The University of Wisconsin-Eau Claire proposes a new Bachelor of Science (B.S.) and Bachelor of Arts (B.A.) degree in Geospatial Analysis and Technology (G.A.T.) within the Department of Geography and Anthropology. This major was designed in accordance with the timeline specified within the UW System Growth Agenda Grant, the Geospatial Education Initiative (GEI). G.A.T. majors will have the option to pursue either a Bachelor of Science (B.S.) or Bachelor of Arts (B.A.) degree.

The proposed major will ground students in current geographic and geospatial traditions while enhancing existing technical and pedagogical methods in a multidisciplinary learning approach. Due to the fact Wisconsin is lagging behind its neighbors in terms of geospatial related employment, this degree will provide students with cutting edge skills to enhance economic growth in Wisconsin. Furthermore, the G.A.T. is aligned with the University’s liberal education goals. This comprehensive major is intentionally integrative in design and encourages transformative learning via an engaging curriculum and embedded high impact practices, such as internships and undergraduate research opportunities, and by enhancing critical thinking both inside and outside the classroom. This comprehensive major is comprised of 60 credits in a 120-credit degree and will ensure students will complete all liberal education goals and other university graduate requirements in four years.
geospatial certificate, 30 students were enrolled in the program. A total of 12 students completed the requirements for the geospatial certificate in 2013-2014 and 14 students completed in 2014-2015. Students graduating with the geospatial certificate were primarily majors in geography, biology, geology and computer science. The expected enrollment and graduation projections for students entering the program are in Figure 1. The projected enrollment numbers for years one and two are based on students currently enrolled as geography majors, minors, or in the geospatial certificate program who are projected to choose the G.A.T. major. Thereafter, we anticipate 25 new majors each year. The current University-wide retention rate after the freshman, sophomore, and junior years is 83%, 75%, and 70%, respectively. Based on those retention rates, by year 5 we expect that 80 students will be enrolled and 20 students will have graduated.

**Tuition Structure**
Students will be assessed the standard undergraduate tuition and fees that all UW-Eau Claire students pay. For the 2014-15 academic year, the residential tuition and segregated fees total $4,372 per semester for a full-time student who is enrolled in 12-18 credits per term. Of this amount, $3,681 is attributable to tuition and $691 is attributable to segregated fees. Full-time students will be able to complete all degree requirements in eight semesters. For students enrolled part-time in the program, the residential cost of tuition and segregated fees is $364 per credit.

The only additional fees assessed to students in this program will be two special course fees. Students will be assessed a $200 special course fee for the Unmanned Arial Systems course. In this course, students will build their own UAS and the fees will cover the costs of materials. The other course assessing a fee will be Geography 336 Field Methods. Students are currently assessed a $50 fee for this course to cover equipment upkeep and transportation costs due the field based nature of the course; that fee will continue in the G.A.T program.

**Department or Functional Equivalent**
The proposed program will reside in the Department of Geography and Anthropology.

**College, School, or Functional Equivalent**
The G.A.T. program will be housed within the College of Arts and Sciences.

**Proposed Date of Implementation**
Fall 2016

**INTRODUCTION**

**Rationale and Relation to Mission**
Faculty in the Department of Geography and Anthropology were awarded a UW System Growth Agenda Grant entitled “Geospatial Education Initiative” in 2014. The funded grant expanded on prior work enhancing geospatial offerings with an interdisciplinary approach in conjunction with the Departments of Computer Science, Physics, and Information Science at UW-Eau Claire. This grant also helped build relationships with private businesses and enriched our geospatial curriculum.

Specifically, the fully funded GEI grant is a three year initiative that aims to increase the number of Wisconsin graduates placed within successful careers in the geospatial industry, as well as related industries, by directly improving access to high quality academic programs and innovative educational opportunities. The geospatial sector encompasses technologies such as GPS (global positioning systems), GIS (geographic information systems), web mapping, and earth imaging satellites. These cutting edge technologies are used to map, visualize, and analyze the world around us. Increasingly, these technologies and the resulting spatial data are in high demand as their utility in decision making and problem solving becomes evident across industries ranging from health care to business development. The GEI’s three core goals will: 1) enhance teaching and learning by developing informative relationships between UW-Eau Claire faculty and Wisconsin businesses; 2) create a sustainable and relevant internship program with geospatial-related businesses; and 3) transform geospatial education through innovating existing curriculum, developing new course offerings, additional certificates and the G.A.T.

The mission statement of UW-Eau Claire is to “…foster in one another creative, critical insight, empathy, and intellectual courage, the hallmarks of a transformative liberal education and the foundation for active citizenship and lifelong inquiry.” Currently guided by our Centennial Plan, it is within UW-Eau Claire’s mission to provide rigorous, intentional, and experiential undergraduate liberal education for life and livelihood. The proposed major in Geospatial Analysis and Technology is fully consistent with that mission and encapsulates the Centennial Plan by utilizing a number of the stated goals including Goal 1: Fostering Purposeful Learning, Goal 2: Promoting Connected Learning, Goal 3: Accelerate Global Learning, and Goal 6: Focus Programmatic Resources. Connected to these goals, this proposed major is intentionally integrative and allows for transformative learning via an engaging curriculum and embedded high impact practices, such as internships and undergraduate research opportunities, both inside and outside the classroom, providing unique opportunities to increase student’s technological skills through the liberal arts approach to integrative learning.

Need as Suggested by Current Student Demand

The number of majors in geography has increased from seventy-five in 2008 to 115 in October of 2015. Much of this is attributed to collaboration with departments (i.e. biology) to grow our environmental geography comprehensive major as well as increased interest in geospatial technologies. The addition and success of the geospatial certificate was the catalyst for this proposed program. The G.A.T. degree will supplement the needs of our current geography majors, while also providing additional support for students with greater interests in geospatial technologies. Discussions with business leaders as part of the GEI grant activities provided evidence that employers are searching for graduates with geospatial skills. Graduates are at an advantage if they have both a spatial perspective as well as an understanding of science and technology. The core of the major, which is rooted in geography, and the flexibility of the course plan of the comprehensive G.A.T major allows for easy movement between our current geography major and the G.A.T. program. Outside of UW-Eau Claire, the G.A.T. will also
provide a solid foundation for students interested in pursuing graduate work. This is specifically true for the newly proposed master’s degree in GIS at UW-Stevens Point. Students who successfully complete the G.A.T., and are interested in graduate level GIS work, will be well prepared to complete this master’s degree.

Need as Suggested by Market Demand

The geospatial technology sector is already recognized as a high growth industry by the U.S. Department of Labor, Employment and Training Administration. The anticipated growth in the geospatial industry, estimated at 35% annually by the Geospatial Information and Technology Association, presents a tremendous opportunity for UW-Eau Claire to increase the number of graduates placed within successful careers in Wisconsin and beyond.

The geospatial industry is strong within the state and recent trends suggest the growth will continue. The County Business Pattern data collected for Wisconsin by the U.S. Census Bureau indicates that in 2011, there were 161 businesses employing 639 people directly classified within the geospatial industry. The CBP data, however, grossly underestimates the number of businesses that are engaged in the geospatial industry. Job posts for geospatially related employment on the Wisconsin State Cartographer’s website have seen a steady increase over the past decade with over 180 posts alone in 2013. These numbers clearly demonstrate the demand for graduates with geospatial expertise in the state.

The success of the current geospatial certificate program at UW-Eau Claire also demonstrates the demand for geospatial education. During the initial offering of the geospatial certificate, 30 students enrolled and that enrollment continues to the present date; these numbers suggest strong demand for geospatial program offerings. Many of these students have already been awarded high-demand positions at leading companies in Wisconsin and beyond such as Esri, Garmin International, Continental Mapping, Ayres Associates, Xcel Energy, Mandli Industries, and National Geographic. The Geospatial Certificate program and the quality of the students graduating with this credential have already led to Wisconsin and nation-wide companies recruiting UW-Eau Claire students for high demand and highly skilled careers. That is to say, UW-Eau Claire is uniquely positioned to fill this industry need.

In January 2015, a study was commissioned with the Education Advisory Board to gauge potential geospatial job markets in the upper Midwest. They examined all job opportunities for 2014 and identified over 1,500 geospatial related jobs requiring a Bachelor’s Degree. The largest number of geospatial related job posting was found in Cook County, IL (Chicago). The next largest, with over seventy-five postings, was in Peoria County, IL, followed by Hennepin and Dakota Counties in MN and Dane County in WI. Further analysis of key words used in job postings between 2013 and 2014 found large increases for the use of generalized titles such as System Administrator (+50), Hydrologist (+15), and Data Analyst (+15), all of which are tied to geospatial technology.

The job postings for geospatial technology related positions in the study region identified many of the skills and knowledge that are provided in the courses for the proposed G.A.T major. This overlap of job requirements and curricular learning outcomes, especially in the realm of Geographic Information Systems (GIS), demonstrates the alignment of our curricular design with the market demand for employee skills. The most common job titles included GIS Analyst, GIS Specialist, Geospatial Analyst, and GIS Technician. A more specific inquiry of Wisconsin and Minnesota identified 419 job postings specifically requiring a Bachelor’s degree related to geospatial technologies. Of these jobs, the key word GIS, ArcGIS, or Geographic Information
Systems was utilized 504 times. While many jobs may not use key words identified by this report, the EAB report illustrates growth of the geospatial industry as well as the potential for growth throughout the region for the skills related to the courses taught in the proposed major. Likewise, UW-Eau Claire’s location between the Twin Cities and Madison provides an ideal location to attract students who wish to pursue geospatial training.

**Emerging Knowledge and Advancing New Directions**

The proposed G.A.T major will offer an array of courses that capture emerging knowledge and advance new directions in the pedagogy of geospatial technologies. As part of the G.A.T., faculty will develop and offer several new courses based on cutting edge technology such as Business Location Analytics, Light Detection and Ranging (LiDAR) and Unmanned Aerial Systems (UAS). As indicated in the letters of support in the GEI, these technologies are in high demand, yet they are not accessible to our students. Currently, no other UW System campus is offering this type of cutting edge curriculum. Students will benefit from first-hand experience with survey grade GPS, fixed wing UAS, rotary UAS, telemetry equipment, infrared and thermal infrared cameras, data analytics software, and powerful workstations.

LiDAR and UAS are examples of new technology that are not yet integrated into the curriculum at UW System campuses but have high economic growth potential. For Wisconsin business to take advantage of these high growth areas, they need quality staff that are well versed in these areas. UW-Eau Claire has several faculty with expertise in these specialized areas and is well equipped to teach this knowledge as part of the proposed major. According to a 2013 survey conducted by Markets and Markets, the global LiDAR market is currently valued at $255.35 billion and is expected to expand by 16.6% through 2018. LiDAR is a technology used to scan surfaces such as buildings, rock formations, and vegetation to make ultra-detailed 3D maps. UAS is another cutting edge technology that is not yet integrated into existing curriculum in the UW System. Unmanned aerial systems are remotely-piloted aircraft fitted with a variety of sensors and can be used in many civilian applications such as search and rescue, mapping, and precision agriculture. This industry is poised for major growth in the next decade: the Association for Unmanned Vehicle Systems International predicts a $13.6 billion economic impact in the first three years of integration of UAS into National Airspace (beginning in 2015), along with the creation of 34,000 manufacturing jobs and more than 70,000 new jobs overall in the first three years. The report estimates that Wisconsin will see an $88 million economic impact from 2015-2017 and the creation of nearly 700 new jobs. Currently, there are no viable options offered in Wisconsin to obtain UAS training to staff Wisconsin jobs. The nearest centers providing UAS workforce development are Kansas, North Dakota, Indiana, and Oregon. The G.A.T. will provide UAS focused geospatial courses (in collaboration with the Physics Department) to provide Wisconsin businesses with qualified UW System graduates to hire for these new jobs.

**DESCRIPTION OF PROGRAM**

**Institutional Program Array**

The proposed G.A.T. major fits well in the College of Arts in Sciences at UW-Eau Claire, due to the strong foundation of spatial thinking developed by the Geography and Anthropology Department as well as the long history of collaborative projects with many other departments across campus. Grounded within a liberal education framework, the “innovative” G.A.T. curriculum highlights core geographic tenets and expands spatial thinking connected to
science and technology (STEM). The current major offerings in the Geography and Anthropology Department provide a strong geographic foundation while allowing students to broadly explore interests in geographic thought (i.e. international or environmental). The current geospatial certificate does provide additional curricular offerings, but the G.A.T. allows for a collaborative approach that drills into the unique technical approaches geospatial science and technologies offer.

Other Programs in the University of Wisconsin System

Geography programs are found at UW-La Crosse, UW-Platteville, UW-River Falls, UW-Stevens Point, UW-Milwaukee, UW-Madison, UW-Whitewater, UW-Green Bay, and UW-Parkside. The initial Notice of Intent for the G.A.T. was supported by all programs and universities throughout the UW System. While each program offers unique experiences, the proposed G.A.T. will establish a strong foundation in traditional geography, but will also offer courses specific to UW-Eau Claire (i.e. UAS). Furthermore, the inclusion of courses from other departments (e.g., information systems, computer science) at UW-Eau Claire is a distinctive feature of the G.A.T. major. There is no evidence to suggest that the G.A.T. will negatively impact enrollment in geography programs across the state. In fact, as with the previously mentioned UW-Stevens Point master’s degree in GIS, the G.A.T. could act as a portal to this degree and help recruit students into the program.

Collaborative Nature of the Program

The proposed G.A.T program will be a collaborative inter-departmental effort at UW-Eau Claire, but it will be a stand-alone program at UW-Eau Claire.

Diversity

Faculty in the Geography and Anthropology Department are fully aware of equity, diversity, and inclusion challenges in science and technology, including low participation by women, people of color, and other underrepresented groups. Issues such as privilege, gender and sexual identities, poverty, and social justice form key components in our introductory geography courses required for all majors (i.e. Human Geography and Conservation of the Environment). Beyond the classroom, ethical issues using geospatial technologies are addressed in a required Geospatial Ethics Workshop that will be incorporated into the GIS II course. Other creative high impact practices include traveling throughout the state to high schools and two year colleges, scholarships, research, and student involvement.

Travel: members of the GEI have engaged in outreach programs by traveling to high schools, STEM events, and two your colleges in an effort to bring faculty to a wide array of students, especially first generation students, throughout Wisconsin.

Scholarships: Through the use of Department Foundation funds, the department is now offering $1,000 scholarships for first year students and transfer students, with further funding ($1,500) available for those same students that make satisfactory progress towards their degree. All underrepresented groups are strongly encouraged to apply. http://www.uwec.edu/admissions/paying-for-college/scholarships-loans-grants/

Undergraduate Research: The Geography and Anthropology Department has a long history of supporting undergraduate research. Beyond funding from the Office of Research and Sponsored Programs, the department also provides additional travel support for students presenting research at conferences. This money is specifically used to reduce costs to students to
encourage them to attend conferences without the additional stress of funding. Faculty strives to offer these opportunities to students from underrepresented groups.

Student Involvement: Geography and anthropology students are active in the department in advancing EDI. The most recent example has been the creation of a student lead group Supporting Women in Geography (SWIG). The goal of this group is to discuss and provide feedback to faculty to help increase the participation of women in the discipline.

Student Learning Outcomes

The G.A.T. has established specific domain learning outcomes. These learning outcomes were strongly influenced from two established bodies of knowledge: the Geospatial Competency Model provided by the U.S. Department of Labor (2014)\(^7\) and the Geographic Information Science and Technology (GIS&T) Body of Knowledge (2006)\(^8\) created by the University Consortium for Geographic Information Science. The G.A.T. will focus on a solid foundation in geospatial science, technology and spatial analysis.

The core learning outcomes for the G.A.T. are as follows:

1. Apply spatial perspectives to understand human, physical, and human environment processes.
2. Global perspective: apply knowledge of how people, places, and regions are linked by global networks and processes (such as globalization, international trade, immigration, internet technology, global climate).
3. Demonstrate the skills necessary to perform standard geospatial tasks.
4. Demonstrate proficiency in industry standard software and using industry standard field equipment.
5. GIS: design, compile, and develop a spatial database and set of analytical tools within a Geographic Information System framework appropriate to a given problem.
6. Remote Sensing: apply the skills of preprocessing optical remotely sensed data, customizing or developing a suitable algorithm to extract biophysical and/ or sociocultural information from the data, and utilizing the information in a given geospatial problem.
7. Mapping: apply the skills of operating GPS equipment to the collection of geospatial data in a variety of field mapping environments for the purpose of integrating GPS data with existing Geographic Information System resources.
8. A) Analytics: design, compile, and develop a spatial database and set of analytical tools within a Geographic Information System framework appropriate to a given problem OR
   B) Apply the skills of preprocessing optical remotely sensed data, customizing or developing a suitable algorithm to extract biophysical and/ or sociocultural information from the data, and utilizing the information in a given geospatial problem.
9. Organize, manipulate, analyze, and visualize scientific datasets via computational and statistical methods.
10. Construct scientific applications using an industry standard programming language.
11. Identify and apply components of information systems (databases) to solve problems and make decisions.
12. Demonstrate respect for persons, communities, equity, social justice, environmental systems, and how to use geographic knowledge and skills to maximize the benefits and minimize the harm to others.
A central tenet of the program is that students learn best when challenged by experiential learning. The G.A.T. requires a Geography Capstone or internship as well as an advanced GIS or remote sensing project based course. In the advanced GIS or remote sensing course, students will develop a project proposal, complete the project, and present the results. Several other courses required in the major, including the geospatial field methods and GIS II course, are also hands-on and incorporate experiential learning.

The proposed G.A.T. program will provide students with the knowledge and skills needed for lifelong learning. The overarching G.A.T learning goals are directly tied to liberal education learning goals at UW-Eau Claire. The following four core goals are infused throughout the G.A.T. major:

- Knowledge Goal: build knowledge and awareness of diverse peoples and cultures and of the natural and physical world through the study of arts, histories, humanities, languages, mathematics, sciences and technologies, and social sciences.
- Skills Goal: develop intellectual and practical skills, including, for example, inquiry and analysis, critical and creative thinking, written and oral communication, quantitative literacy, information literacy, and teamwork and problem solving.
- Responsibility Goal: apply personal and social responsibility for active citizenship and develop skills needed to thrive in a pluralistic and globally interdependent world.
- Integration Goal: integrate learning across courses and disciplines, and between campus and community life.

Assessment of Objectives

The G.A.T. will be assessed through traditional academic methods as well as more innovative methods that will directly involve input from business partners as well as well-established industry competencies. Currently, the Department of Geography and Anthropology has a curriculum wide assessment plan developed in 2013 for all coursework and majors including the geospatial certificate. A yearly assessment report is provided to the Dean of the College of Arts and Sciences and to the University Assessment Committee. The assessment plan, and the associated yearly reporting, will be expanded to include the proposed G.A.T. major. A number of courses in the geospatial certificate program already have several years’ worth of pre-and post-course assessment data based on the Geospatial Technology Competency Model provided by the U.S. Department of Labor. These existing assessment activities, including lab and field assignments, projects, quizzes, and exams, will be expanded to accommodate new course offerings. Upon completing geospatial coursework, students will participate in exit interviews and satisfaction surveys to evaluate the curriculum, instructors and their experience.

Currently, we regularly follow up with alumni and will expand these efforts using existing newsletters, blogs and a LinkedIn alumni group. The internship coordinator will also interview on-site supervisors and potential employers to evaluate and ascertain requisite skills for a well-trained and ready workforce. Business partners will provide additional insights to assess the success of the educational component through examination of the assessment data generated on the geospatial curriculum. By reviewing assessment data on the number of students going through the program, job placement rates, and numbers of jobs created through the program, both economic and educational assessments will be conducted.
Program Curriculum
The proposed B.S. and B.A.in Geospatial Technology and Analysis is a 60 credit major offered in the Department of Geography and Anthropology which resides in the College of Arts and Sciences at UW-Eau Claire. The core of the major consists of 43 credits; 37 within geography and 6 outside of geography. Strongly influenced by the Geospatial Competency Model provided by the U.S. Department of Labor (2014)⁷ and the Geographic Information Science and Technology (GIS&T) Body of Knowledge (2006)⁸ created by the University Consortium for Geographic Information Science, the G.A.T. major will focus on a solid foundation in geospatial science, technology and spatial analysis. The program design encourages timely degree completion, while simultaneously providing students with opportunities to participate in high impact practices such as internships, a department capstone seminar, and/or project-based advanced level courses.

The flexibility of requiring GIS III or Advanced Remote Sensing allows students to follow a course of study of their own choosing. Students can also pursue a separate certificate in web design or information systems by utilizing existing certificate programs in the College of Arts and Sciences and the College of Business. Finally, because the program and individual courses are tied directly to the Geospatial Competency Model and GIS&T Body of Knowledge, all associated learning outcomes are easily assessed with industry standards and mesh well with the UW System Flex Option initiative.

Curriculum for the Geospatial Analysis and Technology Major

University and Liberal Education Requirements Not Met by the G.A.T. Major:
- Arts and Humanities 9 Credits
- Communication 3 Credits
- Cultural Diversity, Equity, and Inclusivity 6 Credits
- Integrative Learning 6 Credits
- Mathematics 4 Credits
- Natural Sciences 3 Credits
- Social Sciences 3 Credits
- Civic, Social, and Environmental Responsibility 3 Credits
- Writing 5 Credits
- Other Electives 18 Credits

Total: 60 Credits

Geospatial Core
- Geography 104 (Physical Environment) 4 Credits
- Geography 111 (Human Geography) 3 Credits
- Geography 135 (Intro. to Geospatial Analysis)a 3 Credits
- Geography 200 (Foundations in Geography) 3 Credits
- Computer Science 170 (Computer Programming) 3 Credits
- Information Systems 240 (Information Systems in Business) 3 Credits

Total: 19 Credits

Upper Division Core
- Geography 335 (Geographic Information Systems I) 3 Credits
- Geography 336 (Geospatial Field Methods) 3 Credits
Geography 337 (Geographic Information Systems II) 3 Credits
Geography 338 (Remote Sensing of the Environment) 3 Credits
Geography 370 (Quantitative Methods in Geography) 3 Credits
Geography 401 (Capstone) or Geography 498 (Internship) 3 Credits
Geography 435 (GIS III) or Geography 438 (Adv. Remote Sensing) 3 Credits
Geography 300/400 (Any non-Geospatial Geography Course) 3 Credits

Sample Electives (at least 17 credits selected from the following partial list)\textsuperscript{b,c}
- Biology 383 (Statistical Analysis of Biological Data) 3 Credits
- Computer Science 319 (Introduction to Web Programming) 3 Credits
- English 313 (Topics in Rhetoric and Tech.) 3 Credits
- Geography 352 (Business Geography) 3 Credits
- Geography 358 (Lidar)\textsuperscript{a} 3 Credits
- Geography 390 (Unmanned Ariel Systems)\textsuperscript{a} 3 Credits
- Information Systems 304 (Fundamentals of Business Programming) 3 Credits
- Information Systems 310 (Systems Analysis and Design) 3 Credits

\textbf{Minimum of 17 Credits}

\begin{tabular}{|l|c|}
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\textbf{TOTAL} & \textbf{120 Credits} \\
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\textsuperscript{a} New geography course, serves G.A.T. major and other geography majors
\textsuperscript{b} At least 6 elective credits must be from courses offered outside Geography
\textsuperscript{c} Non-geography electives must be geospatially related with consent of advisor

In the Department of Geography, despite having most students declare majors in this discipline relatively late in their undergraduate studies, the mean time to graduation is 4.3 years, with 43% of students finishing in four years or less. Much of this success is aided by a special two-year degree plan for students who transfer to geography later in their academic career. The department’s experience in helping students – even those who arrive late to the discipline – graduate in a timely matter will allow students in the proposed G.A.T. program to also complete their degree requirements within a standard 8-semester sequence.

\textbf{Projected Time to Degree}
A prepared student can complete the G.A.T in eight semesters with an average load of 15 credits per semester and full-time enrollment.

\textbf{Program Review Process}

\textbf{Institutional Review}
Academic programs are currently reviewed at UW-Eau Claire every five years, and all geography programs are being reviewed in 2015-16. The review process includes a 3-faculty internal review committee and an external evaluator who also participates in a site visit. The perspectives and recommendations for improvement from these reviewers are forwarded to the Academic Policy Committee and to the Provost for consideration. The proposed G.A.T. major would be included in the department’s next program review cycle.
Accreditation
The proposed degree fits naturally under the approved mission of the UW-Eau Claire and the Department of Geography. Therefore, we do not anticipate that separate HLC approval will be necessary for this new program. Nonetheless, we are prepared to seek HLC approval if required.

ENDNOTES

4 “Employer Demand for Bachelor of Geospatial Analysis and Technology”, 2015. Education Advisory Board, data from Burning Glass Labor/Insight.