Title: Assessing the State of Geospatial Education within the Community College System

Authors: Dr. Mike Rudibaugh and Brooke Ferguson

ABSTRACT

This paper summarizes recent geographic trends associated with the distribution and development of geospatial technology programs within the nation's community college system. Specially, this paper attempts to define, describe, and map the distinct regional trends associated how community college colleges have responded to the growth of the geospatial workforce. A database was developed using geographic information systems to track the location and general characteristics of community colleges across the country. Those colleges with curricula including geospatial education were classified. We then examine the spatial distribution of community college geospatial programs (those with courses and certificate/degree programs), and determine through regional analysis that the western region of the United States contains community colleges with the greatest amount of geospatially-based courses and programs. This paper serves as an introduction to the spatial variability of geospatial education in the United States' community colleges.

INTRODUCTION

This research evolved from the recent funding for a National Geospatial Technology Center (NGTC), which was funded by the National Science Foundation (NSF) DUE #0801893, serving to promote and elevate geospatial education across the nation's 1185 community colleges. In year one of the grant, 2008, the NGTC decided to capture a baseline of the presence of geospatial education across the community college system using geographic information system (GIS) mapping technology. The goal of the project was to serve as an example of how GIS could be used as an evaluation to geographically measure, map, and describe the spatial impact of NGTC impacts on the national community college system over time. Currently, little to no research has ever been conducted using GIS to evaluate the regionalization of National Science Foundation Advanced Technological Education (ATE) Centers and their spatial relationship with Science, Technology, Engineering, and Mathematics (STEM) workforce demands. This paper attempts to add to the literature on the use of GIS to communicate and assess how emerging STEM fields develop regionally across the community college system. In addition, it also demonstrates how geospatial visualization could be used by funding agencies, evaluators, and researchers on the link, if any, between how education programs develop nationally in relation to local workforce demands. Past research on the spatial linkage between Geospatial Spatial Technology GST programs and GST companies indicate patterns do exist. Evidence suggests that GST companies or related employers tend to locate in close proximity to GST higher education programs (Thrall and Campins 2005). Proximity to local or regional supplies of GST educated workers impacts critical site decision in locating GST industries. This paper attempts to geographically outline the current supply of geospatial technicians being produced by the community college system.

Outcomes of this research are to establish a current baseline of which regions, if any, have current advantages in producing, driving, and participating in the geospatial economy.

METHODS

Relative to this paper, geospatial technology is defined as geographic information systems (GIS), global positioning systems (GPS), and remote sensing. Recent findings by the NGTC through workforce studies using developing a curriculum (DACUM) results indicates clearly that geospatial workers are increasingly drawing upon all three mapping technologies in the geospatial workforce (Johnson 2010). Prior workforce studies like the DACUMs from NGTC and concurrent National Science Foundation ATE Projects like the Integrated Geospatial Education Technology & Training program (iGETT) indicate an increasing convergence of GIS, GPS, and remote sensing into technician preparation.

In the fall of 2008 the NGTC began to synthesize resources on the national community college system. Using a variety of sources from the American Association of Community Colleges (AACC) and Environmental Systems Educational Customer Database (ESRI), the GeoTech Center developed a list of community colleges (n = 1185). Using ArcGIS geocoding services, coordinates were retrieved for each college's geographic location. NGTC staff and student workers then proceeded to develop a classification system representing how geospatial education was represented, if at all, within each community college (Figure 1). The tier system developed is listed below:

1. No geospatial courses
2. Geospatial Courses
3. Geospatial Certificates
4. Geospatial Degrees
5. Geospatial Degrees and Certificates

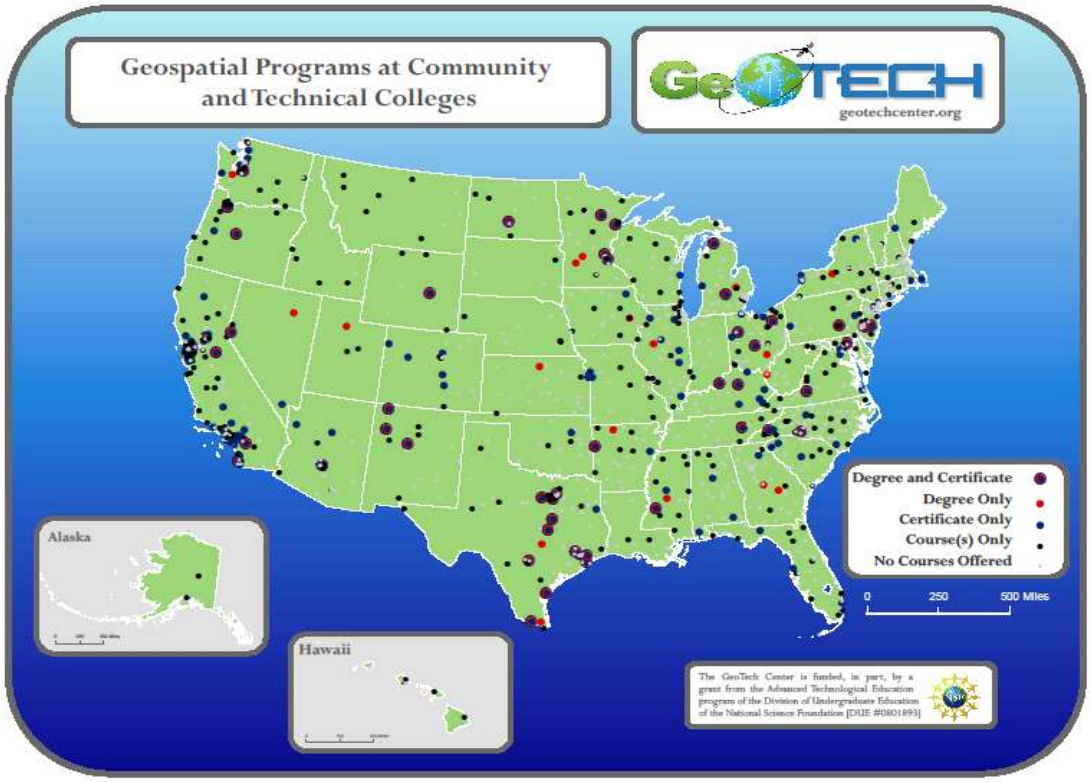

Figure 1. Geospatial Programs at Community and Technical Colleges (2009)

Validation of each college's classification was accomplished using a variety of techniques. During the fall semester of 2008 GIS students within Lake Land College's GIS program began to check each college's website for programming information relative to how each college offered GST classes. Each college was researched to assess if they offered GST courses, certificates or degrees. This information was critical in assessing the state of geospatial education within the nation's community college system. In addition, NGTC research added critical contact information about lead faculty or program directors at each college with GST offerings. Information like instructor name, e-mail, phone number, and department housing GST classes was built into the research database. An intended outcome of the project was designed to provide a professional link between GST instructors at community colleges across the country. The NGTC converted the database into a web-based viewer, which can be accessed from http://www.geotechcenter.org/, to promote greater access to this information in linking students to geospatial programs, resources, and faculty at community colleges.

RESULTS

Using Figure 1 as a spatial representation of the current geospatial programs across the country indicates clear regionalization on geospatial education trends across the country. Colleges with

established geospatial certificates, degrees, or a combination of both indicate stronger tendencies to support and grow the geospatial workforce. National trends indicate the community college system is still developing a capacity to serve the growing geospatial economy (Table 1).

NGTC Map Tier System	Number of Colleges
No GST Offerings	733
GST Courses	287
GST Certificates	96
GST Degrees	19
GST Degrees and Certificates	50

Table 1. NGTC Community College Map Classification by Frequency of Tier Classification

The table above clearly indicates most community colleges have not translated or reacted to the growing geospatial economy. Currently, the community college system has few colleges that have developed formal credentialing options supporting the geospatial economy through certificates or degrees within GST. Breaking down or classifying GST offerings by region reveals more details about the current status of GST education within the nation's community colleges. Each college was assigned by proximity to one of the NGTC partners. These partners were selected for a variety of factors, which include the region they represented, and attempts were made to have most geographic areas of the country represented within the NGTC network of partners (Table 2).

College	Region
Gainesville State College - GSU	Southeast
Lake Land College - LLC	Midwest
Southwest College - SWC	West
Central New Mexico College - CNM	Mountain West
Bismark State College - BSC	Upper Midwest
Kentucky Community and Technical College (KCTC)	Mid-South
Cayuga Community College - CCC	Northeast
Central Piedmont Community College - CPCC	East
Delmar College (NGTC) - DMC	South

Table 2. GeoTech Center Partners by Region

Different regions of the country could very well have different needs, challenges, or opportunities that the NGTC needs to be aware serving the national movement for GST education. Evidence for this project clearly indicates a one-size fits all model for outreach and support to elevate GST education across the community college system is not appropriate. Results from this regional analysis indicate that one region has clearly moved ahead relative to the development of geospatial technology courses, certificates, and degrees (Table 3).

Partner	N	No GST	Classes	Cert.	Degree	Cert. and Degree
GSU-Southeast	130	87	25	12	3	3
LLC-Midwest	206	136	46	16	3	5
SWC-West	218	86	87	83	2	10
CNM-Mountain	64	38	16	6	1	3
BSC-Upper Midwest	63	36	21	3	3	0
KCTC-Mid-South	84	56	11	8	3	6
CCC-Northeast	211	150	41	14	2	4
CPCC-East	108	77	22	5	4	0
DMC-South	101	67	18	2	2	12

Table 3. Community College GST Education by Region

Using regional analysis, the NGTC can now see regional difference and similarities across the national community college system. Awareness appears to be one of the greatest challenges facing the expansion of geospatial technology within the nation's community colleges. Within every region of the NGTC network of partners, except for the West, the modal classification is no GST classes. Clearly, most regions within the United States are still viewing GST as a new developing programming area for community colleges. Most colleges simply have no courses

and very few have any credentialing options such as degrees or certificates. These results suggest NGTC's challenge in most regions of the country relates to awareness of the geospatial technology industry. Community colleges in the Northeast, Midwest, South, Upper-Midwest, and Eastern regions have not responded to the growing demands for geospatially enabled workers. One region simply stands above the others relative to GST programming. Evidence indicates the West Region is the only region of the country the majority of schools have some level of GST offering within each college. Clearly, this region is at a different developmental stage in addressing workforce and industry demands through the region's community colleges. The NGTC's partner in this region, Southwest College, has different opportunities and challenges. Geospatial education in the Western Region appears to have institutionalized across the community colleges. These faculty and their institutions have moved beyond the need for geospatial awareness and are serving the growing needs for geospatial education. These colleges have regionalized this movement forward through their actions associated with the development of courses certificates, and degrees. The NGTC, in turn, will need to potentially offer different outreach and support for these schools as they might have different needs beyond the typical introductory workshops that dominate early professional development events for faculty at community colleges. What competitive advantages have given the Western region the spatial clustering associated GST education within their community colleges? Has the presence of the Environmental Systems Research Institute's (ESRI) headquarters, which is located in Redlands, California, given this region a greater sense of the potential of geospatial technology? In addition, ESRI's International User Conference is held every summer in San Diego and results in thousands of participants migrating from all over the world for this high profile event. Are these events giving the geospatial industry the visibility needed to translate the scale, needs, and employment potential for community colleges to respond? These will be dynamic and interesting questions for the NGTC to respond in attempting to grow and sustain GST programs at community colleges across the United States. Currently, as this research indicates, most areas or regions of the United States are still in a 'lack of awareness' mode as the community college system still has not responded to projected growth of the geospatial workforce.

DISCUSSION

This paper diagrams a current snapshot of geospatial technology (GST) education across the nation's community colleges. Evidence indicates most regions of the country are dominated by colleges with little to no history with developing GST courses, degrees, or certificates. The National Geospatial Technology Center's challenge, as a National ATE Center, is to promote systemic change in how technicians are prepared in supporting the geospatial economy. Currently, most regions of the United States have not responded to the U.S. Department of Labor (DOL) findings relative to the findings associated with the growth of Geospatial Technology Industry. The DOL recently accepted the NGTC's sponsored Geospatial Technology Competency Model (GTCM) in the spring of 2010 (U.S. Department of Labor 2010). The GTCM represents the most comprehensive attempt to define the Geospatial Industry relative to

competencies, behaviors, and skills needed by workers to participate in this sector of the economy. Outcomes of this research indicate some promising results for community colleges to expand GST offerings at campuses across the country. The DOL added five new occupations (Table 4) demonstrating the growth of the geospatial technology industries across the national economy.

Occupation	Employment (2008)	Projected Growth (2008-18)	Growth Rate (2008-18)
Geospatial Information Scientists and Technologists*	209,000	72,600	Average (7-13%)
Geographic Information Systems Technicians*	209,000	72,600	Average (7-13%)
Remote Sensing Scientists and Technologists*	27,000	10,100	Average (7-13%)
Remote Sensing Technicians*	65,000	36,400	Average (7-13%)
Precision Agriculture Technicians*	65,000	36,400	Average (7-13%)
Geodetic Surveyors*	58,000	23,300	Faster than average (14-19%)
Surveyors	58,000	23,300	Faster than average (14-19%)
Surveying Technicians	77,000	29,400	Much faster than average (≥ 20%)
Mapping Technicians	77,000	29,400	Much faster than average (≥ 20%)
Cartographers and Photogrammetrists	12,000	6,400	Much faster than average (≥ 20%)
Totals	**857,000**	**339,900**	

* New occupations established late 2009
Source: U.S. Department of Labor, Employment & Training Administration O*NET Online access June 20, 2010

Table 4. Geospatial Occupations with Employment Numbers and Projected Growth

The U.S. DOL is clearly projecting dramatic growth for the geospatial workforce. Are the nation's universities and community colleges prepared to educate, prepare, and facilitate the projected growth of 339,000 workers needed to support the geospatial economy? In addition, numerous educational studies like the National Research Council's, *Learning to Think Spatially* (2006), argues the importance to elevate spatial thinking in supporting student learning. The report suggest that spatial thinking and awareness to be integrated into standards covering a wide spectrum of academia (NRC 2006). The convergence of rising workforce demands and linkages of geospatial technology to elevate student learning places community colleges in a dynamic position to address these challenges. Community colleges with their diverse missions relating to workforce development, transfer education, and community service programs place these institutions in a unique position to address these challenges. The community college system has not responded on a national scale to the rising workforce demands, or use of GST, in supporting learning from mathematics, social science and physical science curriculum. Clearly the Western Region, as indicated with this research, is leading the national movement as community colleges here have developed more and diverse geospatial education options in support of growing workforce demands. Also, this paper serves to demonstrate how GIS could be used in evaluating federal grant programs like National Science Foundation ATE Centers. The regionalization of

geospatial education within the nation's community colleges is a clear indicator of how location matters. This paper serves to model how GIS, spatial thinking, and economic geography can be linked together to assess on a national scale the growth of a new economy industry like geospatial technology. This paper at its core demonstrates the use of GIS to examine, evaluate, and assess how community college regions respond to national workforce movements in different or similar ways. Successful outcomes of this paper will hopefully lead to greater cross disciplinary discussion between NSF-ATE Centers, community college leaders, and geographers on the use of GIS to evaluate the supply and demand relationships relating to new STEM workforce area like geospatial technology.

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