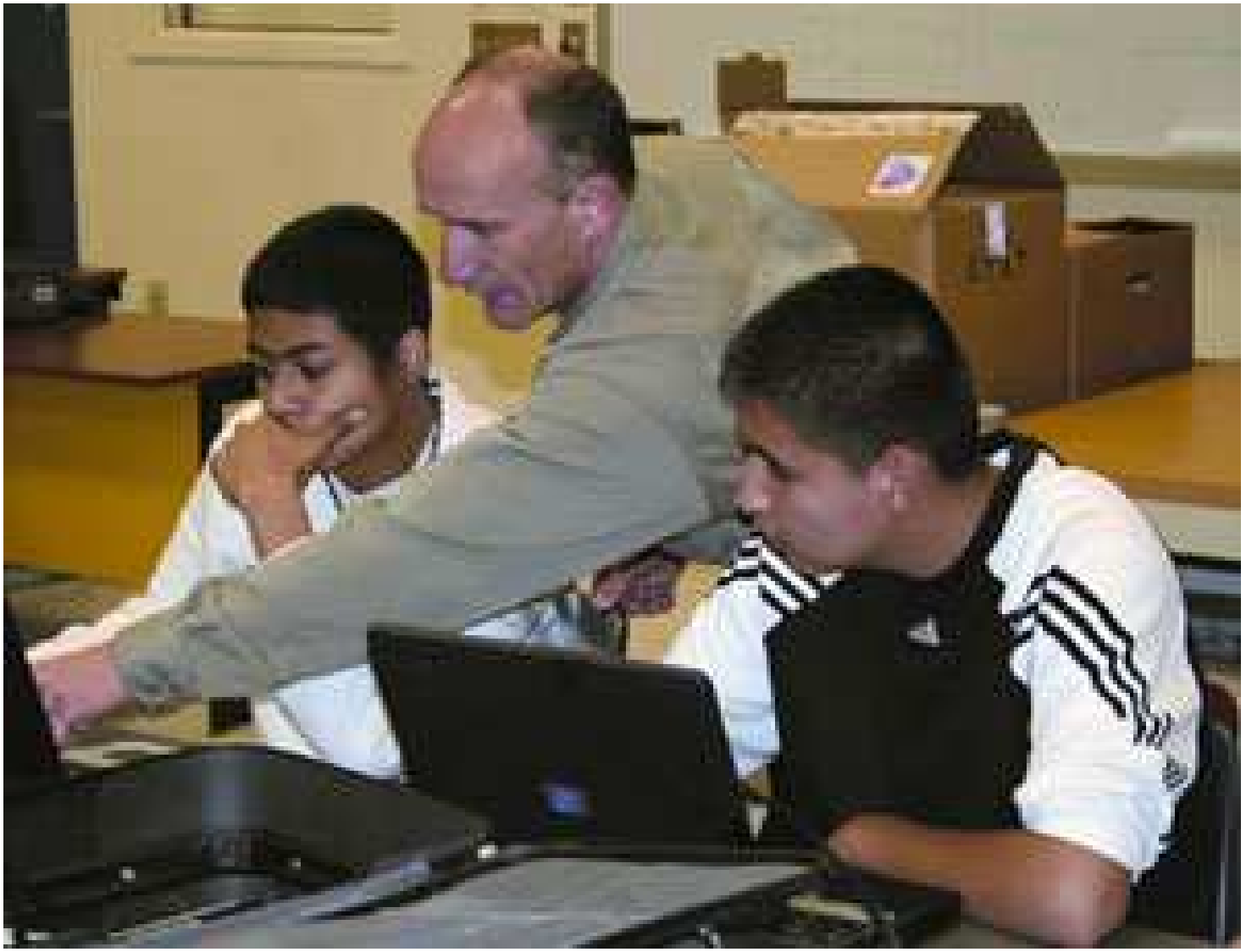
Goal 2: Provide workplace and college experiences to students from underrepresented and rural communities.

The GRACE model advocates the mentorship role of professional GIS/T volunteers and the internship opportunity from GIS/T industries and organizations with a tangible purpose of motivating students' interests in STEM learning and careers. The project will promote strong collaborations between teachers and GIS/T organizations, foster meaningful internships for students, and motivate all students to pursue further career opportunities with GIS/T and obtain professional certification such as ESRI Technical Certification.

In addition, Eastern Michigan University (EMU) is committed to providing high-quality learning experiences to students in Michigan, particularly in southeastern Michigan (including Metropolitan Detroit). EMU, on the basis of its instituted cooperative agreements with school districts regarding pre-college experience and fast-track admission, will extend these agreements to include the participants of the GRACE project. Moreover, two college campus visits per year beginning in Year 2 will be arranged through collaboration with MMSCN and other regional universities in Michigan to crystalize the college going culture for the GRACE participating students.

The needs of GIS mentoring for science teachers

GEO-MENTOR VOLUNTEERS - Support For Teachers & Students



- How are the partners planning to execute the project? – Regional learning clusters, Professional GIS Skills & GIS Mentors!

- The GRACE team through MiCAMP and MMSCN will organize interested Math & Science Centers, School Districts and County Agencies into geographically adjacent learning clusters, where appropriate internship sites will be jointly selected based on the needs in communities. Special attention will be given to schools located in underrepresented and rural communities.

- The GRACE team will collaborate with the largest Michigan GIS/T professional organization, MiCAMP, to develop the intern's skill set based on *the Geospatial Technology Competence Model* developed by GeoTech Center at Del Mar College (http://www.geotechcenter.org/). This intern skill set will be used in conjunction with a selected set of ESRI professional Virtual Campus courses to prepare GRACE students for internships.

- MiCAMP will lead the efforts of inviting and promoting GIS professionals to serve as GIS mentors to school teachers and students.

3. Why Integrate GIS/T in STEM Curricula – for Teachers

The *Next Generation Science Standards* (NGSS) advocate that science education integrates the science and engineering practices, disciplinary core ideas (DCIs), and crosscutting concepts of science and engineering in a three-dimensional fashion across the K-12 years. The integration of GIS/T tools in STEM education provides a perfect environment for creating the three-dimensional learning opportunities.

Instructionally, GIS/T has long been recognized as an interdisciplinary educational technology, supporting high-level thinking and spatial reasoning. Additionally, spatial reasoning and visualization have been demonstrated to be foundational to science, engineering and mathematics.

The GIS/T tools provide the perfect environment for implementing the three-dimensional learning opportunities that entwine the practices, DCIs and crosscutting concepts throughout one learning experience. The extended use of the GIS/T models in the GRACE project will significantly assist in addressing the fundamental science education issues that define the current educational landscape, by providing a format and toolset with support for higher level thinking around core content areas and crosscutting concepts, and demonstrating a practical application of the NGSS model.

4. The Benefits and Commitments for Teacher Participation (the first cohort as an example – 3 cohorts in four project years)

1) 30 insertable GIS-enabled adaptable lessons (30-40 minutes each) that are easily integrated into STEM classes

2) 30 hours blended (16 hours face-to-face and 14 hours online) PD starting in January 2015 ($500 stipend)

3) Attend one week summer institute in July 2015 to crystalize GIS/T education experience ($600 stipend)

4) Tech support from GIS/T professional mentors and pedagogy support from GIS Ed-community

5) Will integrate 10 GIS-enabled lessons in classrooms in two years

5. Why Integrate GIS/T in STEM Learning – for Students

Under a tremendous pressure for improving STEM learning in U.S., The ***Framework for K-12 Science Education*** and the ***Next Generation Science Standards*** advocate that science education integrate the science and engineering practices, disciplinary core ideas (DCIs), and crosscutting concepts of science and engineering in a three-dimensional fashion across the K-12 years.

The eight practices of science and engineering identified in the *Framework* as essential for all students to learn are

P1. Asking questions (for science) and defining problems (for engineering)
P2. Developing and using models
P3. Planning and carrying out investigations
P4. Analyzing and interpreting data
P5. Using mathematics and computational thinking
P6. Constructing explanations (for science) and designing solutions (for engineering)
P7. Engaging in argument from evidence
P8. Obtaining, evaluating, and communicating information

By using GIS, the DCIs, practices and crosscutting concepts become integrated with GIS/T tools, which complements many science and engineering practices. For example:

1) GIS/T serving as data mining analytical and visual aids supports asking questions (for science) and defining problems (for engineering) – **P1**;
2) GIS's integrating data from multiple sources into large data sets supports analyzing and interpreting data – **P4**;
3) GIS's coupling data, analytical models and human interpretations into participatory decision support systems supports developing and using models – **P2**, planning and carrying out investigations – **P3**, and engaging in argument from evidence – **P7**;
4) GIS's coupling with statistical software packages and customizing for complex computations supports using mathematics and computational thinking – **P5**;
5) GIS/T as a computerized mapping system and an integrated multimedia organizer supports constructing explanations (for science) and designing solutions (for engineering) – **P6**, and obtaining, evaluating, and communicating information – **P8**.

GIS/T Are in Demand for STEM Careers

Geospatial technologies (GIS, GPS - global positioning system, and RS - remote sensing)—and the analytical tools for using these systems wisely—now play a fundamental role in the provision of emergency services, transportation and urban planning, environmental hazard management, resource exploitation, military operations, and the conduct of relief operations.

In the years ahead, geographical tools and techniques will be of vital importance to the effort to monitor, analyze, and confront the unprecedented changes that are unfolding on Earth's surface.

Because the uses for GIS/T are so widespread and diverse, the market is growing at an annual rate of almost 35 percent, with the commercial subsection of the market expanding at the rate of 100 percent each year.

7. The Benefits and Commitments for Student Participation

1) Increasing awareness of GIS/T in science, technology, engineering and mathematics (STEM) education and careers through **THREE** instructor-led GIS-enabled lessons (30-40 minutes each) – *Explorer*
2) Enhancing learning practices of science and engineering through **FIVE** instructor-led GIS-enabled lessons involving multiple disciplines and skills – *Investigator*
3) Obtaining industrial standard GIS/T skills through **SIX** virtual campus courses offered by the leading GIS/T company, ESRI, and with mentoring from GIS/T professionals – *Preparation for Interns*
4) Having opportunities to get meaningful workplace experience through a **8-10 weeks** internship in a local agency or industry – *Interns*
5) Interns will receive **$320** stipend for the orientation week and written recommendation letters from their sponsoring agencies or industries

Many thanks for your time!

Questions?

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