# Beyond Access: Assessing Institutional Barriers for Underrepresented Minorities in STEM & High Employer Demand Majors

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***Abstract***
*Access to higher education in Washington State public institutions has reached an unprecedented level for underrepresented minorities (URM); completion rates in STEM and high demand majors however lag behind other groups. Nationwide, URM make up 1/3 of school age population but only comprise 11% of those in STEM occupation. Job growth is increasing in the STEM and high employer demand fields faster than in other fields and, according to the US Census bureau, URM are the fastest growing ethnicities and will become the majority in the US in the coming decades. As demand for STEM and high employer demand graduates increases, higher education policy and practices need to support the reality that an innovative economy in the future will require leveraging a diverse workforce. This study surveys the access to STEM and high employer demand majors among URM students. The quantitative design at the institution level uses data from academic year 2013/14 from public higher education institutions in Washington State to determine URM's level of access and success; At the individual level, the design focuses on the fall 2010 and fall 2011cohorts of first time full time college goers enrolled at the University of Washington Bothell, and attempts to analyze how institutional policies and practices might be related to access for URM in STEM and high employer demand degrees.*

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## Introduction

The new United States' (US) economy will depend upon a diverse workforce in science, technology, engineering and mathematics (STEM) to sustain productivity and growth. Giant corporations in the technology sector recently such as Apple, Facebook, Microsoft, and Yahoo have been on the receiving end of criticism for the limited diversity of their workforces, which are over 70% white and male (Baggley, 2015). The lack of diversity in these organizations however is primarily due to the fact that the US educational system is not currently producing enough STEM and other high employer demand degrees graduates from underrepresented minority groups (URM),defined here as persons of African American, Hispanic American, and Native American racial/ethnic descent. In fact, these corporations have turned to H1B Visas (migrant guest workers) as a way to fill the gap as the total trained US labor force is insufficient for their needs. The H1B visa solution is however a pricy one and one that is not sustainable considering that other nations are aggressively restructuring their higher education and workforce policies to keep their nationals at home now that they understand the link between sustained economic growth and a technically trained workforce, (George, Neale, Malcom, & Van Horne, 2001). URM are the fastest growing ethnicities and are forecast to be the largest segments of the nation's workforce in the coming decades; As such, they provide an untapped reservoir of talent that must be trained to fill technical jobs in STEM and high employer demand fields for the US economy to remain competitive in the 21st century.

Nationally, public institutions strive to increase access to higher education and resources for URM students and have largely succeeded; however, existing policies do not always facilitate URM access to competitive majors in STEM and high employer demand fields. Over the past 25 years for example, even with educational diversity programs that have encouraged and supported URM pursuit of those competitive degrees, their representation still lags far behind that of White, non-Hispanic men. URM make up approximately one-third of the school-age population but they currently comprise only 11% of those in STEM occupations (Tsui, 2007). More recently, since the Great Recession of 2008, access to higher education for URM in colleges nationally have reached an unprecedented level (Tough, 2014). In Washington State, most URM and low-income college students attend public institutions. In 2012, public institutions enrolled 81 percent

of Pell grant recipients, a group we use to identify low income students. Of those, 53 percent attended community and technical colleges, 16 percent research universities, and 12 percent comprehensive institutions. (Education Research Center, 2014).

In light of the fact that public institutions in Washington State have strived to and succeeded to some extent in increasing access for URM students, we must look beyond access as a measure of success and start to think about completion of high employer demand and STEM degrees. Too much emphasis is given to access to and graduation from higher education by URM and not enough to how they navigate the systems, experience the institutions, and how that affects what degrees they end up with. This paper seeks to understand the policies and practices in Washington State public institutions and their relationship to the access URM students have to STEM and high employer demand majors (HED). The study focuses on two cohorts of first time full time students at the University of Washington Bothell, the most ethnically diverse higher education institution in Washington State. This research has two goals:

1. To better understand URM's level of access to competitive STEM and HED degrees in Washington State public 4-year institutions.

2. To understand how URM students navigate the higher education system in Washington State and whether they face barriers that discourage them from STEM and HED degrees.

**Definition of Terms**

High employer demand (HED) degrees in Washington State are identified by the educational institutions, in consultation with the Workforce Training and Education Coordinating Board and the Washington Student Achievement Council, based on the needs of the state. The University of Washington Bothell (UWB) defines the following majors as HED: Applied Computing, Biology, Business Administration, Chemistry, Climate Science and Policy, Computer Engineering, Computing Science & Software, Electrical Engineering, Environmental Science, Interactive Media Design, Mathematical Thinking and Visualization, Mathematics, Mechanical Engineering, and Nursing. STEM degrees are a subset of High Employer Demand majors that excludes Business Administration, Nursing and other less technical degrees from the list. Gateway Courses as defined by the Gardner Institute are courses that are foundational, high-

risk, high enrollment, and with a national failure rate above 30% (Koch & Pristilli, 2014). For the purpose of this study, physical science and math-based gateway courses are the focus.

Despite the growing literature on the need for an increase in STEM major graduates and the vast literature on college access and success of URM, little empirical research has been conducted on how institutional policies and organizational behaviors affect student access to those highly sought-after majors in Washington State. I seek to add to the conversation by examining policies and practices in Washington State's public institutions around major access to determine their impacts on URM students. Particular concern will be focused on whether institution-level policies disproportionally impact URM admittance to highly sought-after competitive high employer demand and STEM degrees.

**Purpose Statement**

This paper considers how institutional policies and practices impact the experiences and outcomes of URM students in Washington State. The study surveys Washington State's higher education public institutions outcomes for underrepresented college students regarding access to STEM and high employer demand (HED) majors once enrolled in college followed by a case study of the 2010 and 2011 first time full time students at the University of Washington Bothell (UWB). Data for a quantitative comparison study design is available for academic year 2013/14 and permits comparison between public higher education institutions in Washington State relative to URM access to and success in STEM. At the individual level, the design focuses on the fall 2010 and fall 2011cohorts of first time full time college goers enrolled at the University of Washington Bothell, contrasts their outcomes as of spring 2015 with their desired majors before they enrolled and attempts to analyze how institutional policies and practices related to access for URM in STEM and HED majors.

## Literature Review

Creating the conditions that foster student success in Washington State public universities has never been more important. Washington State public universities were established to provide accessible, affordable, and excellent education to its citizen (Spaulding, 2013). Historically the low participation of URM students in STEM and HED fields is strongly correlated with cultural barriers in the form of social expectation for different groups, legal barriers that barred minorities' access to education and employment; and institutional discriminatory policies and practices (May & Chubin, 2003). Although we have come a long way since the end of segregation and the demise of the Jim Crow laws with the passage of the Civil Rights Act, the accumulated societal achievement gap for URM students in this stratified society continues to perpetuate inequalities when it comes to access to STEM and HED majors. In fact, it is commonly understood today that student success and access to competitive majors is positively correlated with several factors including pre-college preparation, financial scholarships, co-curricular programs, socioeconomic statues, rigorous math and science curriculum, and quality of high school teachers; by-and-large. All those factors are positively correlated with affluence and non-URM (Tsui, 2007). Furthermore, URM students are more likely to come from low income backgrounds that are associated with lower familial expectations for educational attainment than other groups. This coupled with reduced resources results in college preparation courses and less frequent college placement examinations than found among peers who can afford it (Engberg & Allen, 2011).

The literature tells us that there is a positive association between first generation students and URM groups of low socio-economic status and a big discrepancy between their needs and those of non-URM (Mehta, Newbold, & O'Rourke, 2011). Without mentorship from parents who may not have gone through the higher education system with less social and financial support, URM students of low socio-economic status are less likely to engage in active coping strategies, tend to have less social and academic satisfaction and lower GPA (Mehta, Newbold, & O'Rourke, 2011). Furthermore, for these students, the information given about resources such as financial aid with the aim of supporting them have negative impacts on their outcomes and perceptions about colleges; it also reduces the likelihood of persistence suggesting that college- and financial aid-related information as a means to create college opportunity is not having the

impact it should for URM and low-income students (De La Rosa, 2006). Self-efficacy is another concept that helps us determine how students are likely to do in college in math and sciences and it is also developed early on in high school.

When it comes to social support and its relationship to URM with self-efficacy and attitudes toward math and sciences, factors such as student attitudes, self-perceived abilities, social support in math and science are hypothesized to affect students' willingness to pursue math and science coursework (Rice, Barth, Guadagno, Smith, & McCallum, 2013). Students with high levels of human, social, and cultural capital in high school are also positively associated with attendance to college. Among low-income students, race and parental educational attainment play an important role in explaining enrollment propensities and academic preparation was a highly significant factor in increasing chances of attending college (Engberg & Allen, 2011). Greater support from each of these three agents: parents, teachers, or friends was associated with student reports of higher self-efficacy and more favorable attitudes toward math and science and a decrease in the achievement gap for all students and in particular for URM groups; differences in educational attainment in the math and sciences fields are developed by the time students are in high school and are suggested to be related with demographics such as race, ethnicity, immigration status, socioeconomic status and location (Rice, Barth, Guadagno, Smith, & McCallum, 2013).

High school achievement gaps plays a decisive role in what major students choose to pursue or whether they persist in college. Historically, URM students have been more likely to have achievement gaps in sciences and math. This makes them less likely than non-URM to succeed and earn a college degree; success here being defined as one of the following four indicators: first-year enrollment after high school, first- to second-year retention, earning a grade of B or higher in selected first-year courses, and earning a first-year GPA of 3.0 or higher (ACT, 2010). Remediation rates are lowered during the first year of college for students who took additional mathematics and sciences courses in high school, and thus were more college ready than their peers. This indicates that remediation at the high school level is more effective in preparing under-prepared students for the rigueur of college; absent that, access to college for URM groups without wrap around services to bridge the achievement gap is likely to perpetuate the divide with students of better socio-economic standing.

The conversation about the needs for more STEM and HED is ongoing at a national stage currently but there is a lack of focus on how policies and practices at the higher education level may be impacting those students. Public and private institutions are focused on increasing their selectivity by retaining and graduating a larger percentage of the students within six years. Increasing retention and graduation could prove costly if the academic preparedness of the incoming students dictate a need for remediation. Universities can increase the impacts of their retention initiatives by strategically targeting resource that enhance retention and graduation rates for URM and low income students (Gansemer-Topf & Schuh, 2006).

Given strong demands to demonstrate evidence of student success in higher education, it is no surprise that retention at colleges has been a focus with different populations and groups in society. Retention is the ability of an institution to retain a student from admission though graduation (Seidman, 2007). Colleges and universities spend immense amounts of funding to assist student success in college and help students pursue their goals. Retention is critical to student success. If a student does not continue with their studies, the student will not complete their program. Completion is degree attainment within 6 years. Retention then is critical to the student, faculty, trustees, administrators, support staff, departments, teams, the institution itself, and the whole educational system (Seidman, 2007).

University completion rates (bachelor degree within six years) have also become a hot topic nationwide partly due to the ballooning student loan debt and the need for more qualified workers in the STEM fields. Completion of a higher education degree is less frequent for URM students, particularly if the major of choice is in a STEM field. Students who choose and access STEM majors usually make that decision while still in high school generally by the 9$^{th}$ grade (Wang, 2013); generally, these students have parents in that field or who have parents that can help them achieve better in math and sciences. By the time a student gets to 12$^{th}$ grade in high school, they need a certain proficiency in math to be able to persist in a STEM degree. This suggests that remediation should be more focused in high schools (Wang, 2013).

An examination of patterns of persisting in and switching from an intended college major (chosen in high school) in the third year of college with a focus on STEM majors because of the national effort to increase those entering STEM careers reveals clear differences in persistence by academic field as well as by gender, parental income, and first-generation college student

status with the largest variation by ethnicity. Students with high school performance in math and science, who took advanced placement exams in STEM, who articulated positive science self-efficacy beliefs, and professed a goal of obtaining a doctorate were more likely to persist in varied ways across STEM majors (Shaw, 2010). We also have evidence that URM students who succeed in accessing STEM majors subsequently graduate at almost the same rate as non-URM in those fields. A study by Cole & Espinosa found that Latino students are less likely to enter STEM but more successful when in, particularly if their parents are college graduates as well. In that particular study, high school GPA had a significantly positive influence on the college GPA of Latino students' majoring in STEM (Cole & Espinoza, 2008).

There is a vibrant debate in the literature as to whether remediation works in achieving graduation for under-represented groups. Garcia and Kurlaender evaluated the effects of remedial placement using unique administrative data on college completion at the nation's largest public four-year higher education system and found that remediated students, who completed their required remediation courses by their second year, had very similar graduation outcomes as their non-remediated counterparts (Garcia & Kurlaender, 2013).However, Garcia's study does not address students who fail to complete the remediation program nor does it give us a rate of students who actually do complete it. Students who require remediation are different from those that do not which makes it hard to isolate the effect of remediation on college outcomes from other effects such as weaker academic skills, undefined goals, or lack of motivation. By controlling for demographic characteristics and academic skills, students in developmental courses can do as well as students who never participate in developmental education. They also found that that at four-year colleges, remediation yields a 6-7 percent negative effect on degree completion (Attewell, Lavin, Thurston, & Levey, 2006).

Of course we cannot talk about remediation without talking about the burgeoning cost of higher education. Education costs have increased drastically as the absolute cost of tuition has increased by 5.1% yearly on average over the past three decades in public institutions and by 3.5% in private institutions (Ehrenberg, 2012); part of the increase was driven by published rankings, such as those of U.S. News and World Report, which are based partially on institutions' expenditures per student and by technology adoption that comes at a high cost. Increased tuition were also the result of a decline in state appropriation for public schools. As a

result, full time faculty numbers have declined from 80% in 1970 to just 51.3% in 2007; reliance on adjunct faculty could be problematic as a 10 point increase in the percentage of full-time faculty not in tenure-track positions was associated with a 4.4 percentage point reduction in graduation rates at public master's-level institutions (Ehrenberg, 2012).

Current literature suggests that state funding has a direct link with graduation rates at 4-year public institutions. A 10% increase in state appropriations per student at Public universities leads to an increase in graduation rates of about 0.64% overall when all other factors are held constant (Zhang, 2009). This holds true for institutions that have enjoyed increases in funding and those that saw a decline in state appropriation. In addition, the positive association seems to hold for all research/doctoral, masters, and baccalaureate institutions. Although this is not a very cost effective way to increase graduation rates, it is important nonetheless since we know that URM science students are particularly affected by their ability to finance college, which inhibits both their academic and social adjustment. In fact, financial concerns affect science students from all racial groups more than did their non-science counterparts. The prevalence of these financial concerns certainly has strong policy implications and merits further Investigation.

The literature also suggests a relation between institutional revenues, expenses, and graduation rates (Sheperd, 2014). Higher education institutions organizational behaviors and policies have varying effects on students that depend upon their demographics and attributes (Berger, 2000). Increases in academic support expenditures and instructional expenditures positively affect graduation rates in particular for first generation students while increases in research expenditures have the opposite outcome (Ryan, 2004). These findings suggest that research funding in public institutions could have a negative impact on under-prepared students. As funding decreases, universities allocation to expenditures in the categories of instructions, academic support, student services, and research also tend to decrease leading to a negative effect on graduation and persistence rates. Increasing allocation in three of the categories (student services, instructions, and support) lead to increases in graduation rates while decreasing research expenditures have the same outcome. For low test scores/high Pell grant aid students, URM students, the allocation cuts further reduce the likelihood of persistence or admittance into highly competitive majors.

The theory of individual habitus coined by Pena in 2006 guides my research and hypothesis; Pena's multi-faceted framework of organizations and policy environments articulates that "an individual's habitus regarding college choice is expected to reflect an individual's demographic characteristics, particularly gender, race/ethnicity, socioeconomic status, as well as cultural and social capital" Human capital investments at the center of this model, emphasizing the importance of academic preparation and the availability of financial resources in calculating the cost-benefit analysis associated with college decision-making (Engberg & Allen, 2011). My study addresses a gap in the literature by examining public universities in Washington State policies around major access to determine their relationship with URM students' access to STEM and HED degrees.

**Research Method**

Rooted within the theoretical framework of the individual habitus I employ a cross-section analysis Washington State colleges and universities followed by a quantitative case-study of UWB to assess the following research questions:

*Question 1*: Compared to other Washington state institutions, how is UWB doing and what are the options that are available for improving access and success?

*Dataset:* Data for phase of the study were drawn from the Statewide Public Four-Year Dashboard of Washington State through the Education Research & Data Center (ERDC). The dataset is at the institutional level and contains information from all Washington State public four-year higher education institutions from academic year 2013/14 with the following variables: enrollment rates of first-time full time students by ethnicity, graduation rates by ethnicity, degrees obtained by field, Pell Grant eligibility and average amount per student receiving it, and cost of education.

*Design:* A cross-sectional descriptive quantitative design is used for the part of this study to establish baseline differences between the public higher education institutions in Washington State. The data from the state's public dashboard is collected at one point of time, and the focus is on the level of access of underrepresented minorities compared to the other groups without introducing interventions. The unit of analysis is the institution; students are classified as URM

and Pell eligible based on the federal guidelines from the Department of Education. The institutions in this study are the University of Washington Bothell (UWB), the University of Washington Seattle (UWS), the University of Washington Tacoma (UWT), Washington State University (WSU), Western Washington University (WWU), Central Washington University (CWU), and Eastern Washington University (EWU).

*Question 2:* Compared to non-URM students, how are underrepresented students at the University of Washington Bothell faring in regards to access to STEM and high employer demand degrees?

*Dataset:* data for this phase of the study is drawn from the University of Washington's Enterprise Data Warehouse (EDW), and the University of Washington Bothell's website. The EDW dataset, at the individual level, comprises all first time full time cohort of students for fall 2010 and 2011 at the University of Washington Bothell; variables collected include requested majors, first generation status, Pell eligibility, SAT/ACT composite scores, ethnicity, math and sciences courses taken during first year including GPA, Actual major at UWB. In addition, majors, information including prerequisite, application process, and other requirements were obtained through the UWB website.

*Design:* I follow data for the fall 2010 and 2011 cohorts of first time full time (FTFT) students admitted at the University of Washington Bothell (UWB) to contrasts their eventual majors relative to their intended majors. These observations will enable us to discuss possible impacts of policies and practices on student outcomes. Data from the state's dashboard was entered into SPSS, recoded into categorical variables at the interval level to allow for the analysis. It was then recoded using averages or aggregate measures where needed. Degrees at the institutions were recoded into two categories: STEM / high employer demand and non-STEM /high employer demand based on Washington State's definitions. As this is partly a comparative analysis to investigate how policies in the institution may impact different groups, no manipulation of the data is required as seasonability is not an issue. The main independent variable in this study is URM. However, it is necessary to hold constant other potential sources of variation including Pell eligibility, gender, and gateway courses completed. Regression analysis is employed to consider their effect on participation STEM and HED degrees.

*Analysis Methods:* For the analysis of this case study, I started with descriptive statistics of the population to measure differences in incoming characteristics of the cohorts. I then ran a multivariate analysis to address missing data issues as they arose; an ANOVA test across the following four groups to determine whether there were significant differences in the incoming academic profile among these groups: 1) URM students who requested STEM or HED majors and are in those majors, 2) students who requested STEM or HED but are not in those majors, 3) students who did not request STEM or HED but are in those majors, and 4) students who did not request STEM or HED and are not in those majors. A logistic regression model was run to determine which of the factors or variables in the study influenced the likelihood of majoring in STEM or HED majors versus not; a Chi Square to test whether underprepared URM and non-URM students are less likely to major in STEM/HED.

To control for impacts associated with incoming characteristics of students versus those at the higher education institution, gateway courses in math or science that are historically difficult to pass and that are required for access to STEM / HED majors were identified and included in the model. By correlating GPA in the first gateway math or science course at UWB to the actual major of students it is possible to determine whether URM students who demonstrate subject matter aptitude, as measured by attaining a grade at or above the 50th percentile mark, were as likely to major in STEM / HED as other student groups. A second correlation analyses, controlling for student socio-economic status, as measured by Pell Eligibility, was undertaken to examine access to STEM/HED majors for URM and Non-URM. Finally, a chronological analysis using a linear regression to compare students declared expected majors at UWB versus the actual majors they actually graduate in.

There is an internal validity concern with this phase of the study as it is hard to establish a causal relationship between policies at the institutions and access to majors for underrepresented groups; the qualitative phase of this study seek to address that concern for students at UWB in trying to explain observed trends. Since the groups in the study are not randomly allocated, I will use statistical controls to insure similarities in GPA and family income between the groups compared to increase the likelihood that observed differences are attributed to access to majors policies. There are no external validities concerns with this study as I am using the national

definition of the groups and all higher education institutions must use the same definition and collect the information.

*Expectations:* At the onset of this research, I expect that URM students are less likely to major in STEM or HED majors than other students groups with the same background characteristics at UWB just as the literature suggests nationwide. However, once URM students demonstrate success in the first math or science gateway course, we should expect them to access STEM and HED majors at the same rate as other groups. If there is still a discrepancy in access between URM and non-URM students after success in the gateway course, then we can say that administrative barriers may be impacting access to STEM and HED degrees by URM.

**Results & Discussion**

**Question 1: Compared to other Washington state institutions, how is UWB doing and what are the options that are available for improving access and success?**

*Background Data on WA State Colleges and Universities:* the quantitative analyses in this study centers mainly on UWB. For academic year 2013-14, in terms of admission, UWB was the second most selective institution in the state of Washington with a 75.6% admission rate behind only UW with its 55.2% admission rate. UWS also graduates the largest percentage of its students compared to the other institutions with a graduation rate of 80% for 2013/4 academic calendar; UWB's 68% is tight in line with Western Washington and Washington state universities and well ahead of the other public institutions (see table 1).

**<u>TABLE 1:</u> 2013-14 ADMISSION RATES, STANDARDIZED TESTING SCORES, AND GRADUATION RATES**

| Colleges/ University | Admission Rate | SAT or ACT Required | Average SAT Score | Average ACT Score | 6-year Graduation Rates (2013-14) |
|---|---|---|---|---|---|
| Central Washington University | 82.2% | No (if high | 1460 | 20 | 56% |
| Eastern Washington University | 79.7% | No (if high | 1435 | 20 | 48% |
| Evergreen State College | 97.1% | Yes | 1605 | 23 | 52% |
| University of Washington Bothell | 75.6% | Yes | 1495 | 21 | 68% |
| University of Washington Seattle | 55.2% | Yes | 1815 | 27 | 80% |
| University of Washington Tacoma | 85.2% | Yes | 1425 | 20 | 49% |
| Washington State University | 82.1% | Yes | 1525 | 22 | 69% |
| Western Washington University | 83.7% | Yes | 1657 | 25 | 69% |

**Source: data drawn from Statewide Public Four-Year Dashboard of Washington State through the Education Research & Data Center (ERDC)**

When it comes to admission requirements and standardized testing scores, UWB is once again aligned with the remaining institutions with the exception of UW Seattle whose admitted students' SAT and ACT scores rank in the top 20$^{th}$ percentile nationwide. The majority of the institutions required SAT or ACT scores be submitted as part of the application process; Central Washington and Eastern Washington waive entry test requirements for students with a high school GPA above 3.5. UW Seattle the also the largest institution (43,762 Total Students) and the most expensive of the group with an in-state tuition including fees of $12,397 per year.

Eastern Washington offers the cheapest in-state tuition at $7,961 and has the lowest graduation rate at 48%. UWB, as part of the UW system, has the same tuition as UW Seattle but is slightly cheaper due to lower fees. Overall, the percentage of students eligible for Pell grants range from 25% at UW Seattle and Western Washington to 46% at UW Tacoma; UWB falls right in the middle of the pack with 34% of its student eligible for Pell (See table 2).

**TABLE 2: 2013-14 WA STATE 4 YEAR PUBLIC COLLEGE AFFORDABILITY DATA**

| Colleges/ University | In-State Tuition 2014 | Out-of State Tuition | % undergrads receiving Pell Grants | % Freshmen on ay AID |
|---|---|---|---|---|
| Central Washington University | $ 8,976.00 | $ 20,886.00 | 36% | 81% |
| Eastern Washington University | $ 7,961.00 | $ 19,612.00 | 39% | 85% |
| Evergreen State College | $ 8,574.00 | $ 20,661.00 | 43% | 84% |
| University of Washington Bothell | $ 11,911.00 | $ 31,485.00 | 34% | 68% |
| University of Washington Seattle | $ 12,397.00 | $ 31,971.00 | 25% | 56% |
| University of Washington Tacoma | $ 11,902.00 | $ 31,476.00 | 46% | 85% |
| Washington State University | $ 12,327.00 | $ 25,409.00 | 33% | 79% |
| Western Washington University | $ 8,863.00 | $ 19,752.00 | 25% | 71% |

**Source: data drawn from the Statewide Public Four-Year Dashboard of Washington State through the Education Research & Data Center (ERDC)**

*Diversity Outlook:* looking at the diversity data in Table 3, it appears as though Washington State public institutions can be broken into two categories with the University of Washington forming one group, and everyone else forming the second. This is partly due to the fact that the percentage of white students is well above 64% in every institution that is not a UW and drops to just around 48% in the UW system. However, once the number of students who are not considered underrepresented (White and Asian students primarily) are combined, the story becomes more nuanced; Western Washington with well over 81% of its students White or Asian becomes the least diverse followed by UWB with 71.5% of its students falling in that category. UW Tacoma would be considered the most diverse in this scenario as only 63.8% of its students are either White or Asian; the remaining institutions are all within a couple of percentage points between each other (UW Seattle 67.9%, WSU 69.5%, Central Washington 68.6%, Evergreen

State 69.7%, and Eastern Washington 69.4%) (see table 3).

**<u>TABLE 3:</u> DIVERSITY PROFILE OF WASHINGTON STATE INSTITUTIONS INCOMING STUDENTS FOR 2013-14**

| Colleges/ University | % White Students | % Hispanics Students | % Race Unknown Students | % Asian Students | % Black or African | 2 or more races | American Indian or Alaska native | Native Hawaiian or Pacific Islander |
|---|---|---|---|---|---|---|---|---|
| Central Washington University | 64.40% | 11.40% | 9.50% | 5.30% | 2.70% | 5.30% | 0.50% | 0.40% |
| Eastern Washington University | 66.50% | 11.50% | 7.00% | 2.90% | 3.40% | 4.20% | 1.20% | 0.30% |
| Evergreen State College | 66.30% | 7.00% | 8.90% | 2.30% | 5.10% | 7.10% | 2.50% | 0.30% |
| University of Washington Bothell | 48.50% | 7.80% | 1.90% | 23% | 4.90% | 5.30% | 0.50% | 0.80% |
| University of Washington Seattle | 48% | 6.40% | 3.50% | 19.90% | 2.50% | 4.40% | 0.60% | 0.40% |
| University of Washington Tacoma | 48.90% | 8.90% | 6.80% | 14.90% | 6.80% | 6.40% | 1.20% | 1.40% |
| Washington State University | 64.30% | 9.70% | 4.00% | 5.20% | 3.00% | 6.00% | 0.60% | 0.40% |
| Western Washington University | 75.50% | 6.70% | 1.10% | 6.20% | 1.50% | 7.30% | 0.40% | 0.10% |

**Source: data drawn from the Statewide Public Four-Year Dashboard of Washington State through the Education Research & Data Center (ERDC)**

***<u>Question 2:</u>*** **How are underrepresented students at the University of Washington Bothell faring in regards to access and success in STEM and high demand degrees?**

Of the 911 first time full time students admitted at UWB in the fall 2010 or 2011, 47.2% were female and 52.8% male; 21.5% were URM students, 3% international students, and 75.5% White or Asian students. In all, 37.9% of the students were Pell eligible and 46.1% self-reported as First-Generation College students. 53.6% of the cohorts requested STEM or High Employer Demand (HED) majors during the application process compared 13.9% for other major, 32.5% of the group did not request a major in their application. 84.4% of the cohorts took at least one of the gateway courses identified for this study and 44.9%received a grade of 3.0 or better, 28.8% graduated already, 32.1% dropped out, and 38.7% are still enrolled. 91.4% submitted composite mathematics and reading comprehension SAT scores with a mean score of 1031.46, a median of 1030 and a standard deviation of 156.8.

As of winter quarter 2015, 39.6% of the initial cohorts either accessed STEM / HED majors or have graduated with one; 31.1% either accessed non-STEM/HED majors or have

graduated with one; and 31% may have dropped out already or are still seeking access to a major at UWB. The discrepancy in numbers between the dropped out category (32.1%) and those who have yet to access a major or dropped out (31%) is due to the fact that a small percentage of students drop out after accessing a major at UWB. The numbers are different when looking at the URM and non-URM groups separately to some extent as table 4 below depicts; We see that URM students median score in SAT is well below the score of non-URM, URM students are more likely to be Pell eligible (55.6% eligible compared to only 34.3% for non-URM), and that although both groups take gateway courses at the same rate, non-URM students are more likely to receive a 3.0 or better GPA in those courses (47.2% versus 37.8%). A Chi square of the SAT and URM variables suggest a weak negative correlation, r.-.230, n=911, p<.01.

**TABLE 4: URM AND NON-URM COMPARISON OF SAT/ACT, PELL ELIGIBILITY, AND GPA TAKING UWB GATEWAY COURSES**

| | URM n=196 | Non-URM n=680 |
|---|---|---|
| Median Math/Reading SAT Scores | 970.00 | 1040.00 |
| Pell Eligibility | 55.6% | 34.3% |
| Took Gateway Course | 84.7% | 84.6 |
| 3.0 GPA or > in first Gateway course | 37.8% | 47.2% |

**Source: Data drawn from the University of Washington EDW for the fall 2010 & 11 cohort of first time full time students**

As far as major choice and access, URM students were less likely to request STEM / HED majors at 47.4% compared to 55.4% for non-URM students; they were also less likely to access a STEM/HED major after having requested it at 29.1% compared to 39.6% for non-URM. 31.1% of URM who requested STEM/HED majors ended up I one of those majors, 36.5% ended up with a different major, and 32.4% did not access a major at UWB; for non URM, those numbers are 41.3% who requested STEM/HED accessed one of the majors in that category, 30.2% accessed a non-STEM/HED major, and 28.6% did not access a major at UWB. These numbers suggest that URM students in general are less likely to request a STEM/HED major,

less likely to access it once they select it, and less likely to succeed in a gateway course even though they take those courses at the same rate as non-URM students.

**TABLE 5: MAJOR REQUEST AND ACCESS FOR URM AND NON-URM STUDENTS**

| | URM n=196 | Non-URM n=680 |
|---|---|---|
| Requested STEM / HED Major | 47.4% | 55.4% |
| Requested Non-Stem / HED Major | 16.8% | 13.2% |
| No major requested | 35.7% | 31.4% |
| Accessed STEM / HED | 29.1% | 39.6% |
| Accessed non-STEM / HED | 33.7% | 30.7% |
| Did not access Major at UWB | 36.2% | 29.7% |

**Source: Data drawn from the University of Washington EDW for the fall 2010 & 11 cohort of first time full time students**

The results above so far have not taken into account the incoming students preparedness to succeed at UWB. Table 6 below depicts the results of URM and non-URM students who already took a gateway course and succeeded with a GPA above a 50$^{th}$ percentile at 3.0 or above in the course. The assumption here is that a student who succeeds in that first science or math gateway course at UWB with a GPA above the 50$^{th}$ percentile of the campus in math and science courses is academically ready for the rigors of STEM and HD courses. The total population that falls into that category is 74 URM and 335 non-URM students.

**TABLE 6: CHARACTERISTICS AND RESULTS FOR THOSE WHO TOOK AND SUCCEEDED IN GATEWAY COURSES**

| | | URM n=74 | Non-URM n=335 |
|---|---|---|---|
| Median Math/Reading SAT Scores | | 950 | 1050 |
| Pell Eligibility | | 54.1% | 32% |

**Source: Data drawn from the University of Washington EDW for the fall 2010 & 11 cohort**

**of first time full time students**

The first striking thing to notice about this groups is the median SAT score is lower for URM students who did well in the gateway courses compared to those URM students who did not. This could be because the number of students in the study is too small leading grading practices of the various instructors in gateway courses to affect the results. It is worth pointing out that SAT is not always the best indicator of academic success. SAT score are higher for non-URM who did well in gateway courses compared to non-URM students who did not do as well. That is interesting since we see that more than just incoming SAT scores could be contributing to the success of URM students in gateway courses. Variables' differences between the groups such as Pell eligibility however remain similar after narrowing the cohort to only those who succeeded gateway courses with high grades.

**TABLE 7: COMPARATIVE RESULTS CROSSTABS OF URM AND NON-URM STUDENTS AFTER GATEWAY COURSE SUCCESS**

| | | Actual Majors | | | |
|---|---|---|---|---|---|
| **URM Status** | **Requested Majors** | No Majors/ Dropped out | Non-STEM/ HED Major | STEM/ HED Major | Totals |
| Non-URM Students n = 335 | No Major Requested | 35 | 33 | 38 | 106 |
| | | 33% | 31% | 36% | 100% |
| | Requested non-STEM/HED | 5 | 20 | 7 | 32 |
| | | 16% | 63% | 22% | 100% |
| | Requested STEM/HED | 53 | 45 | 89 | 187 |
| | | 28% | 24% | 48% | 100% |
| URM Students n = 74 | Did not Request a Major | 11 | 16 | 8 | 35 |
| | | 31% | 46% | 23% | 100% |
| | Requested non-STEM/HED | 3 | 3 | 2 | 8 |
| | | 38% | 38% | 25% | 100% |
| | Requested STEM/HED | 10 | 8 | 13 | 31 |
| | | 32% | 26% | 42% | 100% |

**Source: Data drawn from the University of Washington EDW for the fall 2010 & 11 cohort of first time full time students**

The access gap to STEM/HED majors between URM and non-URM students narrows for this groups of students. Although the difference in socio-economic status as suggested by Pell eligibility remains similar to the whole cohort's, the percentage who requested STEM/HED and

accessed it goes to 42% for URM and 48% for non-URM students. Furthermore, 25% of URM students from this group who requested non-STEM.HED majors and 22.9% of those who did not request a major at all accessed STEM/HED majors; the numbers for non-URM students are respectively 21.9% and 29.6%. These findings suggest that URM students who take and succeed a gateway curse with a GPA of 3.0 or above have less of an access gap to STEM/HED major than non-URM students compared to other URM students. It is interesting to note that one third of students who initially did not request a major and succeed in a gateway course accessed a STEM/HED major. It also interesting to find approximately a third of students in each category (requested STEM/HED, requested non-STEM/HED, no request) dropped out or are still not in a major at UW Bothell.

**TABLE 8: REGRESSION ANALYSIS FOR DETERMINANTS OF ACCESS TO STEM/HED**

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .377[a] | .142 | .124 | .7711 |

a. Predictors: (Constant), grade, PELL, SAT

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | .896 | .540 | | 1.658 | .099 |
| | SAT | -.001 | .000 | -.112 | -1.346 | .180 |
| | PELL | -.020 | .133 | -.012 | -.148 | .883 |
| | grade | .031 | .006 | .388 | 4.833 | .000 |

a. Dependent Variable: Major in STEM or HED

**Source: data drawn from EDW and analyzed with SPSS software**

A regression analyses to determine the variable that acts as the best indicator of likelihood to access STEM/HED reinforced that suggestion as it found that grade in first gateway course is best indicator; it was moderately associated to major in STEM/ HED b=.388; p< = .001

(See Table 8). SAT Scores and URM have a weak negative correlation, b=.-112; p< = .001; SATs therefore is not a good measure to predict access to STEM/HED majors.

**Conclusion**

From the results of the explorative first part of the study, we see that UWB is indeed similar to most other public institutions with the exception of UW Seattle in Washington State in terms of admission rates, graduation rates, and URM population rates. Although this fact does not make the results to this study generalizable, it informs at the very least what role academics plays at one institution when it comes to access to STEM and HED majors.

The results of this study suggest that the university is not adding barriers that further hamper URM students' access to STEM/HED major, but it is clear that incoming characteristics of the students in the cohorts studied were not overcome. URM students do seem to be at a competitive disadvantage in educational preparedness and therefore less competitive when it comes to accessing highly competitive majors. There is a limitation to this study as the grouping of all STEM and high employer demand majors into a single category may have been too broad to allow for the interpretation of the results; further studies may need to separate more competitive majors from the groups and STEM from high employer demand degrees to better analyze how URM students are doing in each category vis-a-vis other students groups.

As for the two assumptions I started with, the findings suggest that URM students are indeed less likely to major in STEM or High Employer Demand majors than other students groups with the same background characteristics; however, I must reject the second assumption as URM students do not access STEM majors at the same rate as other students even after completing the first gateway course with a high GPA. This could be due to the fact that access to the majority of STEM and high employer demand majors at UW Bothell requires more than just completing the course requirements; rather, students most navigate an admission process similar to external transfer students that includes a formal application, submission of unofficial transcripts, an admission letter, and a written test in the case of the Business school. To make matters even worse, information on how to apply and access the majors and application deadlines are different form one department to the next which could lead students to err in their

applications. We know from the literature review that administrative barriers disproportionally negatively impact URM students, a targeted study at how exactly UWB students are affected may prove beneficial in seeking reforms to address impacts of policies and procedures on access and completion of all students at UWB.

The results further suggest that a policy intervention is needed at UWB to account for differences in educational attainment between URM students and other groups in regard to access to STEM and HED majors. Gateway courses in particular play a significant role in determining access to those sought-after majors; almost 85% of all students in the 2010 & 11 cohort took at least one of those courses with more success for non-URM students compared to URM. A targeted program at those courses instead of specific students may yield the best return on investment as far as preparing students for STEM/HED majors regardless of their incoming characteristics.

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