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Exploring the Use of Geographical Information Systems (GIS) in Recruitment and Retention of
Underrepresented Multicultural Students at a Public Midwestern University

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Abstract

Universities and colleges are using Geographical Information Systems (GIS) in new capacities in higher education beyond geography courses. GIS can provide a visual representation of demographic distributions and trends of student enrollment patterns that may not be observed in typical data sheet analysis. GIS has the ability to enhance the visual perception of data by mapping layers of data information and its relationship to location. GIS has the potential to assimilate patterns related to hot or cold spots of student retention and recruitment. This research examines how (GIS) can help enhance the recruitment and retention of underrepresented multicultural (URM) students (African Americans, n=1082; Latino(a), n=689; Native Americans, n=136; and Southeast Asians, n=439) enrolled in the Midwestern university (2011-2013) by identifying hot and cold spots related to locations at enrollment. Results from ArcGIS showed a high density of students enrolled from the Southeastern quadrant of the state. Distance from home, financial cost, and the business school at the university were the main factors students identified as contributing to their decision to apply. Results from ArcGIS maps also suggest potential recruitment areas for URM students could focus on the North area of Illinois and North and North central Wisconsin. Implications for the use of GIS tools in identifying recruitment patterns, and recommendations for future program development are also discussed.

Chapter One

Introduction

This study was conducted to evaluate if Geographical Information Systems (GIS) would be a valuable data analysis program to assist with recruitment and retention of underrepresented multicultural (URM) students in higher education settings. GIS is a system that captures, stores, and analyzes geographical data through the merging of technologies such as cartography, statistical analysis, and computer science (Coppock & Rhind, 1991). GIS also has the potential to identify hot spots which are statistically significant clusters of special data with high values and cold spots which have low values (ESRI, 2013a). More specifically, this study collected data from 60 out of 2,346 URM undergraduate students from a public Midwestern university from 2011-2013 about their educational experiences and journeys, with specific emphasis on college preparation and recruitment.

Research Questions

The three research questions that guided this research study were:

1. Which locations are hot spots of the target zones to assist in recruitment of URM students of the Midwestern University?
2. What factors affect the URM students' higher education choice?
3. What changes could be made to improve recruitment of URM at the Midwestern University?

These questions are important to this research study because they address the issue of recruitment. Information from questionnaires was gathered, coded, analyzed, and then mapped into layers through GIS. From the analysis, hot spots areas represent the condition of frequent

clustering of groups of people or frequent occurrences of events that show a high concentration in a specific spatial distribution. The hot spots can also highlight common areas that signify potential areas of future recruitment.

As a means of responding to these research questions, 60 URM students were given a questionnaire regarding ethnicity, distance from Midwestern University to URM students' homes, school district and university locations, age level and economic status. The criteria for participants in this study included being of diverse ethnic backgrounds (African American, n=26; Latino(a), n=14; Southeast Asian, n=16; and Native American, n=4), gender (males, n=20; females, n=40), and undergraduate full-time status. Student participants volunteered at student organization meetings or in a scheduled meeting with the researcher to complete the questionnaires. Institutional Review Board approval was obtained on October 29, 2013 prior to starting the study and details can be found in Chapter 3.

Purpose of Study

After working for the Multicultural Affairs/Student Success Department at a four year institution, I experienced laborious data collection methods through on-line spreadsheets resulting from queries. Queries allow the user to retrieve data reports from external databases without retyping the data information. The user asks a question about the data and then creates data reports and one dimensional charts and graphs. Queries omit data that is not needed for analysis. The sorting of data was useful. However, data analysis could have been improved through the application of Geographical Information Systems. The GIS mapping can give a better visual orientation of data because of the layering abilities. Map layering is the process of symbolizing the data through a visual representation on a digital map. Individual layers of data analyze different information. The layers are laid on top of one another to see where the data

overlaps to begin to identify correlations. This assists the analyst with efficient and in-depth critical interpretation for improved results. In addition, two administrative staff were interviewed for the researcher to gain valuable insight into the current operations of admissions and Multicultural Affairs offices. Therefore, this study was designed to provide valuable insights regarding the use of GIS to assist administrative staff with recruitment and retention of underrepresented multicultural students in higher education settings. It is the intention to have tools available for faculty and staff to better analyze data results by having useful maps and charts to improve recruitment and retention for URM students.

Chapter Two

Literature Review

Governmental legislation has afforded college institutions the ability to serve underrepresented multicultural (URM), low income, and first generation students. However, with the changes in the country's economic situation, federal funding cuts have been occurring (Nelson, 2012; Sias, 2011). College institutions need to take a close look at how they provide recruitment services and whether these provisions are occurring in the most cost effective and efficient methods relative to meeting the needs of students. Universities posit that data drives recruitment and academic support. With the recent introduction of Geographical Information Systems (GIS), many companies have begun to see the powerful impact the layering of data (process of symbolizing the data through a visual representation on a digital map) can have to effectively analyze and project outcomes (Luptom & Strassberg, 2013; Martinez & Ramirez-Gomez, 2013; Robertson & Heuer, 2013). GIS could also be applied to the higher education system, specifically to the retention and recruitment of URM students.

GIS has been used primarily for geography and mapping purposes in the last half a century (Coppock & Rhind, 1991). With rapid advancements in technology, faculty and staff that are trained in GIS will have effective processes to link data for productive and efficient data analysis. The following review of literature will first describe underrepresented students and identify challenges these students face in their pursuit of higher education. Issues around the decisions of URM students to attend two year community colleges or four year colleges are explained. Next, I suggest the social justice framework to ground the project, and introduce College Access Programs and initiatives such as TRIO Programs (McNair Scholars and Upward Bound) that support URM students in higher education. I then introduce Geographical

Information Systems (GIS), and make a case for expanding the use of this tool in higher education, which is the focus of my project described in Chapter Three.

Underrepresented Minority Groups in Higher Education

According to the Office of Policy Analysis and Research (2013), URM students are defined as “all who indicate African American, American Indian, Hispanic/Latino(a), or Southeast Asian alone or in combination with other races/ethnicities” (p. 4). According to Fry and Lopez (2012), “Hispanics are now, for the first time, the largest minority group among the nation’s four-year college and university students. And for the first time, Hispanics made up one-quarter of 18- to 24-year-old students enrolled in two-year colleges” (para. 2). While there has been some improvement in enrollment trends of underrepresented students, many barriers to higher education that still impact URM students, such as low self-confidence, lack of college preparation, family commitments, postponed enrollment, living at home, extracurricular events, acquire a GED, or distance from home. In the next section, I discuss some of these barriers faced by URM students pursuing higher education.

Challenges Faced in Pursuing Higher Education

Underrepresented students face many challenges when considering higher education. Some of these risk factors include low self-confidence and the inability to imagine themselves in college (Cahalan & Curtin, 2004; Kezar, 2001). Several other factors that impact underrepresented students include: lack of college preparation in math and English, cost (necessitating part or full-time work), family commitments (having dependents), postponed enrollment, living at home, extracurricular events, having to acquire a GED due to lack of high school diploma, and distance from the educational institution (Fry, 2004; Lemire & Snyder, 2006; Perez, 2010).

One study suggested that African American students often face the most challenges to participating in higher education. According to Lemire & Snyder (2006), African American students “came from the highest percentage of single parent households” and took out the highest amount of financial aid and therefore have the highest amount of student loans to reimburse after college. In addition, African American students took the highest percentage of remedial courses (Lemire & Snyder, 2006). In this same study, it was noted that African American and Hispanic students spent the most time working part-time and participating in philanthropic events than other groups of students.

Enrollment in Community Colleges Compared to Universities

Historically, two year colleges favorably and disproportionately serve underrepresented students compared to four year universities (Opp & Smith, 1995). The National Center for Educational Statistics, which studies degree-granting institutions, analyzed college enrollment data over time from 1976 to 2010, with the following growth occurring amongst multicultural students: “Asian/Pacific Islander students rose from 2 percent to 6 percent, and the percentage of Black students rose from 9 percent to 14 percent. During the same period, the percentage of White students fell from 83 percent to 61 percent” (U.S. Department of Education, 2013, para. 6).

Underrepresented minority students frequently turn to community colleges with two year programs instead of four year universities (Gilbert, 2008; Perez, 2010). The decision may be based on the path of a family member. For example, if siblings or relatives are currently enrolled at a community college, it is likely that a prospective student will follow suit (Perez, 2010). The author also states that this often occurs because older relatives refer the new students to

established contacts, such as: advisors, professors and mentors. In addition, the older students are familiar with transportation routes or availability of carpooling.

Underrepresentation of multicultural students is an issue at four year institutions because “equity does not mean equality” (Manning, 2009). Just because students are accepted to a four year institution does not mean that their journeys will all look the same. URM students may experience injustices that the majority races do not. As this research project used a social justice framework to work towards changing systems and removing barriers to injustice, the next section explains this perspective.

Social Justice

Culture in the United States has been primarily based upon the struggles and successes within our own society from a white man’s perspective. Power and privilege are traditionally seen through the experience of White, heterosexual males (Iverson & Taylor, 2009). The 1950’s brought about change by means of the Civil Rights Movement and the *1954 Brown v. the Board of Education of Topeka, Kansas decision*. African American students were given the “permission” to attend all white institutions of higher learning. This opened the doors to equal opportunity and access to higher education for underrepresented students (Gasman, Hutcheson, & Sanders-McMrtry, 2011). Social justice, in this context, may be defined as the “elimination of institutionalized domination and oppression” (Young, 1990, p. 15). The higher education setting can be a highly oppressive setting for underrepresented students (Hall, 2006; Shin, 2008; Torres & Mitchell, 1995). However, over the last half century, predominately white schools have evolved into more diversified campuses including different student perspectives, backgrounds, and experiences. By diversifying campuses, the United States can have a stronger workforce with productive citizens (Cooper, 2010, para. 8).

The Civil Rights Movement of the 1950s and 1960s, pushed for changes in the law, policies, and social movements. Affirmative action and equity was centered on institutional efforts to enhance the diversity of University faculty, staff, and students and the elimination of discrimination. By focusing on social justice for all, and by implementing affirmative action and equity, discrimination was reduced. Minority groups were targeted for greater equity in services and opportunities. This led to the development of Affirmative Action programs, race-sensitive admission programs, and equal opportunity programs in colleges and universities. However, even though there has been much transformation, URM students continue to face significant challenges in recruitment, admissions, and retention.

Predominantly white universities present a challenge to underrepresented minority students. These schools typically strive to recruit top students using grade point averages and standardized tests as the main admittance requirements (Sedlacek, 1999). This poses a challenge to underrepresented students who face many barriers to gaining admission to predominately white higher education facilities: cultural ignorance of students and staff; frequent rejection of diverse, underrepresented students by some campuses; lack of financial resources for academic support; lack of diverse faculty and staff; and students' perceptions of cultural isolation (Benton, 2001). The motivation to fully include URM students must come from the top administration down in order for the staff to support and mentor the students and set a role model for the students to follow.

When URM students make the decision to pursue higher education, it is not an easy decision. When the URM students see minority faculty at all different management levels at the institution, the students begin to see role models at the campus (Smith, 1991).

Some elements of this support include: realistic descriptions of campus activities and culture, diverse curricula, academic support services, teacher mentoring support, and a comprehensive offering of campus activities. Underrepresented students must also be able to look at the campus through multiple lenses. According to Dubois (1965), URM students need to see the campus from their own perspective but as well as the majority's perspective while defining their cultural identity.

If flexible admissions criteria were put into effect, students of ethnically diverse backgrounds could apply to a variety of majors. Researchers have stated that there should be consideration in the admissions process for inclusion of the following: letters of recommendation, special skills and abilities, leadership roles, socioeconomic status, and geographic location (Sedlacek, 2005). Shin (2008) stresses that "The everyday experiences of violence, poverty, stress, discrimination, and racism that many applicants of color have faced throughout their life demands an emphasis on sources of information about these students other than a few sets of numbers (p.184). When underrepresented populations of students have been disproportionately living in high poverty situations, there is often a correlation to their educational experiences that cause reduced capabilities on standardized tests (Trent, Owens-Nicolson, Eatman, Burke, Daugherty, & Norman, 2003).

Research indicates that there is much that can be done to retain students until graduation. If faculty are educated and possess a social-justice orientation, diverse students have a better chance at being retained (Benton, 2001). Higher education professionals that are committed to evaluating their own views of cultural systems and the views of the institution for which they work can be transformative educators for social justice (Edwards, 2006). According to Rogers and Molina (2006), there are several initiatives that would assist underrepresented students. The

first is a strong commitment from faculty and staff to see students through to graduation. The second is a commitment from faculty and staff members to be honest with their own biases and come to terms with them for the betterment of underrepresented students. Third, the curriculum needs to be diverse with multiple viewpoints. Smith (1991) states that diversification of staff allows for input into what is taught and how is it taught” (p. 134). In fact, having faculty and staff of diverse backgrounds take the time to attend campus activities, ~~this~~ helps student integration into the school culture. Lastly, faculty and staff need to be compassionate to student experiences and perspectives of the underrepresented student.

Edwards (2006) stated that it is important to understand the necessity of having allies that can support the negative oppression from that of dominate social groups. With an increase in social justice allies, barriers can be broken down and there can be liberation for the oppressed. Allies will stand up for inappropriate comments and behavior. They will advocate for equality and be reflective of their own behavior towards social justice for all.

All of these factors will assist in enhancing retention and graduation rates of underrepresented populations of students. Research indicates that the quicker the mentoring process goes into effect the quicker students will assimilate into their new surroundings, giving them security in knowing they have a protected time to address questions or concerns (Benton, 2001). The next section discusses how governmental funding helps URM students overcome barriers to higher education and break down walls to oppression.

Educational Opportunity Programs.

The United States is a country ostensibly built on freedom. With this freedom, there is an implied commitment to providing equal opportunities. The government should be committed to providing equal access to educational opportunities for all Americans regardless of their race,

ethnic background, or economic circumstances. A previous section of the literature review described some of the challenges students experience in pursuing degrees in higher education. This section describes two of the federally funded TRIO programs that were established to provide equal opportunities to assist students who are economically disadvantaged, students who are first generation college students, or students who fit both criteria.

First, legislation that established the TRIO programs is explored. With the economic crisis in the United States, TRIO programs are at risk of partial or full loss of funding (Nelson, 2012; Sias, 2011). More important now than ever, universities must have informed recruitment and retention programs for sustainability of activities and initiatives. This project serves to inform two programs in particular, Upward Bound and McNair Scholars Program. The following sections describe the participants, goals, services, and impact of these two programs. This section concludes with an explanation of how this project intends to support these programs.

Legislation for TRIO Programs. According to the U.S. Department of Education (2011), federal funding for underrepresented students wanting to go to college was established in 1964 through the Economic Opportunity Act established by Lyndon Johnson's War on Poverty. This establishment of the Economic Opportunity Act gave way to the Higher Education Act of 1965. The Higher Education Act of 1965 was created to give universities and colleges financial assistance to assist students that are underrepresented as well as improve library resources and expand college programs (McCants, 2003). Then from the Higher Education Act of 1965, Federal TRIO programs were created which used Title IV funds. According to UC Davis Financial Aid (2009), Title IV funds were established to give students financial aid to attend college.

Three TRIO programs were established, Upward Bound, Talent Search, and Student Support Services. Over time, additional programs were added, which included the Ronald E. McNair Post-Baccalaureate Achievement Program (U.S. Department of Education, 2011). This project focuses on the Upward Bound and McNair Program because they both are critical to the university's recruitment and retention efforts to close the achievement gap for student success. Currently, these programs support disadvantaged students' progress from high school to graduate school.

The Upward Bound Program. The Upward Bound Program is a pre-college program sponsored by the United States Department of Education that services more than 50,000 students nationwide (Cahalan & Curtin, 2004). Upward Bound services are directed towards students who are classified as first generation and/or whose family is of low income status. Upward Bound students are high school students who have the intention of continuing their education in the higher education setting. According to Dervarics (2006), at least 30 percent of students enrolled in the program must qualify as "academically at risk." Thus, approximately one-third of the students in the program "have not yet met state standards on math and language arts assessments in eighth grade" (Dervarics, 2006, para.7). The author also states the other qualifying factors for students to be eligible for Upward Bound include having "a GPA below 2.5 or [if they] have not taken certain rigorous math courses by eighth or ninth grades" (para. 7).

The mission of Upward Bound is to provide secondary students with the skills needed to be successful in higher education. College preparation services are offered in five different academic areas: foreign language, mathematics, science, literature, and composition (Peterson's, 2013). Additional assistance is given to high school students via counseling, which includes: academic training in test taking, tutoring, mentoring, test prep practice, directions with

completing college applications and financial aid applications, study skills workshops, and summer enrichment programs.

In research conducted by Silva and Kim (1999), they found that students that participated in the Upward Bound program in high school were four times more likely to graduate with an bachelor's degree than students with the same background who did not partake in TRIO programs. Longitudinal research from Seftor, Mamun, & Schirm (2009) also concurs with Silva and Kim as the length of time in Upward Bound programs appear to relate positively to postsecondary enrollment and completion. Seftor et al. state in the results of their study, "Longer participation in Upward Bound was associated with higher rates of postsecondary enrollment and completion. An additional year of Upward Bound participation was associated with a nine percentage point increase in the rate of enrollment at four-year institutions and a five percentage point increase in the likelihood of receiving a bachelor's degree" (p. xv) . Seftor et al. (2009) reported unfavorably that there was "no detectable effect on the likelihood of completing a postsecondary credential in the seven to nine years after high school" for Upward Bound participants (p. 45). However, the study did note that Upper Bound participation "increased the likelihood of earning a postsecondary certificate or license from a vocational school" (p. xvi).

In considering the positive impacts from a variety of services provided by Upward Bound, secondary students are set up for success in the higher education setting. With these supports put into place, as well as the retention services available when the student arrives on campus, the student has an equal opportunity for success. The support services do not end when the student is accepted into a university. Students are encouraged to take part in college retention programs such as the McNair Scholars Program.

The McNair Scholars Program. The McNair Scholars Program began in 1986 after amendments were added to the Higher Education Act (US Department of Education, 2011). The McNair Program was authorized by Congress in 1987 to commemorate astronaut, Dr. Ronald E. McNair, an African American man who lost his life in 1985 during the Challenger space shuttle incident. According to the US Department of Education, about 71% of McNair Scholars are low-income and first generation college students. In addition, according to the US Department of Education (2005) and US Department of Education (2007), in the 2004-2005 academic years, more than two-thirds of the McNair Scholars were female.

McNair programs are designed to encourage eligible disadvantaged students to consider careers in college teaching as well as prepare for doctoral study (Finlandia University, 2013). McNair programs include opportunities for research and other scholarly activities, summer internships, seminars to prepare students for doctoral study, tutoring, and academic and financial counseling (Georgia State University, 2013). More specifically, the McNair programs offer opportunities for students to receive financial aid planning and academic counseling. Students are also offered mentoring services through university faculty (Utah Valley University, 2013) and experience cultural events that enhance students' diversity.

McNair Scholars receive the support needed to become globally competitive despite the challenges that they faced upon admission to higher education (Bell, 2012). In 2011-12, two thirds of the 3,300 McNair Scholars took STEM (science, technology, engineering, and math) courses at the undergraduate level (Bell, 2012). According to Bell (2012), approximately 28% of McNair Scholars pursue graduate degrees in science and engineering. According to the U.S. Department of Education (2012), in 2006-2007, approximately one half (53%) of McNair

Scholar students enrolled in graduate school within one year of getting their baccalaureate degrees.

Upward Bound and the McNair Scholars program are invaluable programs that grow and strengthen students interested in obtaining undergraduate and graduate degrees. By studying students that participated in both programs, it is possible to identify ways to address future recruitment and retention strategies. The use of Geographical Information Systems (GIS) can expose areas of services and locations that need further exploration and provide a new means for improving programs and increasing student enrollment. The next section, will present background information about this technology's potential to be used to inform recruitment and retention efforts in higher education.

Geographic Information System

Geographic Information System (GIS) is a computer software tool that has the ability to manipulate data into mapping layers which can be useful in interpretation and analysis of information. First, this section will describe the origin, early applications, and current day uses of GIS. Next, technical functions of GIS will be described. Lastly, GIS usage in higher education will be introduced.

During the past century, GIS has become the new cartography in map making. Maps are of great importance as they have evolved over thousands of years to define historical perspective, identify geographical regions, mark territories, and provide surveys of important data information. Maps can give viewers a better perception of where things are located, why they are located there, and their relationships to other things. This creates a better visual orientation of how everything is presented together.

Cartography, also known as topography map making, dates back to the time of the Babylonians through the use of clay tablets. Ptolemy also was a famous cartographer during the ancient Greek and Roman time period around A.D. 85-165 (Aber, 2008). The early history of GIS, in its most infantile stages, begins before computer times. According to Tuthill (2003), Dr. John Snow's famous map of city routes of contaminated water in 1849 determined that the cholera outbreak was carried by the water and not airborne infections as previously thought. In 1965, Geographic Information Systems (GIS) was created by Canadian Forestry Services to manage the harvesting, preservation, and management of tree and wooded areas throughout Canada. McHarg (1992), who was a Landscape Architect, used multicolored transparencies to identify better locations for road development in 1969.

More recently, GIS is known for its ability to project data through map layering which can be useful in interpretation and projection of different types of informational data. GIS is known for its advanced mapping technologies by allowing mapping to go beyond 2D and 3D operations from paper maps to computerized technology. These capabilities can be useful in business, government, education, environmental, navigational sources and other commercial usages. More specifically, GIS is beginning to be explored in agriculture, botany, computing, economics, mathematics, photogrammetry, surveying, and zoology (Goodchild, Maguire, & Rhind, p. 9). Social media sites like Foursquare, Facebook, Twitter, and other location based technologies depend on GIS as part of their informational systems (ESRI, 2009a).

How does GIS Work? GIS is a valuable tool for people who need to interpret and analyze data on a map or graph. Ocansey (2010) states, "By understanding geography and people's relationship to location, we can make informed decisions about the way we live" (para. 4).

GIS operates with four main components: hardware, software, data, and live ware (Goodchild, Maguire, & Rhind, 1991). Hardware is defined as any type of computer that can handle the GIS software. The software is the program that allows the computer operator to manipulate the data. Data is stored in the computer and is then used based on the needs of the operator. Data is expensive to collect, store, and manipulate due to large volume from the national or international surveying and mapping collection of data, satellite and aerial imagery, as well as the collection of coordinates, full addresses, and zip codes. Worldwide efforts are occurring with remote sensing satellites. Liveware are the people who are designing, operating, and implementing the hardware, software, and data to make GIS work (Goodchild et al., 1991).

According to Goodchild et al. (1991), GIS has three overlapping systems: map view, data base view, and spatial analysis. **Map view** is commonly used by thematic or topographic mapping agencies. There is much map processing where data is manipulated and patterns are analyzed and each data step creates a new map. High quality maps are created that offer layers, themes, and coverage useful for mapping agencies. Next, **data base view** of GIS usually requires a computer science emphasis. The computer operator inputs transactions into simple queries into the computer software. The queries then yield analytical options in maps. The data needs to be manipulated by the operator for matching the data with the desired results. Lastly, the **spatial analysis** of GIS is the most recent component to mapping. Through analysis and modeling additional dimension can be added to previous mapping techniques. Spatial analysis allows the researcher to organize and integrate their data by looking at geographical features.

Applications of GIS in Higher Education. The majority of GIS programs in higher education have been linked to the training of prospective geography students for employment in data mapping. However, more recently, initiatives have started to gain momentum relative to

providing GIS mapping to other areas in higher education, such as: police departments, campus security, marketing, and the alumni networks (Castagna, 2011; Jardine, 2003; Reyes, 2012; Romeo, 2005). Faculty and instructional staff have also been able to use GIS in their teaching and research (ESRI, 2009b; Flynt & Fournier, 2011). Literature is limited, specifically, to GIS usage in the retention and recruitment of the URM population of students at higher education settings.

Colleges and universities throughout the United States have seen an increasing interest in using GIS in other areas outside the normal geographical foundations. According to ESRI (2013b), faculty, staff, and students can directly benefit from GIS and data management in every department at the university. The idea is to use a campus-wide initiative to use spatial thinking and geospatial tools to inform and support its curriculum, research and operations, in addition to promoting a spatially-infused learning community within the university. Through the use of a spatial lens, students and university staff can begin to visualize the information they have and use the information to solve problems (ESRI, 2013c). By using GIS, visual orientation is becoming more advanced as the technology improves (Goodchild et al., 1991).

GIS is finding its place in education. Interestingly, in 2004, “the US Secretary of Labor named geotechnologies as one of the three fields most in demand for 21st Century decision making” (ESRI, 2007, para. 8). Boyes, Buckley, Lyszkewic, and Berry (2010) stated, “The step from digital map data to spatially distributed solutions involves a paradigm shift from descriptive 'Where is What' mapping to prescriptive 'Why, So What and What If' modeling” (para. 3). Use of GIS programs in higher education has been linked to the training of prospective geography students to use this programming for geography employment purposes. However, more recently,

GIS mapping has increasingly become apparent in other areas in higher education, including: campus security, enrollment, teaching, marketing, and the alumni networks.

Universities throughout the United States used GIS in admissions programs and recruitment, while some technical colleges have incorporated them in their summer camps. According to Del Mar College (2012) in Texas, TRIO programs are using GIS to help with data analysis, mapping their student involvement, and assisting with other groups to establish federal grants. Minni (2008) presents information about students attending Summer Research Camps. The students explore how water flows in and around the campuses and then they use GIS to complete data analysis, map their involvement to evaluate cooperation and efficiency of workers as well as assist with other groups to solve waterway problems in the city.

According to a study completed by Hanewicz (2009), GIS is helpful for administrators in higher education to understand the student/consumer base in order to meet their needs and retain them. Hanewicz (2009) researched the effects that spatial difference made amongst students who left school, stayed enrolled, and graduated within six years of beginning. Living near the universities was significant for students who stayed in school (Hanewicz, 2009). This is one factor of location that affects student retention.

In a study by Cameron and McLaughlin (2006), student retention was analyzed based on GIS to produce a visual geographical representation of patterns for students that are at-risk. The sample consisted of community college transfer students who enrolled at DePaul University between Fall 1999 and Spring 2003. The data was plotted on Microsoft MapPoint in the following ways: frequencies of community college transfer students for each zip code of the previous residence was secured and the zip code for each of the community colleges was listed; the proportion of non-retained students vs. retained students for each previous location zip code

was calculated; a map of the average predicted probability of retaining for non-retained students at each zip code was constructed. Cameron and McLaughlin (2006) concluded that “by using mapping techniques, one could visually comprehend issues of previous location for not only retention queries, but for various aspects of student experience” (p. 7). The authors commented that their study was small and the possibilities of data analysis in GIS are ‘limitless’ to mapping student retention in higher education (p. 7).

Universities are seeking new creative ways to address constant budget constraints. Admission Consortia was one option for universities to get new perspectives on recruitment and retention strategies (Barnes, 2012). The Admission Consortia consisted of associations of universities with enrollment experts that came together to share what was working well and what was not in recruitment and enrollment strategies in order to survive revenue caps and budget freezes. These shortfalls in budget have sometimes forced universities to work together to develop systems to assist with maintaining collegiate school structure.

Barnes (2012) studied the collegial behavior of the professionals enrolled in the Admission Consortium. He used the Resource Dependency Theory to provide a framework to guide his analysis and findings. His case study data was collected from interviews with directors and deans from public universities within the same student enrollment market.

The methodology used in this study was a qualitative case study that was designed to evaluate the behaviors of professionals within the same consortia and consider the recruitment markets in which these professionals compete. Sampling criteria involved three components to the selection process: participants had to actively serve a minimum of three consecutive years with the admission consortium; participants had to actively serve their three years in a row in the consortium with the same university; participants were required to hold senior staff positions

(Barnes, 2012). Once the sample was obtained, the data was coded and placed into definitive groupings which produced key concepts to assist with the interpretation of the findings.

The findings in this study conclude that when colleges are in competition with each other for tuition revenue, university professionals are often unwilling to share their ideas. In fact, universities began looking at out-of-state tuition favorably to increase their substantial resources. The Resource Dependency Theory revealed that public universities that were most dependent on the state aid were forced to seek alternative revenue, usually in the form of tuition. With this factor, universities have to consider two variables; either seeking out-of-state applicants to gain higher tuition reimbursement or raising tuition costs for in-state residents. Unfortunately, when universities need to market outside their current geographical region this can create significant competition with existing rivalries and starting new ones (Barnes, 2012). Reluctance in sharing information about enrollment data occurred with enrollment professionals. Barnes states, "The pressures exerted by market forces on collegiality demonstrate a degree of vulnerability to the markets influence" (p. 29).

Gilbert (2008) presents another way of looking at the admission's process through GIS technology called Applications Quest. This technology was created after affirmative action cases arose from 2003 U.S. Supreme Court decisions that affected the University of Michigan. According to Gilbert (2008), "The U.S. Departments of Education and Justice encouraged activist groups to challenge universities on the use of race in the conduct of admissions, financial aid, and academic support programs" (p. 13). The Applications Quest software was created in an effort to fairly screen students' applications to higher education to be measurable and reproducible. This software has the ability to data mine and conduct analysis to provide a holistic review of admission, school placement and academic support programs. It provides a

reproducible and measurable approach to holistic review through data entry, unlike manual entry holistic review (Gilbert, 2008). Many errors can occur in manual review because it is not reproducible and measureable. According to Gilbert (2008), manual review is subjective and gives a preferential treatment.

Applications Quest was designed to measure the difference or the similarity between applications. A relative scale was created to compare two different applications. From this relative scale, a difference matrix was created. This difference matrix identified clustering of applicants that would represent holistic, diverse applicant pools with the hopes of College Admission Departments selecting applications from each cluster which would then optimize holistic diversity (Gilbert, 2008).

This case study involved a small controlled group of admission applications from a research-oriented university within the psychology graduate program. Two hundred twenty six applications were received in 2004 with seventeen available admission slots open. Different attributes were taken into consideration, including the following: ID, international or domestic application type, citizenship, race, gender, degree level, where first degree occurred/second institution for advanced degree/third institution, grade point average at the third institution, GRE verbal score, GRE quantitative score, TOEFL score, permanent city of residence, permanent state, permanent zip code and the school action of accepted or rejected for graduate school (Gilbert, 2008).

Three steps occurred in this case study. The first was the creation of a difference index based on the seventeen 'accepted' application results that were entered into Application Quest by the graduate committee. The goal of the difference index was to compare every application with each and every other application. So the average difference of the 17 applications was 44%. The

group of candidates consisted of eleven females and six males, ten students applying for doctoral studies and seven for masters. Eleven of the applicants were US citizens and six were not specified. One candidate was Hispanic, three Asian, eleven white, and two not identified.

The second step involved considering the 'qualified' applicant pool. Students that met or exceeded the lowest GPA and/or GRE score were kept in the applicant pool. All others were eliminated. Then Applications Quest processed the scores. The new qualified applicant pool had 207 applications. The difference index for the qualified applicant pool was 41 percent based on the average of all the difference values for all the applications. There were 156 males, 193 doctorate applicants and 14 seeking masters, 135 were U.S. citizens, 8 foreign and 64 not identified. Three were Native American, eight Hispanic, ten Asian, eighteen black, 152 white and sixteen not identified. Seventeen applicants were recommended from this qualified applicant pool.

The third step involved ensuring that the 'recommended' and 'accepted' applicants were separated. The recommended applicant pool's difference index was 56 percent looking at the average of all the difference values for all the applications. With the final analysis, there was a stronger distribution of students amongst the 'recommended' group of applicants. According to Barnes (2012), the results of his findings were that through use of the holistic Applications Quest, the recommended applicants were 12% more diverse than the accepted applicants. The other strength of the Applications Quest software is that the results are reproducible and measurable. This GIS software program could be used over and over again for equitable admissions processes without the concerns of manual entry that are biased.

GIS Case Studies. Many colleges and Universities are using GIS to help visualize demographic distributions and understand trends of student enrollment (Zhou & Wu, 2005).

Market penetration indexes and gravity models were used to analyze student enrollment in Zhou and Wu's (2005) study, which suggested that by attempting to combine early theoretical studies with GIS technology, universities can better understand enrollment patterns. Market penetration indexes (MPI) are a GIS method to analyze the spatial patterns of a university's recruitment area as well as compare these patterns with regions of competing institutions. However, MPI does not look at distance like the Gravity Model. The Gravity Model analyzes the university's student enrollment. The importance of distance is calculated to see the potential to attract and generate students and/or the efficiency of the transportation system. According to Ohio Board of Regents (OBOR, 2005), the data used in the study was from the OBOR 2003 enrollment of Ohio's Public Instruction of Higher Education. The dataset showed numbers of Ohio residents enrolled in thirteen four year state universities from each county. ArcGIS was used to analyze and map the data, Zhou and Wu were able to show how GIS data technology can be used to analyze university enrollment relative to the market penetration index and the gravity models. Although the study provided insight into the study of recruitment to the higher education setting, the authors concluded that further study was needed.

Mora (2003) analyzed the application of GIS in admissions and in recruitment. Mora (2003) reported that university administration have three goals for undergraduate admissions: quantity, quality, and diversity (race and ethnicity, geographic location, academic area, gender, etc.). Mora researched the admissions process at Ohio State University in order to assist with cost saving measures: introducing the planning process of analyzing patterns of enrollees using a conversion rate or a yield rate; employing GIS technology to look at the data through a layering process to see all angles of recruitment; using GIS software to identify geographic areas where the greatest prospects for future recruitment were located.

Ohio State University implemented the changes by using Empowering Market Analysis (EMA), and according to Mora (2003), this integrated internal student attribute data with external geo-demographic data, digital mapping, and predictive modeling into one interactive and powerful environment. Geo-demographic data looks at a broad range of characteristics about a group of people. Digital mapping is computer-ready geographical information that can be used to display or analyze information on a computer. Predictive modeling is data-mining procedures that analyze previous data along with current data to predict possible outcomes. Using EMA has allowed Ohio State University to move past only using GIS for mapping, and they now are able to use the technology for strategic and tactical decisions. They have been able to use methodologies and tools to solve recruitment issues at their campus and other campuses.

A pilot study was conducted by Martin (2000) to build a GIS database that would identify different school districts in the state of Pennsylvania that may offer potential for recruitment of minority ethnic groups to Kutztown University. Kutztown was 2.3% below the Pennsylvania State System of Higher Education average for minority student population (Martin, 2000). In order to complete the state mandated Performance Outcome Plan, Kutztown University needed to make changes. Martin's study used the Demand Potential Model to consider the spatially distributed market: school districts with higher average SAT scores were considered for recruitment targets; data were used from Kutztown University records, ACT test scores, Pennsylvania Department of Education, and the US Bureau of the Census. By using these records, Martin (2000) was able to look at the following information for freshman entering the college: gender, ethnicity (African American, non-Hispanic, American Indian/Alaskan Native, Asian/Pacific Islander, Hispanic, and White, non-Hispanic), degree program code, high school ID code, county, state, and country.

Martin (2000) used a Demand Potential Model for the basis of his research. The Demand Potential Model is used to determine the effect that supply and demand of potential URM high school students and distance have on enrollment to Kutztown University. Different GIS maps were made to include critical data that would be useful to Kutztown admissions personnel. According to Martin (2000), this database revealed sixteen school districts in which Kutztown University did not enroll African Americans even though a substantial amount of students were college bound. This knowledge has assisted Kutztown University in developing targeted recruitment efforts in these sixteen counties to help raise their diversity at the University.

Martin (2001) continued his study of the Demand Potential Model to identify target school districts to improve minority enrollment into Fall 2000 to Fall 2001. He focused on using travel time rather than straight-line distance in order to graph out the state's school districts. The other focus of this study was to look at the relationship of on-site visits of admissions personnel and the direct correlation with enrollment patterns. In order to research this issue of diversity, The Office of Research and Planning at Kutztown University provided data regarding visits to high schools. Information was data-mined to merge information regarding ethnicity and school district. Of the 1,485 freshmen students that came to Kutztown University, 83% of the students came from 212 out of 530 school districts in Pennsylvania (Martin, 2001). Using travel time rather than straight-line distance produced a higher demand potential of students that would be considered future recruitments because their location is further from the university (Martin, 2001).

Martin (2001) also revealed a direct relationship of the on-site visits by Admission personnel to high schools. There were positive relationships in school districts where admissions personnel visited more than once and the enrollment of African American freshmen. There also

was an increase in Hispanic freshmen enrollment from multiple site visits. By the end of this study, Kutztown University had met their goal of having greater diversity on their college campus and this was achieved by meeting and exceeded the state system average for minority enrollment in higher education. Kutztown University in 2001 had 11.45% minority representation in freshmen classes where the state system average was 7.5% (Martin, 2001). Moreover, Kutztown University planned to expand their use of GIS technology to their Admissions Office and the Assistant to the President for Enrollment Management due to the positive results of using GIS to improve recruitment and diversity on the Kutztown campus (Martin, 2001). According to Martin (2001) study, The Admissions Office and Enrollment Management Office at Kutztown University can begin to look at the competitiveness of colleges from prospective Pennsylvania high school students through the use of GIS technology.

Synthesis

The use of Geographical Information Systems (GIS) has shown that it is a current practice in multiple locations around the world (Castagna, 2011; Flynt & Fournier, 2011; Jardine, 2003; Reyes, 2012; Romeo, 2005). This technology can expose areas of services and locations that need further exploration and new means for improving program development. Higher education is not running as efficiently as it could due to the lags in effective data analysis. GIS mapping can enhance the visual perception of data by mapping layers of data information and its relationship to location to efficiently analyze services and programs in higher education. More specifically, underrepresented multicultural students are at risk of losing opportunities at four year universities due to federal funded program cuts.

In an effort to diversify campuses, the United States can have a stronger workforce with productive citizens (Cooper, 2010, para. 10). Universities are seeking new creative ways to

address constant budget constraints in federally funded programs that will indeed support underrepresented multicultural students. Many URM students favor a two year college setting (Gilbert, 2008; Opp & Smith, 1995; Perez, 2010). Four year universities are concerned with finding more effective ways to recruit and retain students through graduation.

By studying students that participated in Upward Bound and McNair Scholars programs, it is possible to identify ways to address future recruitment and retention strategies that potentially could offer cost savings to the university. My project, discussed in Chapter 3, intends to utilize GIS tools to analyze recruitment patterns at a Midwestern university setting. The visual effects of the data map layering will reveal strengths and weaknesses in current recruitment practices based on a sampling of student responses. The “hot spots” identified weaknesses that can be further evaluated to improve services and programming.

Chapter Three

Methodology

This study utilizes GIS map-making tools in the recruitment and retention monitoring process of underrepresented students in a public Midwestern university. The purpose of this qualitative research study was to collect preliminary data from the university's Admissions Office, Multicultural Affairs Student Success (MASS) Program, and Pre-College TRIO Program in order to demonstrate how effective ArcGIS tools can be in monitoring the recruitment process of underrepresented students through data mapping analysis.

In this chapter, I present the methodology used for my research study. This methodology includes the following: study questions, participants, data collection, instruments (interviews and questionnaires), and data analysis, including Excel spreadsheet data analysis, and designing of the ArcGIS maps.

The following research questions guided the study:

1. Which locations are hot spots of the target zones to assist in recruitment of URM students of the Midwestern University?
2. What factors affect the URM students' higher education choice?
3. What changes could be made to improve recruitment of URM at the Midwestern University?

Interviews with staff provided a background that informed the development of study goals and assisted in interpreting results from questionnaires. Data from questionnaires informed both questions one and two.

Participants

TRIO Program and MASS Program participants in this study were from a Midwestern public university with a total population of 12,034 at the time of the research study. The researcher obtained a list of student participants in MASS and TRIO Programs from the Director of McNair Scholars Program and Academic Network. All student participants were of legal adult age, ranging from 18-25 years old.

Data included information from two administrative staff interviews and 2,346 students that are affiliated with the TRIO or similar programs. A subset of this population consisted of 60 underrepresented multicultural students who completed questionnaires. These participants were from diverse ethnic backgrounds (26 African Americans, 14 Latino(a), 16 Southeast Asians, and 4 Native Americans), gender, and undergraduate full-time status. The males represented a specific number (n=20), and the females represented a higher specific number (n=40) due to having a higher ratio of females within the TRIO/MASS Programs.

Data Collection Procedures

The Institutional Review Board (IRB) materials packet was submitted on October 25, 2013. Advisor approval was granted and having met the requirements for working with human subjects, this IRB request was approved on October 29, 2013.

The research included two parts. The first part of the research study included identification of campus administrators who provided initial interviews regarding administrative procedures in relation to admissions, retention, and recruitment of underrepresented students. Later, the research study was expanded to include a questionnaire that consisted of twenty questions (refer to Appendix B).

Interviews. Two interviews occurred at the Midwest university with Admission (AP) and Diversity (DP) personnel. Written consent was granted for tape recording of all interviews. AP was interviewed in the admissions department of the university. Three interviews occurred in increments of thirty minutes. I asked AP interview questions (Appendix C) in each of the meetings. Next, I interviewed the Diversity personnel in the Department of Multicultural Affairs. The Diversity personnel responded to all interview questions (Appendix D) during an hour-and-a-half interview. Following the interviews, the tapes were transcribed. I then coded the transcriptions of both interviews.

Questionnaires. Table 1 lists the method of data collection from participants. A convenient sampling of the underrepresented groups in higher education was appropriate for this project. The researcher contacted students by presenting at student organization meetings. The 60 research participants volunteered to complete the research questionnaire, either on the premises during student organization meeting times (Table 2), at the university office of the researcher, or on their own time (returning the surveys on a different date). The purpose of this research study was explained to the participants during each student organization meeting. The researcher read the informed consent form to the potential participants prior to the questionnaire survey (Appendix A) and then was available for any questions that the participants had. Each participant signed consent for confidentiality of information provided. Participants were informed that they could decline the questionnaire at any time and they were allowed to review the questionnaire before giving consent. Each participant also had the opportunity to ask questions directly to the researcher. Students completed questionnaires in a room located at the university, and each questionnaire took between 15 and 20 minutes.

The identities of participants were safeguarded using numbers and pseudonyms. The reference list with the numbers and pseudonyms was kept in the locked filing cabinet in this researcher's office file drawer.

Following the collection of data from the questionnaires, data was entered into an Excel spreadsheet and data was sorted to organize for the data layering with the GIS tool, ESRI ARC-Version 10.1, further described under analysis.

Table 1

Data Collection Matrix-Type of Information by Source

Information Source	Interviews	Questionnaires
Trio Students	No	Yes
MASS Students	No	Yes
Associate Director of Admissions	Yes	Yes
Assistant Vice Chancellor of Multicultural Affairs	Yes	Yes

Table 2
Timeline of Questionnaire Data Collection

Collection Date	Participating Group	Students Attending	Questionnaire Completed
Thursday, Nov. 7, 2013	Southeast Asian Organization	40-50	11
Thursday, Nov. 7, 2013	Latino Unidos Organization	20-30	0
Tuesday, Nov. 12, 2013	Black Student Union	40-50	0
Friday, Nov. 15, 2013	Neon Corporate Fair	20-30	3
Monday, Nov. 18, 2013	Native American Student Org.	12	1
Wednesday, Nov. 20, 2013	M.A.S.S. Study Table	30	6
Thursday, Nov. 21, 2013	King/Chavez Class	40-50	29
Oct. 29 th - Nov. 29 th , 2013	Individual Survey Participant	N/A	10
Total		202 - 252	60

Instruments

The personal interview questions were developed to provide the researcher with information about the current process of student recruitment to compare with student questionnaire data and identify trends and gaps in services in admissions, recruitment, and retention of underrepresented students (Appendix C, D). They also provided a pathway for information gathering about past, present, and future concerns and plans for the diversity goals of the campus and the assimilation of the underrepresented students.

The questionnaire was developed (Appendix B) to provide information in order to look at mapping data to analyze current trends within underrepresented students at the Midwestern public university. The hot spots identified in the data give insight to administrative staff and faculty for cost effective services and program development and modification in the future.

Data Analysis

In this section I present the analysis of the interviews, questionnaires, and maps.

Interviews. The interview research participants were given pseudo names to protect their identity. Interviews were transcribed by the researcher. An **AP** indicated information from admission personnel and **DP** indicated information from diversity personnel. Themes within the interviews were underlined and then transferred to a narrative word document. The interviews were read over three times for coding purposes. The information was coded by looking at commonalities of responses amongst both interviewees and secondly, coding was guided by the specific responses to questions as they related to research questions. Categories were created on an Excel spreadsheet. Common themes were grouped into key categories for further analysis. When information pertained to the same theme, it was listed under the common theme. Themes used in the interview questions included: Data Assessment, Data Usage, Engagement of Students with GIS, Engagement of Staff with GIS, Methods of GIS, Plan of Action for Department, Goals for Students, Competitive Colleges, Former GIS Efforts, and Recruitment Efforts (Current/Past).

Information from interviews was considered along with results from questionnaires to determine if programming services for URM are being met. These findings are presented in Chapter 4.

Questionnaires. A description and theme development was conducted from 60 participants whose data was collected from 20 survey questions. When coding and organizing the questionnaire data, I numbered all the surveys from 1– 60, identified the ethnicity and gender

in the top right hand corner, and then separated the questionnaires according to timeline dates from the start of October 29th to November 29th.

The following are categories that were assigned on the Excel spreadsheet in the following order for the closed ended questions: Survey I.D.; Ethnicity; College Diversity Program; 1. High School (HS) name/HS Location (City, State); 2. HS Population; 3. HS Primary Ethnicity; 4. Demographic Areas-Income Level; 5. Applications to Other Universities (State vs. County); 6. Recruiters; 7. Transfer Student/AP Courses; 8. Pre-College or College Preview; 9. Transportation on Campus; 10. Commuter/Type; 11. Support/Type; and 12. Family Attend/Who.

The remaining part of the survey, narrative responses were open ended questions. These questions were coded and responses were first written with Survey ID number and then narrative response was written under each code. Similar narrative responses included multiple Survey ID numbers following the narrative response. The following narrative themes included: Reasons to Come to Midwest University, Location/Distance, University Culturally Diverse Before Admission, University Culturally Diverse After Admission; Financial Aid/Scholarship/Grant; Demographic Area Affect Decision to Attend; Recommend To Others; Recruitment Improvements.

After the data was coded, I sorted the data for each theme. For multiple choice questions, I coded each response with the letters used in the survey. I then tallied the same letter responses for each theme and figured out the percentage of participants for each subdivision of each theme. In the narrative section, not every participant responded to each question so there are limited results for responses.

After questionnaires were coded, information was entered into GIS tool, ESRI ARC-
Version 10, to show the layered mapping of the following themes: distance, ethnicity, economic
status, and school districts and university locations. Eight GIS maps were created with a layering
technique to present the data. The process in Excel is further explained below and these findings
are presented in Chapter 4.

Excel Spreadsheet Data Analysis. The crucial step in designing and developing the
ArcGIS data maps was organizing the different data layer information sheets into separate excel
spreadsheets and organizing them into specific categories that related to addresses, counties,
states, and ethnicity. The MASS student data roster (n = 2,346) from Fall 2011 to Fall 2013 was
used and it included five different semesters of student data roster listings. This data was
combined into one master MASS student roster excel spreadsheet. The following categories were
established on the Excel spreadsheet in the following order: Home Address, Home City, County,
Home State, Zip code, Ethnicity, Career Street (year in college), Level (year of schooling by tens
digits:10-freshman, 20-sofmore, 30-junior, 40-senior), Total Cumulative Credits Earned, and
Student ID. I did a data sort of all the students I.D.'s during the 2011-2013 years and deleted any
duplicates of student I.D. numbers. Without deleting duplicates the same students would be
repeated from each semester.

The excel data for all the maps was organized by data sorting different categories
alphabetically from A to Z and subtotaling themes to get specific numbers per county. I first set-
up an Excel spreadsheet with home address, city, county, state, zip code, ethnicity, year in
school, total credits, and student I.D. Then, I data sorted alphabetically the states, county, and
ethnicity. I used the subtotal in the breakdown of ethnicities by each county. I also created a
separate Excel spreadsheet for each ethnicity group (African-Americans, Latino(a), Native

American, and Southeast Asians) for each spreadsheet. The categories were broken into five areas which was ethnicity, state, county, city, and zip code. I sorted the Wisconsin and Illinois city location first with the data sort in Excel, alphabetized the counties, and lastly, subtotaled themes to total the number of students within the counties. GIS maps were designed to help evaluate the recruitment patterns of the URM population from 2011-2013 on a county level, mapping the 60 survey participants' responses.

Designing the ArcGIS Maps. The exact steps used for GIS entry are listed in Appendices E and F. Eight maps were developed using Arc Geographical Information Systems (GIS) Version 10.1 mapping tools to help identify the potential recruitment patterns or areas within the URM attending a Midwestern university. The first map (Appendix G) showed a dot-density of 1,275 URM students in MASS in 2011-2012. This map identifies the county location of 2011-2013 in Wisconsin and Northern Illinois. The second map (Appendix H) has the layering of dot-density and choropleth map. The addition of the **choropleth** allows for shading or symbols within the map to indicate predefined areas with the property or range that is identified in the map key. This map included 2,346 URM students and shows the variation of the URM students' ethnicity (African Americans, Southeast Asian, Native American, and Latino(a)) from each county. The eastern county boundaries are exaggerated. -Appendix I is the same map as in Appendix H, however, it has the proper boundaries for counties and state borders. The next five maps are all choropleth maps showing counties of origination from students from Midwestern university from 2011-2013 and the designated ethnicity (Appendix J, African American, n=1,082; Appendix K, Latino(a), n=689; Appendix L, Native American, n=136; and Appendix M, Southeast Asian, n=439).

Finally, the last map (Appendix N) displays the survey results of the 60 URM participants in Wisconsin and Northern Illinois, location of the high schools where they attended, variations in universities they applied to, how many applied to each University, the ethnicity break down, and the underrepresented students 2011-2013 county population attending the Midwest University.

The first part of generating the results was to assign the shape files with the correct projection and datum which used the project tool in Arc Toolbox Universal transverse Mercator (UTM), North American Datum (NAD), 1983 Zone 16. Sources of Data that were used in this analysis include: State Boundary, County Boundary, City Boundaries, 2011-2013 MASS student data information, university addresses, high school addresses, and additional data information from the sixty student surveys. The GIS Software used in this process included: Arc Tools and Geoprocessing to project, buffer, clip, intersect, dissolve, and overlay operations.

In the next chapter, the results of the research using the above methodology will explicitly be discussed.

Chapter Four

Results

This chapter outlines the results of the use of GIS in the analysis of recruitment patterns of underrepresented multicultural (URM) students at a Midwestern University, factors that impact the URM students' higher education choice, and changes that could be made to improve recruitment strategies for URM. In this chapter, I first review the study process (data from interviews and questionnaires), and then I present findings in response to each of the main research questions.

Interviews were conducted with the admissions personnel and diversity personnel. The interviews allowed for the gathering of information about admission procedures for recruitment and recruitment programs such as "Wheels to Education" and Pre-College programs that are established for URM recruitment purposes. The first interview was with the Assistant Director of the Admissions Office. He outlined the admission process funnel, answered a thirteen question interview and helped to reveal previous methods of admissions data mapping with topography maps. The Admissions Office hired an intern student from the geography department to complete a cartography map ten years ago to look at students on a county level.

The other interview was conducted with diversity personnel at the same Midwest university. The purpose of this interview was to be informed of URM program services available, TRIO program outcomes, and goals of student retention for MASS. Both interviews addressed the third study question, which identified recommendations for recruitment and retention efforts for URM students.

The surveys were conducted with the convenient sampling, and 60 URM were sampled. All the participants that completed the survey's represented the URM population of African

Americans (n=26), Native Americans (n=4), Latino(a) (n=14), and Southeast Asians (n=16) with a mixed gender from one public Midwest university. The participants that were surveyed attended the King/Chavez class at the Midwest University and/or Student Organizations on campus, such as: Black Student Union, Latino Unidos, Southeast Asian Organization, and Native American Student Organization.

The URM students consisted mostly of undergraduate students ranging from freshman to senior class status. The group also contained some McNair Scholars and Upward Bound Program students as part of the sampling to get TRIO and Pre-College Program perspectives. The purpose of the surveys was to help access information as to why students chose the Midwest public university. Some questions related to what high school they graduated from, did college recruiter's come to visit their schools, where they applied to college and if location had a factor in choosing their university (Appendix N).

Research Questions

The three research questions that guided this research study were:

1. Which locations are hot spots of the target zones to assist in recruitment of URM students to a public Midwestern university?
2. What factors affect the URM students' higher education choice?
3. What changes could be made to improve recruitment of URM at the Midwest University?

The results from interviews and questionnaires that informed each of these questions are reported below.

Question 1 – Which locations are hot spots of the target zones to assist in recruitment of URM students to the Midwest University? When analyzing the clustering of MASS students, as seen in Appendix I, current hot spots are locations that have 284-725 students attending the

university are displayed. These hot spots are observed in Milwaukee, Dane, Rock, and Kenosha counties. By analyzing the clustering of student populations, hot spots can be identified for future recruitment. Admissions and diversity personnel both commented in interviews that the Oshkosh and Green Bay areas are beginning to expand due to admissions recruitment efforts with a high concentration of Hmong population. The area in North Central Illinois should be considered for recruitment; there is a need for this student population to consider attending the university. There are barriers to attending a Wisconsin school due to out-of-state tuition. Despite these barriers, recruiters can discuss scholarship and grant options along with one-year residency options.

Appendix I identifies the total MASS population at the university. Milwaukee County shows a high concentration of URM students. The map also suggest geographic reasons may be a factor, as the locations within a fifty-mile radius to the east, west, and south show as being heavily saturated with MASS students. It is interesting to note that Dodge and Columbia Counties have very few MASS students. These may be hot spot areas to consider for future recruitment considering they are within a 50 mile radius of the university's campus.

The survey identifies the sampling of students representing 15 counties in Wisconsin and four counties in Illinois. The most prevalent representation was 28% of the URM student sampling from Milwaukee County (17/60). The second largest representations with 8.3% URM students were Dane and Walworth Counties and the third largest representations with 5% of the URM students were Racine, Kenosha, and Sheboygan Counties. The other counties represented with two URM students per county in Wisconsin represented were Jefferson, Waukesha, Ozaukee, Manitowoc and in Illinois, McHenry county had two URM students. In Marathon,

Dodge, Monroe, Brown, and Rock Counties in Wisconsin and Cook and DeKalb Counties in Illinois had one student representing URM students at the Midwest public University.

More specifically, the survey results identified students' cities of origination. Of the URM students, 23% sampled lived in the city of Milwaukee, 6.6% lived in Madison, 5% lived in Oak Creek, 5% lived in Racine, and 5% lived in Sheboygan, 3.3% lived in Wauwatosa as well as 3.3% lived in Kenosha prior to entering the University. The remaining sample contained one student representing the following cities and towns in Wisconsin (Delavan, Elkhorn, Fort Atkinson, Glendale, Grafton, Green Bay, Greenfield, Hammond, Hartland, Janesville, Lake Mills, Lomira, Manitowoc, New Berlin, Port Washington, Sparta, Sun Prairie, Sussex, Two Rivers, Walworth, Waunakee, Weston, Whitewater) and Illinois (Bradford, Cary, Chicago, DeKalb, Elmhurst, Woodstock).

High School population was assessed; 57% of students identified their high school size as over 751 students, while 13% of the students reported that their high school size was 501-750 students, and 18% of the URM students attended high schools of 251-500 students. Lastly, 12% of the students reported attending a small high school with 1-250 students.

Demographic environments and income levels were evaluated, and 43% of URM students surveyed identified living in an urban setting. Of these students, 50% identified living within a Moderate Income Level, 46% reported Low Income Level, and 4% reported High Income Level. Moreover, 42% of the total student sample reported living in a Suburban setting, with 84% of the students reporting Moderate Income Level, 8% a High Income Level, and 8% a Low Income Level. Lastly, 15% of the total URM student sample identified living in a Rural setting with 89% of students reporting Moderate Income Level and 11% stated Low Income Level. A High Income level was not reported by students who lived in rural areas.

When URM students were asked what colleges they applied to other than the public Midwest University identified in this study, 50/60 students applied to two or more. According to one interviewee, campuses compete to recruit students, and some are particularly competitive in recruiting URM students. The GIS map, Appendix N, visually identifies the prevalence of colleges being considered by URM students in this study. The GIS map offers a quick reference to identify that Parkside, Milwaukee, Madison, Oshkosh, Steven's Point, and Green Bay were considerations for students that also applied to the university. Results from the questionnaires showed that 28% of students applied to UW-Milwaukee, 20% applied to UW-Madison and 15% to UW-Oshkosh. UW-Steven's Point and UW-Green Bay both had 10% of the students apply for admission. UM-Twin Cities had 8% of URM students apply for admission. The following schools had three or less URM students from this sample apply for admission: UW-Parkside, Edgewood, Carroll, Bethel, Robert Morris, Silver Lake, Michigan, Milikin, North Central, Carthage, Grand Canyon, Lane, DePaul, Northeastern, New York, Marquette, Plateville, Mt. Mary, LaCrosse, Upper Iowa, St. Norberts, Cardinal Stritch, Eau Claire, Bloomington, Ohio State, and Illinois.

Question 2 – What factors affect the URM students' higher education choice? Hanewicz (2009) provided research that indicated living near the university setting was significant for students who stayed in school. The findings from this research study agree with Hanewicz as the most frequent reason students chose the Midwest university was that it was located in a reasonable distance from home. Other reasons for attending this university included that it had a good business school (13%), teaching school (3%), and psychology school (2%). There were 3% of the students that reported attending this university due to sports involvement. In addition, 8% of the students liked the small campus setting and 12% of the students reported the financial

cost for attending was less than other universities. It was noted that 18% of participants wanted a university that was a distance away from their homes but yet close enough that they could get home when they needed to.

Financial aid and grants or scholarships in the 2013-14 school year was awarded to 53% of the participants. Half of the African American URM students reported getting financial aid (n=13/26). About one third of the students (17/60) stated that they received grants or scholarships either from their high school or through MASS at the Midwest university. In this study, 43% (n =6/14) of Latino(a)'s received financial aid and 30% of these students received grants or scholarships. In comparison, 75% (n = 12/16) of Southeastern Asian students receive financial aid, and of these students, 31% received grants and/or scholarships. Lastly 25% (n=1/4) of Native American students received financial aid.

Interestingly, only 2% of URM students indicated influence by a family member who had attended the University (Questionnaire Item #13). However, 50% of the URM students did report that they had a family member attend this Midwest university either in the past or currently. Of these, 8% had a father or mother, 17% a brother or sister, 23% a cousin or other relative, and 2% had a combination of family members attend the university. While about half of the students did have family members who attended the university, only 2% reported this influenced their decision to attend. The results from this study contradicted expectations indicated by Perez (2010) that if siblings or relatives are currently enrolled at a college, it is likely that the prospective student will follow suit.

Despite the differences in literature and sampling results, it does appear that the URM students are receiving support as they continue their journey in the higher education setting even though the family or friends do not live locally or on campus. Responses to Questionnaire Item

#11 showed that 33% of the students receive support from their family. Friends comprise 35% of support for the URM students, and 17% of students receive support from former classmates. While 37% of the students report that they receive much support from their family, friends, former classmates and teachers, 7% of the URM students stated that they receive no support while they are attending higher education.

Information was gathered regarding mobility of URM students to identify if this has an impact on retention. Interestingly, 82% of students identified that they were not commuters. Of the remaining 18% of URM students that do commute, 7% (n=4/60) used their personal vehicle, 7% took the bus (n=4/60), 5% carpooled (n=3/60) and used a different form of transportation (n=1/60). A large number (83%) of the students walk to get around on campus, while 28% of the students use their personal vehicles, 8% car pool, and 2% bikes around campus. Many students use multiple modalities of transportation to get around campus as reported in the questionnaire results.

A small sampling of participants were influenced by the small-town living; however, the same amount of participants responded that urban or rural living had no influence at all on their decision to attend this Midwest University. When URM students in this study visited the campus before they were accepted, 23% stated that they were aware of the diversity of the public Midwest University campus. Prior campus experiences may have included programs such as TRIO, Pre-College Summer Camp-Upward Bound, Wheels to Education and campus tours.

Question 3 – What changes could be made to improve recruitment of URM at the Midwest University? Interviews with admissions and diversity personnel provide insight into the potential improvements GIS tools could make within their departments. Currently, the MASS department and the Admissions Department at the Midwest University mainly utilize a query-

based data system shared through Excel to analyze data according to admission and diversity personnel of the Midwestern public university. Both programs had interns in years past that have conducted in depth analysis through Multiple Regression Models for MASS Programs and a topography map of counties in Wisconsin with the number of students from the university for the Admissions Department.

Fortunately, the ADA can see the usefulness in GIS tools in the Admission process. He would like to see GIS tools assist his department in mapping the demographics of students and the top feeder schools, counties, and virtual tours of the campus. He would like to see the GIS data be inputted for analysis of the Veteran's population on campus as well as Adult Non-Traditional students, athletes, residents, and non-residents. The admissions personnel is concerned that the university is targeting the right spots in-state and out-of-state.

As mentioned earlier, many companies have begun to see the powerful impact the layering of data can have to effectively analyze and project outcomes (Robertson & Heuer, 2013; Lupton & Strassberg, 2013; Martinez & Ramirez-Gomez, 2013). As the diversity supervisor comments, he has a long-term vision for the use of GIS in the MASS department. He feels GIS can help identify the missing links for recruitment and retention of underrepresented students in an effort for students with disadvantages to catch up to those students of privilege. He would like to see a GIS tool that can look at the pressure points of how to get students to take 54 credits in four semesters. Data would need to be collected on current credit loads and the time it is taking URM students to complete these credits, an analysis of why the students are or are not reaching this goal, and feeder school involvement. Based on the current study, GIS tools have the potential for further research in higher education specifically to multicultural programming.

The diversity supervisor has seen the positive effects of the use of GIS tools through recent map-making and summer conference for URM students by his graduate assistant in the MASS department. Furthermore, McNair Scholars receive the support needed to become globally competitive despite the challenges that they faced upon admission to higher education (Bell, 2012). From the summer conference, McNair scholars have been able to use GIS mapping in their research presentations. Moreover, with seeing the direct effect GIS has within his department, he has plans for future expansion. It is his intent to first build staff capacity to learn and use GIS technology. The next phase is to engage students with GIS to give them employable skills and make them eligible for internships. The intent would be to set up a GIS Center within the MASS department. He wants URM students to have an 'edge in the market'.

With building capacity in staff and students, recruiters can then take the GIS maps to prospective students and parents to tell a story to show how the Midwestern university is eliminating the achievement gap. If gaps occur, they will be able to see what is occurring and address the issues. As mentioned by Fry and Lopez (2012), Hispanics are becoming one of the largest diversity groups at college settings. According to MASS Program data (2013), the university currently serves 29% of Latinos participating in Multicultural Affairs and Student Success. According to an interview with the diversity supervisor, his MASS department would like to see GIS assist with recruitment program planning with a goal of building diversity amongst all ethnicities on campus from the current 10-11% to the competitive 20-25% of other Wisconsin Universities.

GIS Mapping. Appendix G helps to examine the usefulness of data layering for identifying the potential hot areas and cold areas for URM recruitment. It was also important to see where the largest clustering of ethnicity groups occurred. In order to better visualize and

interpret the breakdown of ethnicity, four different choropleth maps (related to each URM ethnicity group) were designed to show the higher, mid, and lower densities of African-American (Appendix J), Latino(a) (Appendix K), Native Americans (Appendix L), and Southeast Asians (Appendix M) attending a Midwestern University.

Chapter Five

Conclusions and Recommendations

The following conclusions will focus on two main areas of findings. These two areas of findings were student perceptions and GIS map analysis. When evaluating the effectiveness of a recruitment and retention program, it is critical to understand the students' perceptions and how factors such as distance and competitive colleges play a part in the students' decision making process. It is equally important to be able to visualize data for easy analysis. GIS technology opens the door for deeper, critical thinking due to the visual spatial reasoning that can be achieved through mapping (Kerski, 2007).

The first major finding that can be seen across student responses and GIS map analysis is that distance plays an important role in the student's decision of where to attend college. Students commented that they want to be "Far enough away from home but close enough if they need to get home." Students stated that they had a support network of family and friends at home. URM students utilized MASS services and programs as well as campus clubs to gain further support. Students who came on campus prior to admission were made aware of the diversity on campus. Students who applied without visiting the campus were less aware or unaware of the campus diversity. Demographic areas (rural or urban) college locations did not have a major influence on students' decisions to attend the rural university setting. Other UW schools (Madison, Milwaukee, Parkside, Green Bay, and Oshkosh) were competitive for these students' applications.

There are many findings regarding the relationship between ethnicity and attendance that can be identified because of the GIS software and mapping tools. The three GIS maps (Appendices G, H, I) clearly show a higher density of students within a fifty mile radius to the

Midwest college university. There is a heavy concentration of density dots of URM students from Milwaukee, Dane, Rock and Walworth Counties from Southeastern Wisconsin which are all within 50 miles of the university. The heaviest concentration of URM students are African Americans found in the urban cities of Milwaukee, Beloit, and Madison while the Latino(a) population is dispersed across the state of Wisconsin. Native Americans make up only 6% of the campus diversity.

This research study has been beneficial in exploring the usefulness of Geographical Information Systems (GIS) in the recruitment and retention of Underrepresented Multicultural Students (URM) at a Midwestern University. These tools have the potential to expand the perspective pool of underrepresented minorities to university programs, such as TRIO Programs and Multicultural Affairs and Student Success (MASS). The literature review validates the methods used by other researchers in identifying the usefulness of GIS with other higher education settings such examples, police departments, campus security, marketing, and the alumni networks (Castagna, 2011; Jardine, 2003; Reyes, 2012; Romeo, 2005). With the growing trend of financial cuts in governmental program like TRIO Programs it is clear that universities must be budget minded and GIS maps demonstrate in this study to positively show trends in the data that queries cannot.

The findings of this study could assist faculty in cost effective measures for providing services and programming. These findings could also, with further research, assist faculty and students in becoming competent in utilizing GIS technology that would have the potential to provide career advancement opportunities. Lastly, the findings of this study could assist administrative staff in evaluating and implementing change to increase graduation rates and retention rates amongst underrepresented populations.

Limitations of Study

The research found in this study is important specifically to improvement of MASS programs. However, the results from this research study should not be generalized to all university settings. Only convenience sampling was used for questionnaires. Reliability was not tested and that is a limitation of this study. Being a qualitative study, the information is biased by the student participants' narrative responses and there is room for interpretation by the coder. It would have been beneficial to gain a better sampling of Native Americans into this data analysis. Furthermore, it would have been better to gain more survey responses from participants in student organization meetings rather than the large response at King-Chavez Class. This class is designed for scholarship participants from Milwaukee and Rock County that are future McNair Scholars. Participants in student organizations make up a larger pool of diverse students. The King-Chavez Class is a heavy concentration of African American and Latino(a) students.

This study is further limited by discrepancies in different enrollment data sources. For this research study, student data was provided directly from the MASS Department. However, other research could be used for this study, such as *2013 Racial/Ethnic Heritage Headcount & Percentages of Each Sub-Group of Fall Enrollment* available from Academic Affairs which represents data from the tenth day of admissions to the Midwestern University. MASS data was chosen because it represents the changes of enrollment throughout each semester. There are a variety of factors that could influence this data. Some of these factors include: late admissions, transfers, academic dismissals, summer term students, etc.

In addition to survey and data limitations, there are limitations in the mapping. In Appendix H the US Census Bureau extends Wisconsin and Northern Illinois borders into Lake

Michigan to depict actual boundary lines. If the original shape file would have been used for mapping, all the eastern counties would have been exaggerated to their county boundary lines into Lake Michigan. In order to rectify that situation, the shape file was clipped again using the borders defined by ESRI's data to more accurately depict the shape of Wisconsin/Illinois (refer to Appendix I). Also, a software difficulty occurred within dot density mapping. The university's software for geocoding addresses feature had a limited time membership that had expired. In order to renew the membership it would be a substantial cost to purchase and there was no means at the time of research to purchase this feature. This feature would have individually identified each of the 2,346 students' addresses giving more accuracy to the map. To overcome this barrier, I completed a simple dot density map which is a scattering of the dot representation of location distribution of the given area. In Appendices H and I, the dots are randomly generated within the county boundaries and do not reflect the individuals actual location. Time of this research project was also a limitation for inputting and improving map data due to limited access to the GIS lab and the GIS assistant.

Recommendations for the Future

Overall, the findings from the research support the exploration of the use of Geographical Information Systems (GIS) in recruitment and retention of underrepresented multicultural students at the university. Based on the completion of these visually appealing maps, it is true that GIS software and maps provide effective data collection that can be effectively analyzed by the operator. As the GIS maps provide another form of technology rather than queries to analyze data and explore cost saving measures for MASS Programs, I recommend this technology continue to be used to inform recruitment and retention.

Recruitment efforts should be evaluated to ensure that students are having an equal opportunity to speak with college recruiters in order to plan for their futures. Research from surveys has offered many suggestions for improving recruitment efforts: introduce T.V. commercials promoting the university, inform potential applicants about the diversity, affordable, resources that are available, student organizations, and abroad opportunities. Additional recommendations were for a panel of current students to visit high schools or to show prospective students the Student Share videos introducing the campus. It also was recommended to set up a university booth at sporting events or have a Student Shadow day where a high school student shadows a college student.

Future research studies could include the following recommendations based on findings from this research study. It is recommended that a GIS map of Northern Wisconsin is created with layering features of specific Southeast Asian and Native American student populations identifying including counties, high schools, and home school data. This map would give recruiters more information for those specific populations. In addition, it would be useful to layer data according to programs at the university. How many students from each ethnicity are enrolled in STEM, Education, Psychology, Business, etc.? Lastly, research could be conducted in the area of reciprocal funding for Illinois and Wisconsin. If Northwest Illinois students could have Wisconsin's tuition rate, what would the ethnicity density be at the public Midwestern university knowing that finances are a barrier to many URM students? Would that open the door to achieving the 20-25% ethnicity on campus or supersede that percentage?

This study could be conducted on a larger scale to give researchers further insight to look into the challenges of recruitment and improving effective data management techniques through the use of GIS tools. A longitudinal study could be completed to evaluate the recruitment and

retention process following students from the time they begin Upward Bound to completion of a degree. Universities with higher enrollments of Native Americans could be researched to understand in detail the recruitment and retention of that population in the university setting. Also, universities with motivated faculty and staff could be studied to see the potential GIS tools have in the global delivery of services to university students and then students embedding GIS tools into their own research studies. Some of the potential uses of GIS in Higher Education for Multicultural Affairs and Student Success staff at the Midwestern University are: mapping and tracking participants that attend Pre-College Summer Camps (Upward Bound, STEM, and Acceleration Courses); designing GIS maps with data of MASS students that have attained an Associate of Arts Degree, Bachelor Degree, and Master Degree by County in Wisconsin, Northern Illinois, and International students; mapping and tracking McNair Scholars and Pathway for Success Students; as well as, developing an Upward Bound GIS summer lab class that teaches mapping skills and visual data analysis to Pre-College students.

In the long term, GIS will continue to show expansion into different field areas as demonstrated in various articles found in Higher Education. It's no longer just for geographers but has proven through this capstone project the potential of its usefulness in accessing URM recruitment patterns for a Midwestern University. Incorporating GIS into higher education Administration data assessment will take some time and patience in training staff, but its resourcefulness and its ability to identify different patterns will make it an essential part of data research for higher education programs.

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APPENDIX A

Informed Consent for Student Organization Meetings: GIS for Admissions Project

Purpose:

This research survey is being conducted to collect preliminary data to assess the effectiveness of GIS tools to be used in the recruitment and retention monitoring process of underrepresented students at the Midwestern University. The information collected in this questionnaire will help assess and further enhance recruitment practices for MASS and TRIO Programs.

Your Participation is Voluntary:

Participation in this survey is completely voluntary. At any point during this survey, you have the right to withdraw without penalty. Also, you may skip any question that you choose to. The anticipated time of participation is thirty minutes. The student investigator, John Dominguez, will be available during and after the completion of the survey if there are follow up questions.

Your Anonymity is Important:

This survey is designed to be anonymous to the utmost degree. Confidentiality will be maintained to the extent possible by law. Your responses will be combined with other participants of this study and you will not be individually identified in reports produced from this research study.

Campus Resources:

If you are under 18, you should not complete this questionnaire. By completing the questionnaire you are giving your informed consent to participate in this survey.

Questionnaire Location: All surveys will be conducted at the university.

If you have any questions about your rights related to research, please contact Research and Sponsored Programs.

If you have any questions regarding the research, please feel free to contact the principal investigator or student investigator at the university.

I understand the conditions of this study and am providing my informed consent to being a participant.

Signature of Survey Participant

Date

Address

Phone

APPENDIX B

Why Do Underrepresented Students Choose to Attend the Midwestern University?

This questionnaire survey instrument will be used as qualitative methodology used to identify student's characteristics and demographics through the use of random, homogeneous sampling of 60 University students from Multicultural Affairs and Student Success and TRIO programs.

1) Name of High School: _____

Location of High School (City/State): _____

2) How many students were in your high school?

- A) 1-250
- B) 251- 500
- C) 501-750
- D) Over 751

3) What was the dominant ethnic population within your school?

- A) African American
- B) Latino
- C) Asian
- D) Native-American
- E) Anglo-Saxon
- F) Other

4) What kind of community did you live-in?

A) Urban



Income Level: (Circle One): High Moderate Low Mixed

B) Suburban



Income Level: (Circle One): High Moderate Low Mixed

C) Rural



Income Level: (Circle One): High Moderate Low Mixed

- 5) How many other Colleges did you apply to besides the Midwestern University? And what were their names?

Number of 4 year Colleges: _____ Number of 2 year colleges _____

Name: _____ Name: _____

Name: _____ Name: _____

Name: _____ Name: _____

- 6) Did you have any college recruiters come to visit your high school?

Circle One: Yes or No



Which colleges were represented? _____

- 7) Are you a transfer student or have you taken any college level courses at your high school?

Circle One: Yes or No



Name of the two-year College or classes you attended?

- 8) Did you participate in precollege programs or college preview programs?

A) TRIO Programs (Upward Bound & Pre-College Summer Camps)

B) Other Summer Camps: Name: _____

C) Wheels to Education: _____

D) Colleges Visited Prior to Application: _____

- 9) What transportation do you rely on to get around campus?

A) Personal Vehicle

B) Car Pool

C) Biking

D) Walking

E) Taxi Service

- 16) Now that you have been a student at the Midwestern University, do you feel that the university is a culturally diverse campus? Please explain.
- 17) Did you receive any financial aid or scholarships to attend the Midwestern University?
- 18) Did urban or rural living influence your decision to come to the Midwestern University's campus? Please explain.
- 19) Has attending the university made you more pro-active in recommending family or friends to attend the Midwestern city? If so, why and what are the advantages?
- 20) What could the Midwestern University's recruiters do to make the university more attractive to potential freshman or transfer students from your home town?

APPENDIX C

Interview with Admission Personnel

1. What are the daily responsibilities of Admissions office and how has the process and responsibilities change in the past 10 years?
2. What are the major challenges that your Admission office faces and how have you been able to delegate these issues?
3. What are the demographic and geographic data information do you use, how do you collect the data, what instruments, and what are resource areas you get them from?
4. What type of data do you collect for Admissions and how is it useful in your assessment and analysis of admissions? How effective is the data you use and would you ever consider other methods of data analysis?
5. How has technology advanced in the Admissions process and what are some of the new ways you're using technology for recruitment and data assessment?
6. Do you follow a specific model for admissions and how does this impact recruitment of students (specifically underrepresented minorities)?

7. How do you assess students coming to the university and what are the primary things that Admissions office looks at for acceptance?
8. How does Admissions office approach recruitment of underrepresented minorities and what are the challenges, success, and strategies?
9. How much traveling is a requirement for your position and how do you decide what target areas to travel?
10. In past years, did the Admissions office utilize Geography students to help assist with mapping out admission's or recruitment patterns of students?
11. Would you ever consider the possibility a university GIS student internship in Admissions office to create a series of trial visualizations of the spatial patterns of freshman applicants to illustrate the way in which these visualizations can be utilized in strategic admissions planning?
12. Having a GIS center on campus, would your office consider a Pilot program in training and familiarizing the professional staff of the university's office of Admissions with GIS skills and technology to advance their data analysis and recruitment process? I think that would be a great benefit!
13. What do you see as the future trends in Admissions process and how has your office prepared and adapted for these potential changes?

APPENDIX D

Interview with Diversity Personnel at Midwest University

1. What are the major challenges that TRIO/MASS students face when coming to the Midwestern University and how has the Multicultural Affairs and Student Success (MASS) programs been able to assist the students in overcoming these obstacles?
2. How has technology advanced the success of MASS programming and what are some of new ways you're using technology for student retention, recruitment, and data assessment?
3. How much exposure to GIS have you experienced during your administration role in Higher Education? If so, how has GIS been used and what type of projects?
4. How effective is the data collection your staff uses for MASS program assessments and would you ever consider other methods of data set analysis such as Geographical Information Systems (GIS)?
5. Would you ever consider the possibility of a GIS student interning in MASS office to be utilized in strategic data assessment of student retention and teach GIS research skills to McNair Scholars?
6. Having a GIS center on campus, would your office consider a Pilot program in training and familiarizing the professional staff of MASS with GIS skills and technology to advance their data analysis and evaluations?

APPENDIX E

ESRI ArcGIS Methodology for creating Dot Density/Chloropleth Maps

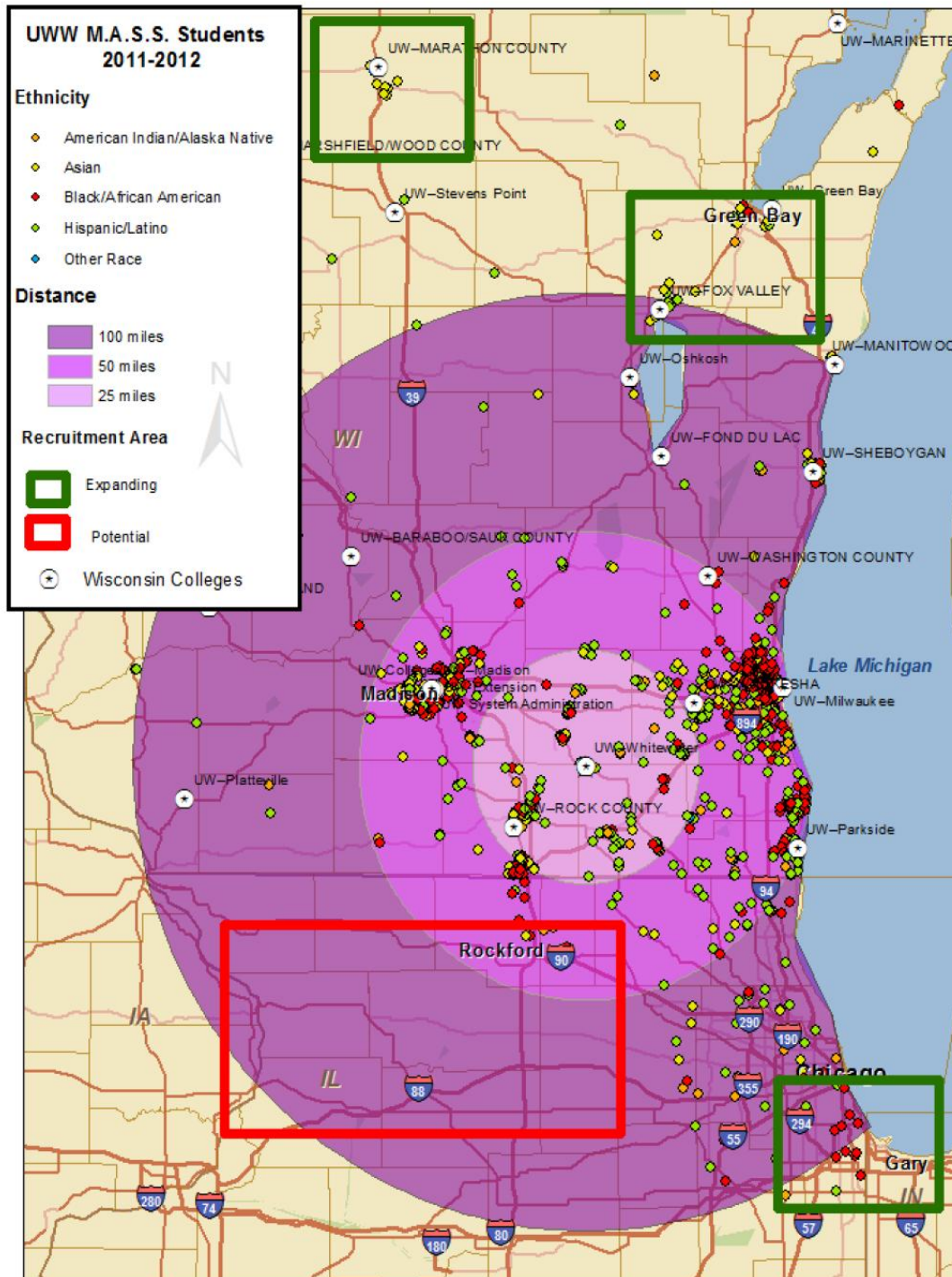
- Located existing shape file of US counties that was created by US Federal Census Bureau for the 2010 Census
- Downloaded and added shape file to Arc Map workspace
- Repeated step 1 to download US Census Shape file for States.
- Selected Illinois and Wisconsin from State files.
- Exported selected features into a new shape file titled “Wisconsin and Illinois borders”.
- Changed projection for the county shape files.
- Clipped the US Census county shape file using Wisconsin and Illinois borders so that only Wisconsin and Illinois counties were included in maps. Named file “Wi_ILcounties”
- Because the US Census bureau extends Wisconsin and Northern Illinois borders into Lake Michigan, the shape file was clipped again using the borders defined by ESRI’s data to more accurately depict the shape of Wisconsin/Illinois.
- Added five fields to the Wi_ILcounties attribute table: MASS student(Total mass students), African Americans, South East Asian, Latino(a), Native Americans
- Populated each field with appropriate information obtained through the office of Multicultural Affairs and students success for each county.
- Displayed total mass student population per county using the following:
Properties>Symbology>Quantities: Graduate Colors> Value: MASS student. We did not normalize the data.
 - o As a number of counties in Wisconsin/Il do not have MASS students, we opted to have six classification groups, with one being zero. The others utilized a natural break classification method.
- Copied WI_ilcounties and created a second layer in the data frame.
- Once again, to visualize the population for MASS students, we went to properties>symbology>quantities: Dot Density. We selected the following fields to be displayed in the dot density: MASSSEA, MASSNA, MASSAA, MASSLAT. Each dot represented one individual of the identified ethnicity per county. All five ethnicities are displayed on a single layer using color coded dots.
 - o Please note: these dots are randomly generated within the county boundaries and DO NOT reflect the individual’s actual location.
- Added a second data frame to act as the inset map for Milwaukee County.
- Copied the two shapefiles from the original data frame so the data would display identically. Zoomed in on Milwaukee County.
- Added a north arrow, scale bar, and legend to the map. Included total counts of MASS students in the legend.

APPENDIX F

ESRI ArcGIS Methodology for creating a Survey Map

- Created 3 empty shapefiles in ArcCatalog. Set their coordinate system to WGS_1984 and projection to UTM Mercator Zone 16N, WGS_1984. Shapefiles were titled: Survey_Universities, Survey_HS, Survey_participants
- Open ArcMap “Street Maps” base map and added three blank shape files to the map.
 - o The Street Maps base map was necessary to correctly geocode the addresses for the survey shape files.
- Turn on ESRI’s editor toolbar and select “Start Editing” add points to shape files.
- Using ArcGIS Address Finder, we located the addresses of the 13 universities. Unfortunately, due to changes in ArcGIS 10.1, we had to locate and mark each universities’ address individually.
 - o Repeat for the addresses of the high schools for participants, and the individual addresses of each participant. “Stop editing”
- Add the following fields to Survey_HS: “Name”, “State”, “City”
- Add the following fields to Survey_Participants: “Ethnicity”
- Add the following fields to Survey_universities: “Name”, “State”, “Applicants (n=FP)”
- Select “start editing”
- Populate appropriate information into attribute fields listed above according to survey results.
- Select “stop editing”
- Open a new blank workspace in ArcMap
- Add the following shapefiles: WI_II Counties, US Census State File (Downloaded for Map 1), Survey_HS, Survey_Participants, Survey_universities
- Select Properties>Categories>Unique Values, with the value field selecting “Ethnicity” to change survey participants layer to display survey participants by ethnicity.
 - o Uncheck <all other values>, we do not have any values but the four identified.
- Display the most prominently applied to universities by going to properties>quantities>graduated symbols.
 - o Decided to focus on Wisconsin universities, a few students applied to out of state schools (no more than 1 per school).
 - o Utilized “natural breaks” for symbol classification.
- Labelled each university.
- Placed a star at Midwestern University.
- Added north arrow, scale bar, and legend to map.

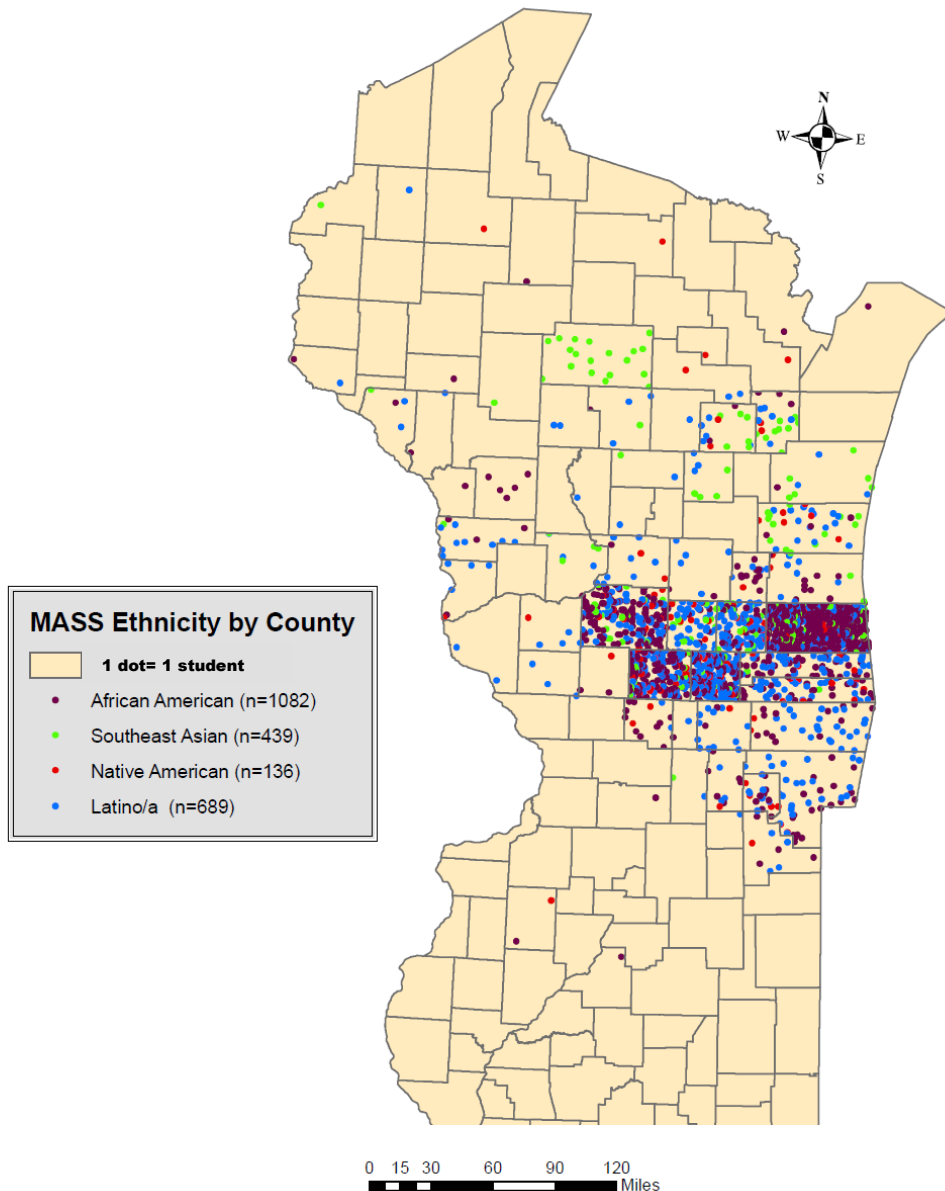
Minority Marketing Recruitment Analysis



John Dominguez, IV, MASS Graduate Assistant 2012
Monica Wilson, UWW Dept Geography 2012

APPENDIX H

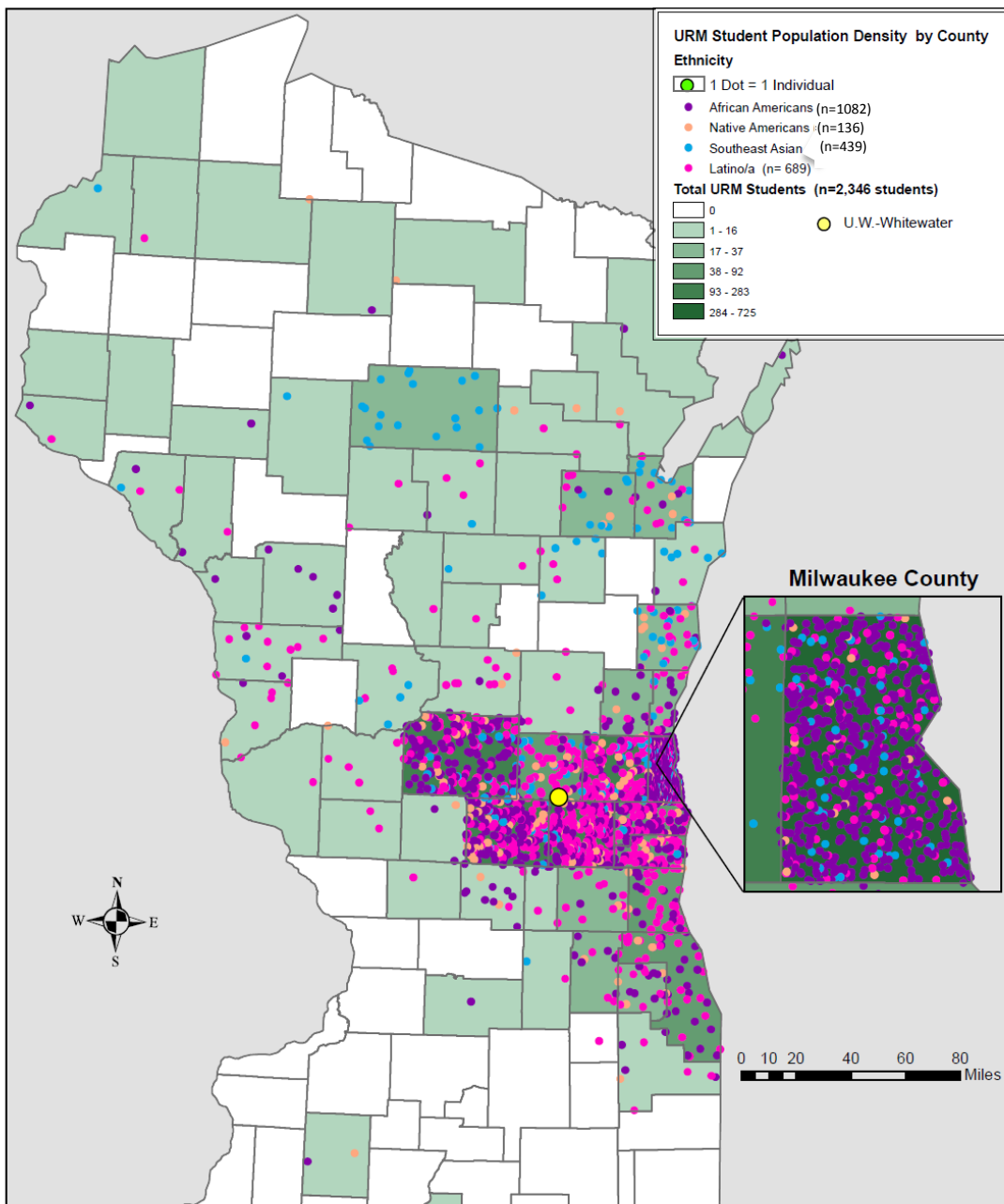
Underrepresented Multicultural Students (URM) Attending Midwestern University (2011-2013) (Wisconsin and Northern Illinois)



Created by John Dominguez and Monica Wilson,
UWW Office of Multicultural Affairs and Student Success

APPENDIX I

Underrepresented Multicultural Students (URM) Attending Midwestern University (2011-2013) (Wisconsin and Northern Illinois)

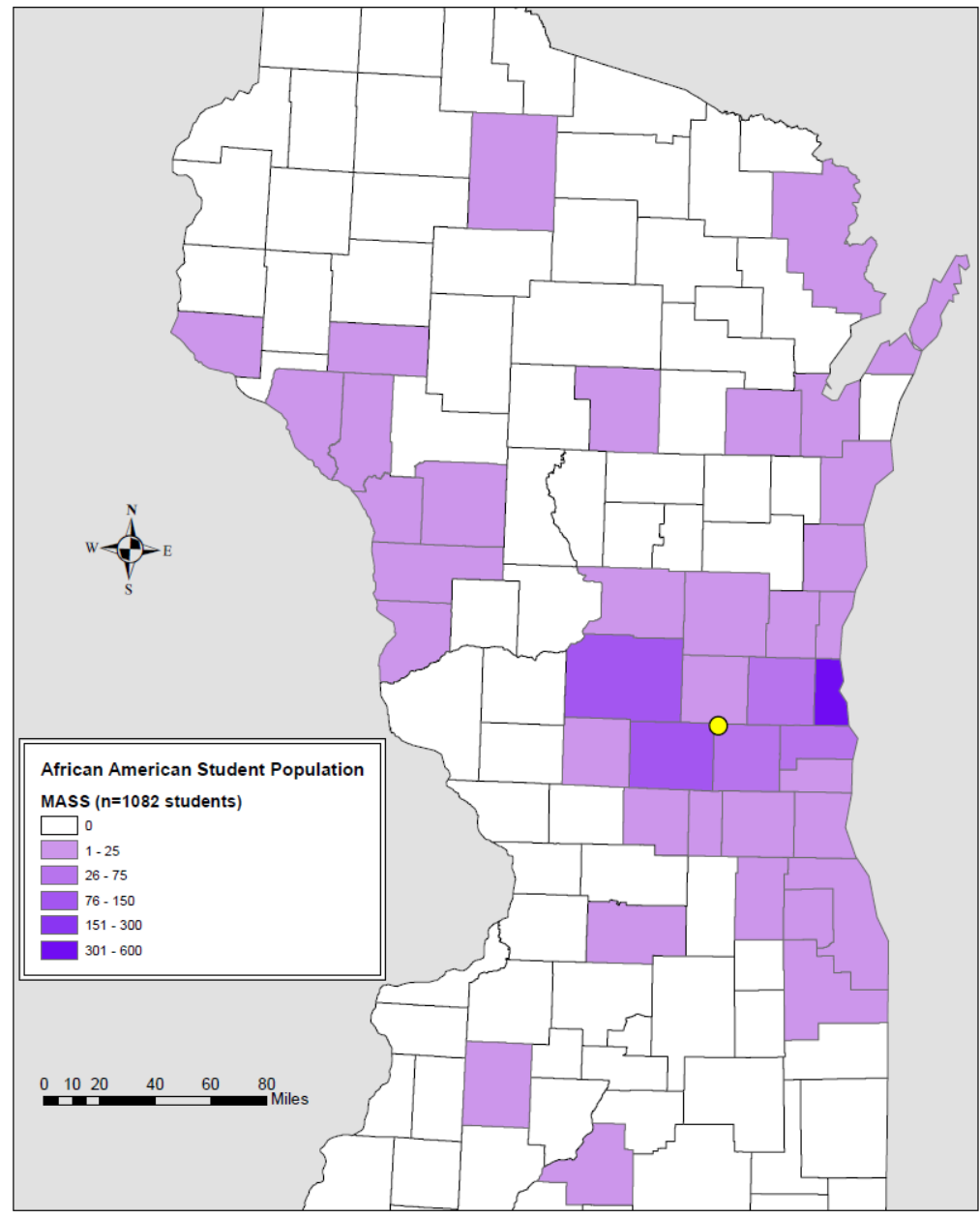


John Dominguez, Jr. and Monica Wilson,
Multicultural Affairs and Student Success (MASS) Office, UW Whitewater

13 December 2013

APPENDIX J

**African Americans Attending a
Midwestern University by County (2011-2013)**
Wisconsin and Northern Illinois



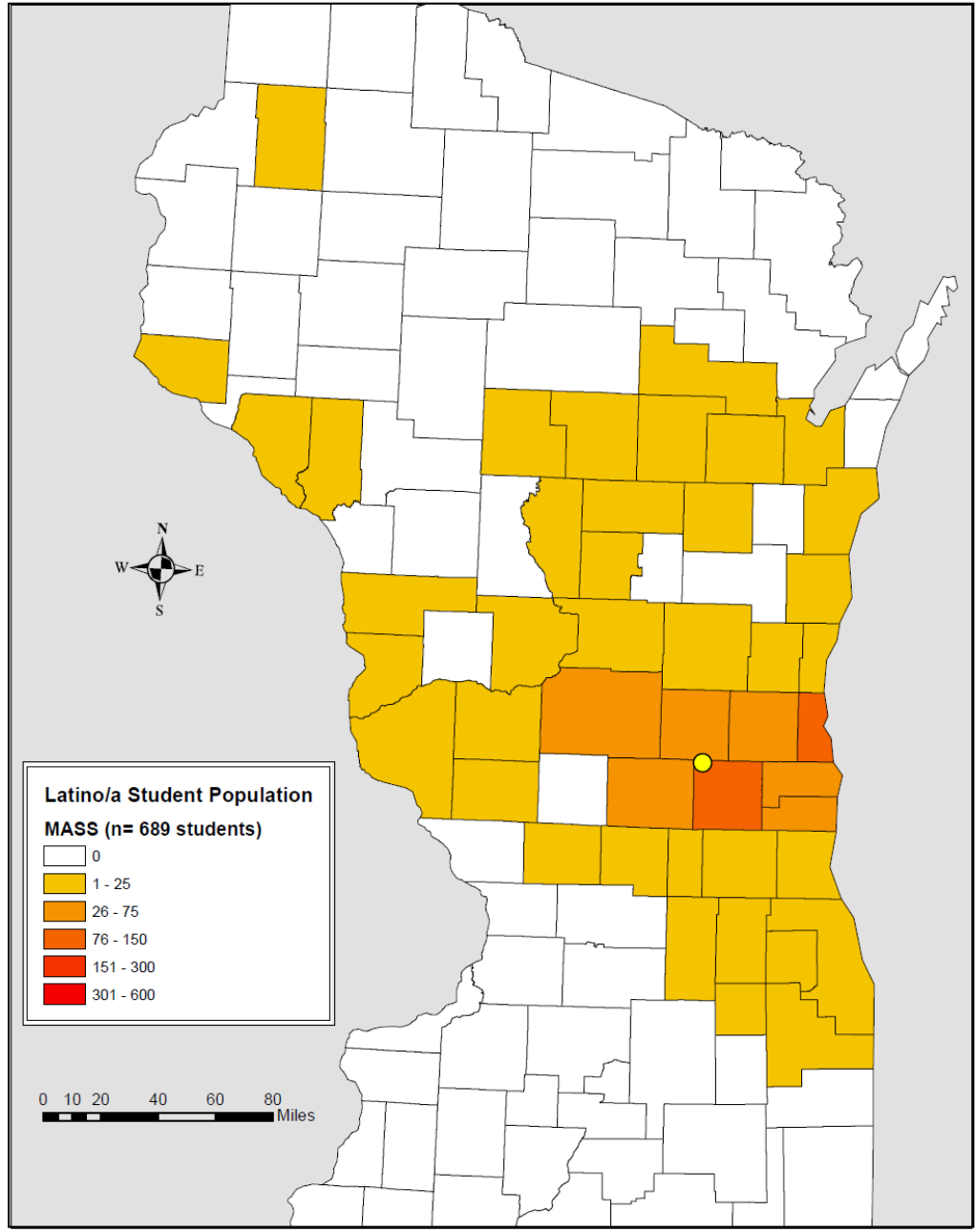
John Dominguez, Jr. and Monica Wilson,
Multicultural Affairs and Student Success (MASS) Office, UW Whitewater

13 December 2013

APPENDIX K

Latinos/Latinas Attending a Midwestern University by County (2011-2013)

Wisconsin and Northern Illinois

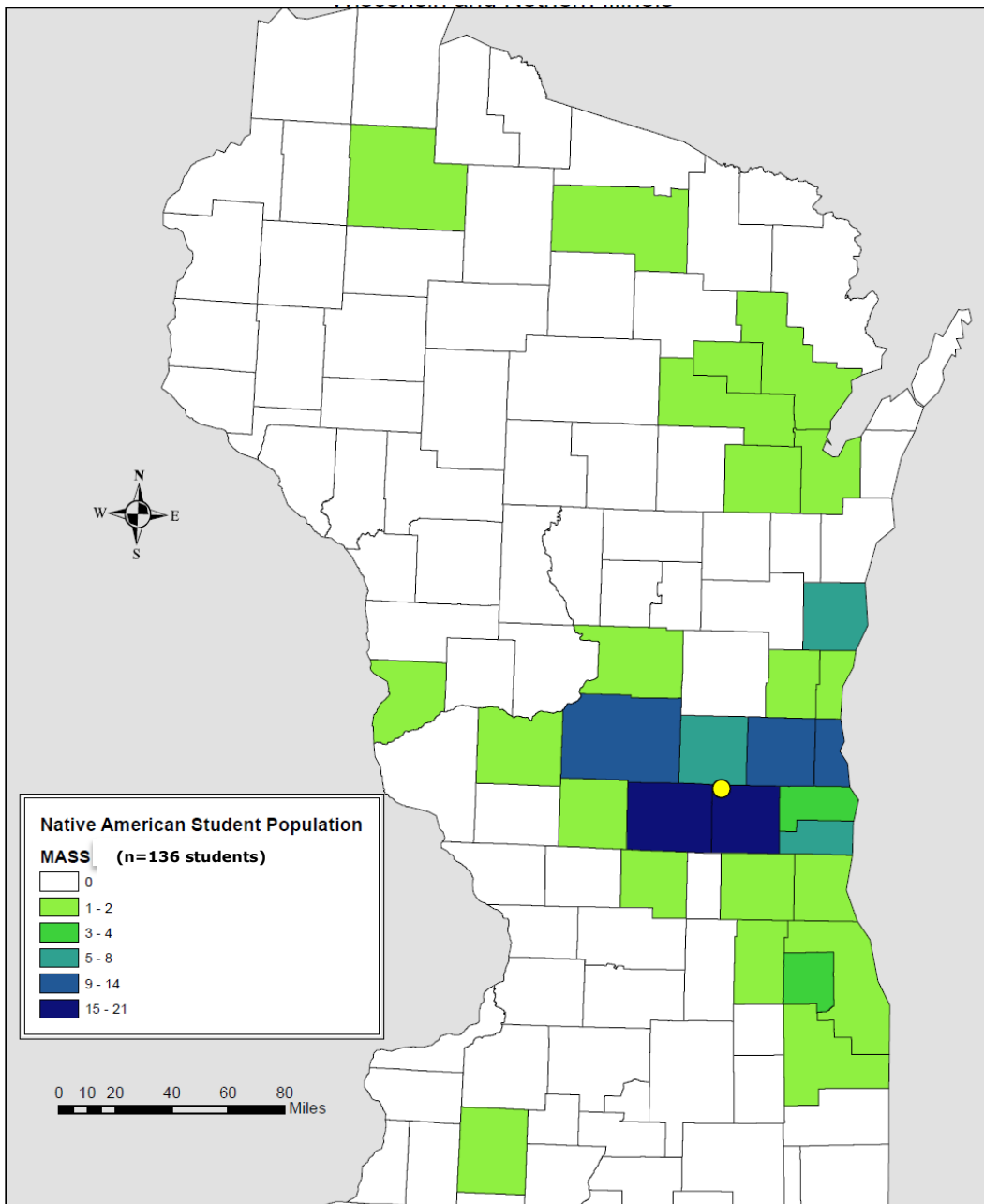


John Dominguez, Jr. and Monica Wilson,
Multicultural Affairs and Student Success (MASS) Office, UW Whitewater

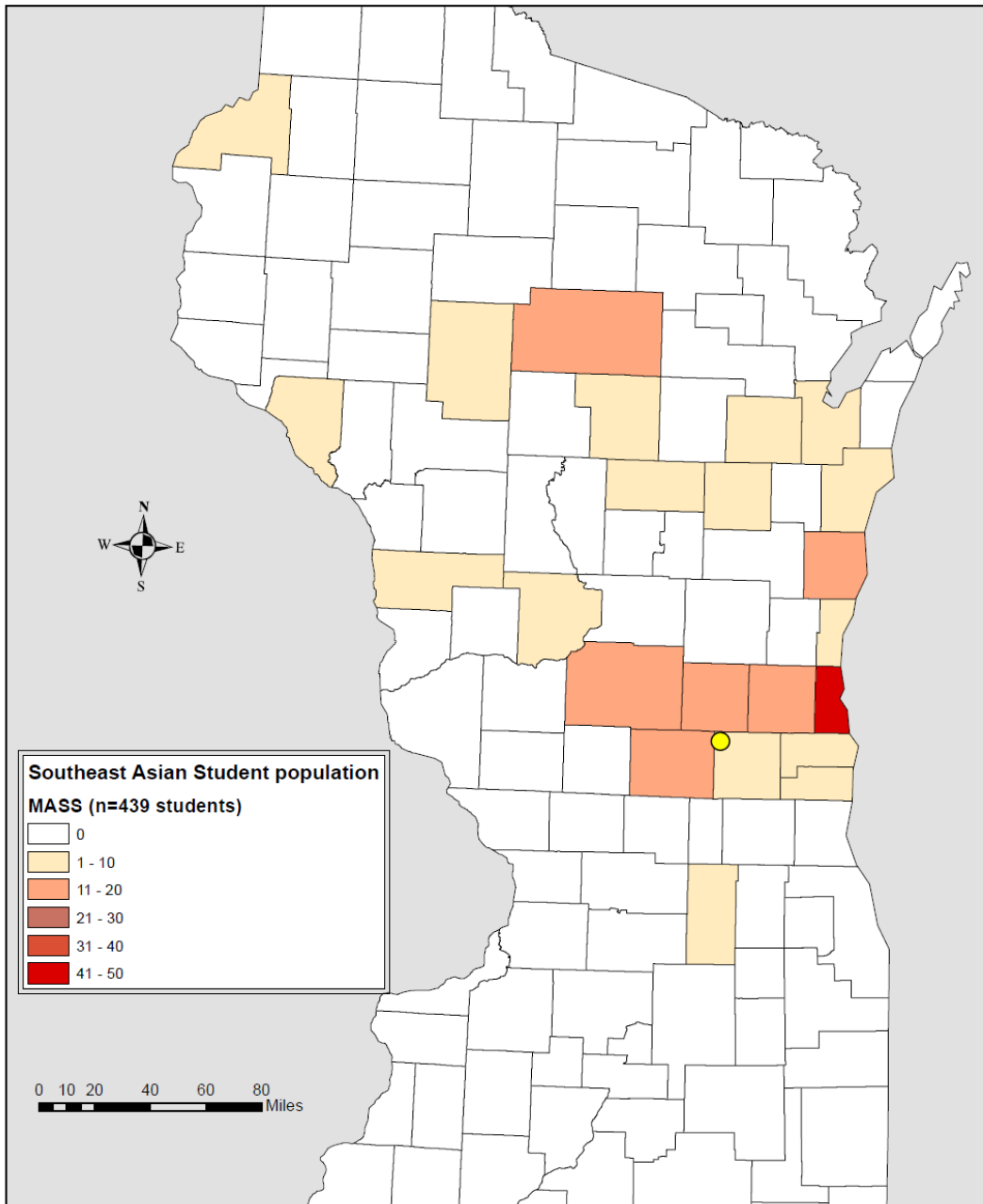
13 December 2013

APPENDIX L

Native Americans Attending a Midwestern University by County (2011-2013) Wisconsin and Northern Illinois



Southeast Asians Attending a Midwestern University by County (2011-2013) Wisconsin and Northern Illinois



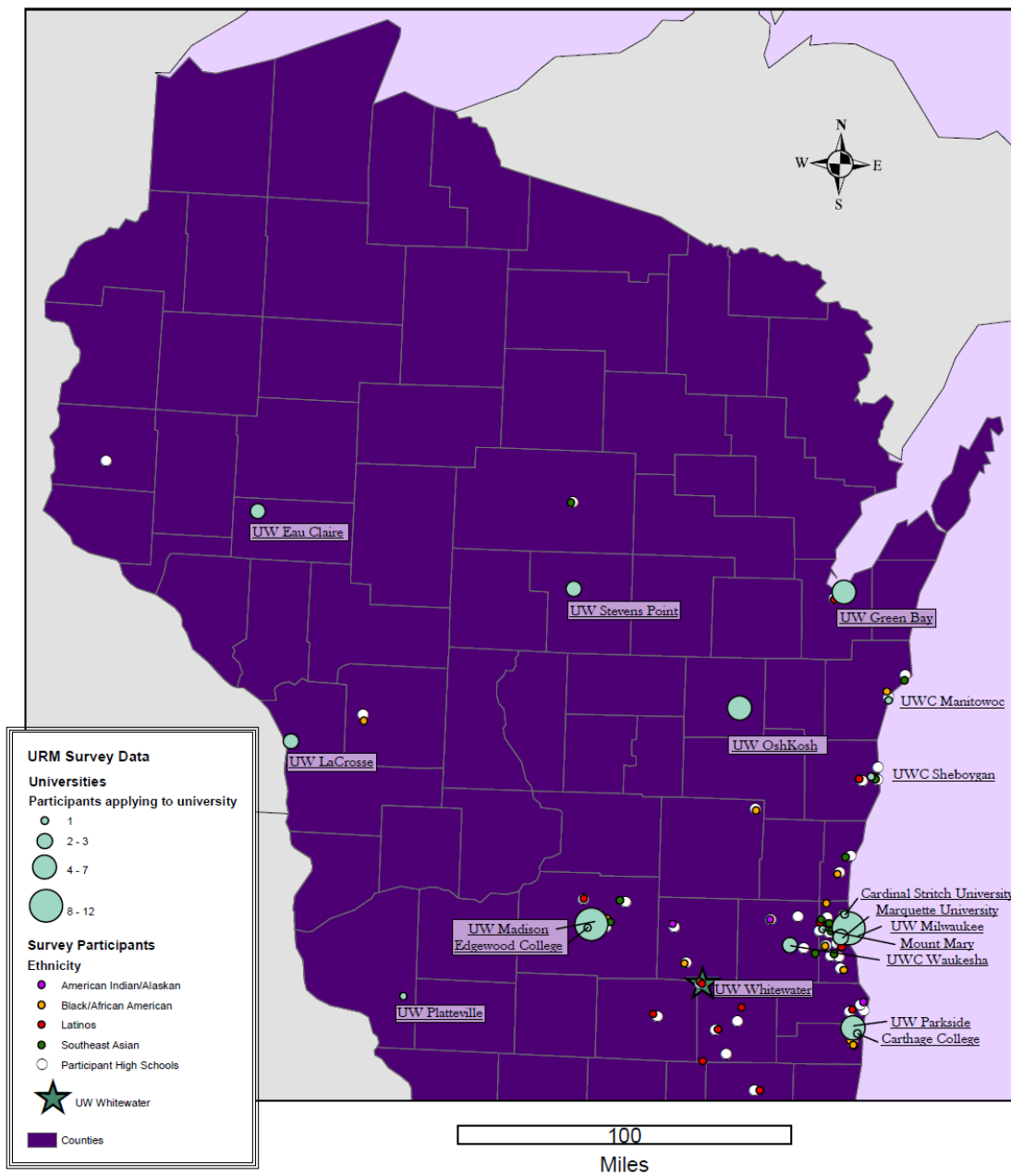
John Dominguez, Jr. and Monica Wilson,
Multicultural Affairs and Student Success (MASS) Office, UW Whitewater

13 December 2013

APPENDIX N

Underrepresented Multicultural (URM) Student Survey Results

60 Respondents, Fall 2013



John Dominguez, Jr. and Nica Wilson
Multicultural Affairs and Student Success (MASS) Office, UW Whitewater

13 December 2013