The Geospatial Semester: How might you make spatial decisions in your school?

Through a unique dual enrollment program between James Madison University and high schools across Virginia, students learn geospatial technologies from their home campus while earning college credit. Originated by Dr. Bob Kolvoord and Kathryn Keranen, *The Geospatial Semester* engages seniors in their final semester of high school by learning how to apply cutting-edge GIS analysis to local issues. Though the Geospatial Semester may not be unique in its attempt to connect students and their community through technology, it has quickly grown from its inception in 2005 with four participating schools to a burgeoning program of 19 different schools in both Virginia and New York with projections to grow to 24 schools in the Fall of 2013. To date, students have earned more than 5,000 college credit hours. While there are many qualities that have earned this program both awards and international recognition for how students learn and use these technologies to solve real life problems, the Geospatial Semester is anchored by three fundamental traits: *its relevant, adaptable design;* its *flexible, creative instructors;* and its *involvement of higher education*.

The Design

Flexibility

Unlike the increasingly rigid structure of many high school classes driven by standardized tests, The Geospatial Semester (GSS) encourages variation from school to school. While there are common components that you will find in each of its classrooms, the GSS structure is designed to be flexible to accommodate the many needs and designs of different classrooms, schools and divisions. At its most basic level, students learn GIS and GPS technologies in their classes on campus and how they might be applied in a variety of fields. This is punctuated by monthly visits from James Madison University (JMU) professors and two formal assessments. The first is a midterm exam where students apply analysis techniques to solve a standard problem or scenario. The second is a final exam where a student or pair of students choose a topic or issue of interest in which they use geospatial tools to investigate or synthesize a solution. In each exam, students participate in a brief oral defense before a small panel of JMU professors where they answer a variety of questions about the interpretation and meaning of their projects.

As a dual enrollment course, students are earning JMU credit for Geographic Science 161-Geospatial Tools and Techniques and/or ISAT 181—Student Research. On their own campus, students are enrolled in whichever course the district or sometimes the school has decided the GSS best aligns with in their program of studies: a Career and Technical Education (CTE), social studies/civics or most often a science course. This provides schools both content and scheduling autonomy. Participating teachers can gear their instruction more

Courses by the Numbers	
Science	13
Civics	3
CTE	3

towards science, STEM or civics applications. In many cases this alleviates (or can eliminate) the restrictions often accompanied by subject pacing guides. Teachers gear their instruction towards content relevant topics and in the case of 'electives' they further explore the interdisciplinary applications of GIS and GPS. In all cases, the frequency of the classes meetings over the course of a semester or year determines the number of credits the students earn from JMU. The GSS has developed relationships with a variety of colleges and universities so that the credit earned by participating students easily transfers to their school of choice.

Relevance

A primary element that allows the Geospatial Semester to be so flexible is its relevance to topics of student interest, and how the students interact with their surroundings. Certainly the students need to learn the software. There is a specific level of competency students need to reach with the software and this can be done in a variety of ways including direct instruction, miniature labs, and tutorial books. GIS is inherently "transferable"—it can be utilized in an increasingly broad array of fields and professions—and JMU emphasizes and strongly encourages schools and classrooms to broaden their focus beyond software skills for skill sake alone to embrace the application of analysis techniques as they explore pertinent topics and issues . For this reason, there is no intrusive pacing guide for the GSS. Instead, teachers and JMU professors look for evidence of software competency in the labs, projects and exams the students complete. Ultimately this approach reinforces the flexibility different schools and districts need to run a course in different subject areas; the classes can pursue meaningful uses of the technology that allow teachers and students to explore their curriculum and content.

> "When I signed up for the class, I thought [it] would be just another science class that our school would try to put a "fun" spin on, but this class is one of the most exciting classes I've ever taken. It makes you think, it challenges you to be innovative, but it's something you can use. It makes the work more meaningful when you know you're doing something that affects your life." ***–Julie, Fairfax County***

By design, there are many ways the GSS keeps the classwork meaningful to the students. A primary emphasis is on 'Problem Based Learning'. Students get the chance to explore problems and issues in a way that breaks through the typical barriers of a traditional classroom. Students not only embrace, but they excel given the opportunity to explore issues that are applicable to them. Teachers and students often choose topics or issues that are pertinent to current events, personal interests, or their school or community. Rather than perform a stock or previously solved lab, students get to address real issues such as mapping and evaluating patterns of crime in their community; identifying the best locations for relocating bears in a national park given

the proximity to food sources and hiking trails; or analyzing the optimal location of solar farms in the northeastern states. In each of these cases, students got to tackle complicated, real-world issues that don't necessarily have a "right" answer.

A final element that allows the Geospatial Semester to stay current with the students (and ultimately flexible) is the understanding that technology and curriculum constantly change. Students have access to software that matches or exceeds what can be found in the professional workplace. Schools share new Trimble Juno GPS devices that allow them to record data in the field and differentially correct it like professional surveyors. Students operate ArcGIS 10 and 10.1 on their classroom computers. This year the GSS has provided access to ESRI's online feature services so that students can create mobile applications to collect and map data with their smartphones. Staying current with the ever-changing technology allows classes to regularly update their techniques and their curriculum. Ultimately, this not only prepares students for the next steps in their education, potential internships and jobs, but it keeps students challenged, creative and interested.

Core Beliefs of Geospatial Semester

- Be Flexible in Integration and Application
- Utilize Problem Based Learning—Be Relevant
- Keep Evolving

Last summer, students from the Geospatial Semester at Washington-Lee High School in Arlington, VA were selected to present their work on stage at the ESRI User Conference in San Diego, CA. After just one year of training in high school, these students were able to analyze and understand how metro stations influence local development, develop a mobile application that would allow local storm water specialists to inventory drains, and utilize remote sensing to identify wetlands within land easements for government officials. In doing this analysis and working on these projects, students not only expanded their understanding of the content, but they had to plan a project, work together and learn to speak in front of a group—all relevant and necessary skills in both academia and the work place. Ryan Miller, their instructor, shared with the 14,000 professionals in attendance, "I use Problem Based Learning in the classroom. It's taking what you do as GIS Professionals and taking and bringing some of that into the classroom….There's meaning and there's purpose in doing this and the students tell me, and I believe them, that its rewarding and motivating to do actual project work."

The Instructors

In *any* class a primary determining factor of success or failure is the instructor. The Geospatial Semester has a variety of teachers, most whose core training is in something other than geographic information systems: biology, earth science, geosystems, chemistry, world history, U.S. history, digital imaging, and CAD to name a few. In all of these cases, the teachers weren't selected for their content specialty but rather for their ability to succeed and function within the core design of the GSS.

The most successful teachers share a combination of traits. A vital quality is a willingness to work outside one's comfort zone. For some, that means relinquishing a sense of 'control' and exploring new aspects of the software alongside the students. Adolescents are technophiles by nature and explore the software in unanticipated ways. When teachers embrace this exploration, everyone's skills, including the instructor's, get better. A desire for continuing improvement is often more important than initial expertise.

Strong teachers also keep their students engaged by staying creative. Encouraging and pursing new project ideas and forming partnerships with groups outside of the classroom keep learning dynamic and students involved. When Geospatial Semester classes have mapped out cell phone coverage on school campuses, analyzed school bus routes, and partnered with groups like the US Fish and Wildlife Service and The Nature Conservancy, students stay engaged and learning is both relevant and engaging.

Core Characteristics of GSS Instructors

- Receptive. Willing to Work Outside of Comfort Zone
- Progressive. Looking Forward and Staying Creative
- Connected. Actively Looking for Partnerships and Applications

MEET THE TEACHER

Instructor: Tara Meadows
School: Luray High School—Page County, VA
Subject Area: Social Studies
Years with Geospatial Semester: 6

Tara Meadow's approach to instruction really captures how staying creative keeps students engaged in what they are doing. JMU faculty member Kathryn Keranen notes that one of Tara's greatest strengths is her "…ability to get students to focus on a self-selected spatial project." In addition to continually helping students explore viable projects of personal interest, she also looks for local groups or organizations that have a need for spatial analysis. In the past her class has partnered with officials with the National Park Service looking into bear relocation. Recently her class partnered with a local organization, the White House Farm Foundation, where in addition to mapping assets and landscaping, they mapped the location of plantings to help project expanding tree canopy over time. The product of this work resulted in an embedded map into the foundation's website. Finding local applications of GIS keep Tara's students interested and result in outstanding projects; six of them have been recognized in the annual GSS map contest over the past 4 years.

The Partnership with Higher Education

Every high school dual enrollment program requires a basic, perfunctory relationship with an institution of higher education to function. However, the heart of the Geospatial Semester's growth and success is James Madison University's *active* involvement and collaboration with participating high schools on many levels. Without this type of support in today's educational climate, schools would be unable to sustain the observed level of performance due to cost, personnel and required experience.

From an organizational level, JMU has committed substantial resources. Through a partnership between its Integrated Science and Technology (ISAT) and Outreach and Engagement (O&E) programs, JMU makes it possible for two faculty members to make monthly visits to each of the participating classes. These visits serve several functions. The visiting faculty observe, teach lessons, or work with students, groups and teachers. The visits provide JMU with a regular opportunity to monitor the rigor and quality of the classes, and they allow JMU faculty to serve as 'instructor on record.' This gives K-12 administrators the ability to insert this course where it best fits in their program of studies, and it prevents individual schools or districts from needing to certify or hire specifically GIS-endorsed instructors, ultimately saving them money.

JMU faculty also play an important supporting role between visits by providing technical, data, and project support to GSS students and teachers. Technical problems often derail GIS implementation in K-12 classrooms and the JMU support helps surmount these problems. In addition, the JMU faculty help shape student projects from interesting ideas into viable efforts. Few teachers have the broad knowledge of data sources and analytical techniques to support the range of projects that develop in their classrooms

"True engagement happens when there is reciprocity."—**Jim Shaeffer**

The economics of dual enrollment vary between districts. In some circumstances, students pay the tuition themselves. In other districts, the cost is shared and in some instances, the district pays the entire cost. For all students, the tuition is steeply discounted from normal, on-campus rates.

From the university perspective, the value of the GSS goes beyond simple economics. The GSS offers a unique opportunity to recruit students to Geography or other GIS-intensive disciplines on campus. While not every student will develop a passion for GIS, the opportunity to build strong relationships with constituent high schools has considerable value.

Jim Shaeffer, the Associate Vice Provost for Outreach and Engagement at JMU, points out that the value hinges on two key components: flexibility and engagement. First, the university must realize that it is serving students other than those directly on campus. While institutions

usually have very strict processes and guidelines, the system needs to be able to adapt to high schools' uniquely different circumstances such as course start and stop times, and registration/payment processes. The second key component is the recognition that that engagement requires reciprocity. Schools have a need for dual enrollment in desirable areas such as STEM. JMU doesn't simply implement a rigid program; it partners with schools by recognizing that everyone brings something to the table. A successful dual enrollment program is a collaborative experience.

In addition to operating the Geospatial Semester program, James Madison University also manages the Virginia K12 GIS Site License Consortium. While educational technology can often go under-supported in public education—Virginia schools benefit from both training and dual enrollment opportunities operating from a centralized location. Teachers, regardless of the whether they are participating in the Geospatial Semester, have access to training at multiple locations throughout the summer and access to online courses through ESRI's Virtual Campus.

Key Roles of Higher Education

- Dual Enrollment
- Supporting Quality Instruction & Provide Training
- Think Out of the Box. Be Flexible and Engaging

MEET THE TEACHER

Instructor: Bill Ryan
School: Colonial Heights High School—Colonial Heights, VA
Subject Area: Science
Years with Geospatial Semester: 6

Bill Ryan's teaching style best reflects the cooperative nature of the Geospatial Semester. If anyone were to walk into the class, it would take a moment to find him as he rarely is at the front of the class writing on the board or demonstrating on the teacher machine. Instead he is embedded within the students; moving from computer to computer offering tips to students and picking up pointers to share with others. According to Bill, "In the Geospatial Semester you don't teach as much as guide students. You can point them [in] the right direction and help them navigate if they get too far off course, but they get to do most of the steering themselves. This gives them the opportunity to learn by doing, not learn by reading." The fruit of this approach are meaningful, community related projects including local crime studies, the creation of a "river walk" along the Appomattox River, and the creation of a disaster template for the city to use to aid in evacuation.

Ten Key Ingredients to a Successful Program

1. Access to Current Software and Hardware
2. Familiarity with Software
3. Flexible Curriculum
4. Dual Enrollment
5. Problem Based Learning
6. Project Mentorship and Teacher Support by University Faculty
7. Introductory Curriculum Materials
8. Formal Presentations
9. Teacher Flexibility
10. Projects Relevant to Student Interests

The Geospatial Semester is an effort to explore "mentored" dual enrollment, where university faculty work hand-in-hand with K-12 faculty to bring students the opportunity to engage with cutting-edge technology and apply it to local problems of interest. The inherent applicability of GIS to a broad array of fields and problems engages students in ways that high-stakes tests never can and never will. The GSS was originated to help high school students remain engaged and working hard through their final semester, in part so that they were ready to begin college work a few short months later. Eight years later, they see this engagement in every school they visit and GSS students have regularly produced remarkable work.

For more information, please consult the GSS website http://www.isat.jmu.edu/geospatialsemester or contact a member of the Geospatial Semester team.

Bob Kolvoord is an award-winning teacher, curriculum developer and researcher at James Madison University, where he serves as a professor of Integrated Science and Technology and Educational Technologies. He also serves as the Interim Dean of the College of Integrated Science and Engineering. With Kathryn Keranen, he is the co-creator of the Geospatial Semester and the co-author of Making Spatial Decisions Using GIS (1st and 2nd edition) and Making Spatial Decisions Using Remote Sensing. He is a member of the NSF-funded Spatial Intelligence and Learning Center and is interested in the impact of geospatial technologies on students' spatial thinking skills. For the last 25 years, he's worked with teachers to help bring data visualization tools to K-12 classrooms. Email: kolvoora@jmu.edu

Kathryn Keranen has 30 years of classroom teaching experience and was instrumental in introducing GPS, GIS and remote sensing into the curriculum in Fairfax County, Virginia. She is an authorized K-12 ESRI instructor and a member of the instructional team of ESRI's T3G Institute. Since, retiring she has worked as a private consultant for many groups and universities. With Bob Kolvoord, she is the co-creator of the Geospatial Semester and the co-author of Making Spatial Decisions Using GIS (1st and 2nd edition) and Making Spatial Decisions Using Remote Sensing. Kathryn currently serves as an adjunct instructor at James Madison University in support of the Geospatial Semester. Email: kkeranen2@cox.net

Paul Rittenhouse is a Geospatial Projects Coordinator and Instructor at James Madison University where he coordinates the Geospatial Semester, manages the Virginia K-12 GIS Site License, and teaches in Geographic Science program. With over 10 years of classroom teaching experience, he has been recognized for both his work as a Geospatial Semester teacher and his integration of spatial technologies into the ecology curriculum at Western Albemarle High School in Crozet, Virginia. Prior to joining the staff at JMU, Paul served as a GIS Coordinator for the international environmental engineering firm TEC Inc. (now Cardno TEC.) Email: rittensp@jmu.edu